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THE ENGINEERING RECORD

ESTABLISHED 1877

AND THE BUILDING RECORD SANITARY ENGINEER

A JOURNAL FOR THE ENGINEER, ARCHITECT, MECHANIC, AND MUNICIPAL OFFICER.

CONDUCTED BY HENRY C. MEYER.

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// THE ENGINEERING RECORD,

BUILDING RECORD AND THE SANITARY ENGINEER.

VOLUME 39. NEW YORK, DECEMBER 3, 1898. NUMBER 1.

THE WORK OF THE ENGINEER.

It is always a pleasure to hear a man who has achieved success in any industry, calling or profession, describe the nature of his work, particularly if he has that broad view of affairs which enables him to see his own pursuits in their proper relation to the others which make up the world's multifold field of activity. We all know Dr. Holmes' entomologist, whose whole thought was centered on an approaching election in a society devoted to his specialty, but are we engineers possessed of a much wider field of vision? May not the physician, lawyer or business man who needs our services laugh in his sleeve, and laugh justly, over our heated discussion of stresses, materials and methods, as if the whole world stood still while awaiting the outcome? These questions naturally arose on listening to the scholarly address of Mr. C. W. Hunt, who retired from the presidency of the American Society of Mechanical Engineers this week—an address marking the successful man of business as well as the eminent specialist in engineering. It is one which will open many profitable fields of reflection, and should be read by every engineer who believes his profession can be improved and its status raised. It is at once a protest against the narrowness which produces a false idea of importance and the carelessness which begets inaccuracy, and contains a plea for the same professional practice which "The Engineering Record" has long advocated, a specialism grounded in the bedrock of scientific truths rather than the superficial smattering of every subject on which the engineering profession is called to render judgment.

In discussing the field and status of the engineering profession, it is necessary to use the word engineer with a definite agreement as to its meaning. Mr. Hunt employs it "in the broad sense of one who is skilled in the application of the materials and forces of nature to the uses of man," and he has the weight of the Institution of Civil Engineers in favor of his definition. But a moment's reflection will show that engineering has changed its character since Tredgold advanced this view of the profession. In his time the great aim was to get things done; how they were done did not matter so much. To-day it is not only necessary to do our work; to be successful, we must do it with the least amount of exertion, in the shortest time possible, and so as to require the least maintenance; in other words, at the least cost. Hence the old definition must be modified in favor of some form recognizing the new conditions, for the true engineer of the present is he who uses the forces and materials of nature in an economical manner for the advantage of mankind. Unless economy, the careful adjustment of means to ends, is constantly in mind, the work descends from engineering to mere building. It is this new demand on the engineer which makes specialism necessary for success. As Mr. Hunt puts it, "the theoretical abstraction of yesterday becomes a demonstration to-day, and to-morrow it is the task of the engineer to apply it to the uses of man. The new discoveries of materials, forces and laws which now succeed each other so rapidly make a corresponding increase of the responsibility and changes in the practice of engineering."

The importance of specialism in the United States is emphasized by Mr. Hunt in an interesting comparison of American and British engineering practice. In Great Britain it is customary for the designer of water-works, for example, to make all the drawings of the pumping machinery, so as to leave to the builder of the engines merely the shopwork. In this country, the conditions are just the reverse. The designer of water-works is generally hardly more than a specially trained purchasing agent, so far as the pumps are concerned; he specifies the main requirements and leaves to the engineers of the competing builders the preparation of the actual designs. This practice makes the position of the manufacturer's engineer one of much importance, and one requiring special training. The bids he submits must protect his firm not only in a general sense, but in every clause of the proposed contract. Every obscure phrase and adjective in the specifications must be examined until it is clearly defined in both legal and engineering senses. "The student then must expect, as a normal proceeding, to supplement his graduating acquirements by further study, together with association with his professional brethren, in order to place himself abreast of the times and to be fitted for the most effective and useful service. Engineering theory and practice are rapidly extending with the general advancement of our economic interests, and the engineer, whether he be a young graduate or otherwise, who does not make use of the modern aids to information, among which are to be counted scientific societies and literature, and a personal association with his brethren, with the innumerable hints and suggestions which come from these, will soon be found struggling with what seems to him adverse fate, but what, in reality, is inferior knowledge, behindhand knowledge; or, plainly speaking, ignorance greater or less. The engineering world has passed by him, and he must then view the working out of the law of the survival of the fittest with what grace he may."

As the retiring president of a national engineering society, Mr. Hunt naturally places scientific organizations in the place of honor among the influences molding engineering practice. The early scientific societies were largely philosophical, discussing theories and experiments which, at the time, appeared to the community at large to have little bearing on practical affairs. The permanently preserved papers presented by the members of these bodies contained the germs from which the sciences of to-day sprang, and as they developed other more specialized societies came into existence, each recording data not only for its own members, but as permanent additions to the general fund of knowledge. "The growth of the societies has been accompanied by a gradual decrease of secret methods of manufacture, formerly so prominent, but which have now practically disappeared in our industries. Manufacturing supremacy is now decided by other factors."

The results of this American system of specialization in engineering and manufacturing, and of the many societies accumulating scientific information available to all, has been to increase wonderfully the importance of engineering, not only in industrial life, to which Mr. Hunt refers particularly, but in the whole life of the people at large. A century ago American engineering was nothing but surveying and rude mill-wright's work, while the conveniences of to-day are very largely the result of the development of the profession. Railways of all classes, steamships, canals, good roads, water and sewerage systems, long-span bridges, high buildings, comfortable homes, inexpensive clothing and food are all due in a large measure to the engineer; even our average longer life has been attributed to his application of the principles of sanitary science in practical works for the benefit of the race.

Is a specialism which accomplishes such beneficent results more narrow and centripetal in its tendencies than other pursuits of the present time? Will the importance of the results compensate for the narrowness of the path by which they are reached? Undoubtedly the answer to these questions will depend upon the nature of the individual in each case, but in a general way Mr. Hunt speaks very strongly of the ennobling influence of the engineering profession. Its work is carried on under unchangeable laws, which must be rigorously adhered to or failure will certainly be the result. "Man builds to master, to resist, or to guide the forces of nature. If he has rightly judged the conditions, his work stands as a permanent monument of the fact; but if otherwise, the irresistible laws of nature will develop the defect and discover his ignorance, incompetence or error to every observer." It is inspiring to an earnest man to feel that the result of his labors will be expressed in enduring works, and a life spent under conditions demanding accuracy in large and small affairs cannot fail to influence character. "The engineer of all men," said Mr. Hunt, "has the most unchangeable and exalted basis for his ethics, the clearest of all knowledge of the disastrous results which will surely follow the violation of law. The very qualities of his mind which make his work a pleasure and a success will all tend to bring his every act into compliance with the inexorable laws of the universe. If it is otherwise, and his conduct is not guided by the laws of right doing and right thinking, and his ethics not in accordance with them, then, and to that extent, he is not an engineer, not one who is skilled in the application of the forces of nature to the uses of man."

MOVING LOAD STRESSES IN BRIDGE STRUCTURES.

The recognition of the fact that the methods of determining stresses in bridge structures for static loads do not apply to dynamic or moving loads has received some emphasis by the recent papers of Messrs. Stone and Seaman in the "Transactions" of the American Society of Civil Engineers. The paper by Mr. Stone was based partly on the fatigue of metals, but largely, also, on observations on the effects of moving railway loads, while that of Mr. Seaman found its rationale in the results of the fatigue experiments of Wöhler and Spangenberg. Both of these papers received editorial comment by this journal, the first on July 9 and the second on November 5. The extended investigation which this subject has received up to the present time has demonstrated the imperative need of experimental determinations of moving load stresses in actual structures by regular train loads, before the solution of the real problem can be reached, and not much else has been demonstrated. "The Engineering Record" has pointed out on more than one occasion heretofore that, strictly speaking, considerations of fatigue do not touch the question, or, rather, it does not touch them, for the conclusive rea-

son that there is no fatigue at even the greatest working stresses employed in design. It is of crucial importance, then, to ascertain what actual stresses exist in the members of girders and trusses when they carry trains at all possible speeds. This is a feature of the problem which is its key, but which does not admit of analytic treatment; it admits only of experimental determination.

Fraenkel, Robinson and others in Europe, India and this country have contributed most fruitful experimental investigations in the field under consideration, but in no one series of experiments yet completed will there be found more of value than in the paper by Professor F. E. Turneaure, in the "Proceedings" of the American Society of Civil Engineers for November, of which an abstract appears elsewhere in this issue. There are recorded in that paper but few less than three hundred experiments, covering plate girder spans from 25 to 85 feet in length, and truss spans from 104 to 200 feet in length, on the Chicago, Milwaukee & St. Paul and Union Pacific railroads. The center deflection of the girder or truss is an essential element in such investigations, although it does not bear directly upon the stress determination. Mr. Turneaure's investigation, therefore, possesses a confirming or assuring completeness, in that he employed a deflectometer as well as extensometer.

The two most important divisions of the problem on which these experimental investigations bear are the effects of train speed and the increased stresses due to the vibrations of the structures under passing trains at different speeds, although the observed relations between center deflections and the chord and web stresses are of much value. While the effects of train speed alone must, to some extent, be inferential in character, yet the author is undoubtedly justified in concluding "that the effect of speed alone on bridges of spans exceeding 40 feet in length is of no consequence whatever." It is not improbable that the conclusion is as applicable to spans under 40 feet as to longer spans, if the track is in first-class condition. As "The Engineering Record" has before observed, no moving train load is suddenly applied, or even approximately so. The sudden application of a load means the instantaneous application of its whole magnitude at one point, and its remaining there long enough to produce double the deflection due to its gradual application. Obviously, no railway train can even approximately fulfill that condition. The sudden application theory has no place in bridge computations. This is an important consideration, for the reason that it has long been held in some quarters that a moving load is essentially a suddenly applied load. As a matter of fact, the alleged effects of suddenness belong to vibration and shock of impact.

That portion of Mr. Turneaure's paper relating to vibrations really includes such shock or impact as existed in his experimental cases. In this category will be found practically all the real difference between the stresses caused by static loads and those produced by moving trains. In this connection it is to be observed that by vibrations are meant not only the effects of the counterbalance weights of driving wheels and of the unbalanced weights of the reciprocating parts, but also the effects of track imperfections, as indeterminate as they may be. Mr. Turneaure's experiments show that the counterbalance weights were the chief vibration factors in those particular cases. Furthermore, his measurements show, with few exceptions, a fair degree of equality between the number of revolutions of the drivers per second and the vibrations per second of all the various structures. This could have been anticipated to some extent, at least, but it shows how much bridge stresses might be reduced under perfectly balanced motive power. The highest speed attained was 60 miles per hour, and up to that limit the apparent maximum stress added by the vibrations scarcely exceeds 50 per cent. of the computed static stress in plate girders not over 55 feet in span. In the remaining girders, 60 feet to 85 feet on span, vibrations add not more than 28 per cent. In the trusses the percentage of stress added by vibrations varied widely, reaching 80 per cent. in one middle diagonal, but seldom running over 25 or 30 per cent. in either the chords or diagonals. These results show that while it will undoubtedly be necessary to perfect and systematize our working stresses for moving loads, it is obvious that the present methods ruling in the best practice are at least safe. These and other main facts of Mr. Turneaure's results, including the practical equality between percentages of vibrations and those of increased chord stresses, can only be completely appreciated by reference to his exceptionally valuable paper.

NOTES.

The Mechanical Engineering of Railways has been recognized for some time as a distinct specialty, and Sibley College, Cornell University, has lately established a school of railway mechanical engineering to give particular instruction in this branch. The principal, Professor H. Wade Hibbard, writes that there are already 20 men taking senior and graduate work in the school, although it was not organized until February. The course can be elected separately by seniors in other departments or by juniors who may have the proper preparation and time; it will not be possible to take the railway subjects of the graduate year without first taking those of the senior year.

A Municipal Rock Crushing Plant has been operated at Burlington, Vt., since the beginning of October, and the figures for the first five weeks are interesting. The items of expense in this time were: Pay rolls, $1,542.10; repairs, $20.68; coal, $106.05; sharpening drills, $25.53; new jaws and toggles for crusher, $122.51; oil, $32.19; dynamite, $18.60; carriage hire, $3.50; lumber, $2.20; royalty, $195.48; total, $2,068.84. The output of the plant during this period was 838 tons of screenings, 948 tons of 1-inch stone, 791 tons of 1½-inch, 209 tons of 2-inch, and 13 tons of tailings, a total of 2,799 tons, and about 850 tons of crushed stone at the quarry. The cost of the stone to the city during this time was, therefore, about 54 cents a ton, while the price generally charged for the same material by contractors had been $1 a ton.

The Height of Buildings in the city of Washington is again under consideration, and the District Commissioners have submitted to the two District Committees of Congress a substitute bill on the subject. This bill restricts the height of non-fireproof residence buildings to 60 feet, or five stories, but allows a height of 75 feet for non-fireproof business buildings. All buildings except churches hereafter erected or altered to exceed 75 feet in height are required to be fireproof, and churches must be of fireproof construction up to and including the main or auditorium floor. No building may exceed in height above the sidewalk the width of the street in front, nor exceed 90 feet on a residence street nor 110 feet on a business street, except on business streets and avenues 160 feet wide, where a height not exceeding 130 feet may be allowed. Wooden or frame buildings are restricted to three stories or 40 feet in height to the roof.

The Cost of Street Cleaning by hand by day labor has been investigated by Mr. Warner Stutler, superintendent of the Street Cleaning Department of the District of Columbia, in accordance with a Congressional appropriation of $15,000 for such work, the purpose being to obtain definite information as to the net cost of day labor as compared with the sum paid contractors. Bag carriers, hand sprinklers, scrapers and other implements were bought, and a force hired, consisting of 38 men, at $1.25 a day and 4 teams at $1. The expenses for four months were as follows:

	July.	Aug.	Sept.	Oct.
Labor	$1,128.12	$1,258.75	$1,211.25	$1,033.12
Teams	95.00	106.00	102.00	93.00
Materials	570.80	7.50	39.00	54.15
Area swept, sq. yds.	7,313,062	7,854,917	7,660,564	6,690,096

The total area of streets cleaned during the four months was 29,518,639 square yards, and the total cost was $5,698.69, about 19 1/3 cents per 1,000 square yards. The contract price for similar work is 32 cents.

The Architectural League of New York is endeavoring to render a public service by giving prizes to encourage the study of certain subjects of importance in which recent work has sometimes shown that much remains to be desired. To this end it has instituted competitions, to close January 16 next. The subject of the twelfth annual competition for the gold and silver medals is reviewing stands and public grand stands, arches, etc., temporary structures required for the purpose of reviewing an army returning from foreign service. The site assumed is in Riverside Park, near Grant's Tomb, and the chief problem is the plan arrangement, a convenient composition easy of access and egress for officials, the troops to be reviewed and the public being sought, to be constructed of the materials commonly used for such structures. The Avery prize of $50 will be awarded for the best design for a war medal for the decoration of soldiers in commemoration of Santiago. The President's prize, a bronze medal, is offered for the best design for a poster for the League exhibition of 1899. This competition is open to members of the Architectural League only. Messrs. Robert W. Gibson, William A. Boring and Daniel C. French are the Committee on Competitions and Awards.

Painting Highway Bridges seems to be sadly needed in Franklin County, Ohio, according to a recent report by Mr. Henry Maetzel, county surveyor, from which the following extract is made: "To say, in a general way, that a great many of the county bridges are simply decaying and being rendered exceedingly dangerous to public travel on account of this lack of paint would be no exaggeration. A great many of the iron and steel county bridges were built at a time and under a plan which did not contemplate the heavy traffic to which they are now subjected; as a consequence, they did not have any excessive sections in their members in the first place, and the action of rust and decay has been such since that time, aggravated by a lack of proper care, that, on some of them, the demands of traffic of to-day approach dangerously near to the limit of safety. The matter of a steel or iron bridge decaying by rust is of a somewhat more subtle nature than most any other accident to a bridge; when a plank or a part of the roadway gives way, or when the abutments collapse, there is an immediate report to you that such a calamity has occurred; when, however, a bridge has been rusted away so far that it is on the verge of failure, it is to all outward appearances apparently as strong as ever, and only its actual collapse will tell you that it was really as bad as it was painted to you. Under ordinary conditions, and with average proper care, nearly every one of the steel and iron highway bridges built in this county ought to give at least fifty years' service. On some that I have examined I doubt if the life of the same, even assuming proper care from now on, will approach one-half of that time. Some are so badly gone that they are practically beyond redemption." This advice is just as applicable outside as inside Franklin County, however, for the average highway bridge, once built, is rarely ever maintained as it should be.

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PERSONAL.

Mr. W. A. La Fountain, street commissioner of Fulton, N. Y., has resigned.

Mr. William M. Davis has been appointed city engineer and superintendent of water-works of Berlin, Ont.

Mr. Henry B. Seaman, M. Am. Soc. C. E., has been engaged as expert engineer to report plans for the abolishment of grade crossings in Syracuse, N. Y.

Civil Engineer A. G. Menocal, U. S. N., retired, M. Am. Soc. C. E., has been detached from duty in connection with the Nicaraguan Canal Commission and ordered to proceed to San Juan de Porto Rico. He is directed to make recommendation regarding necessary repairs and the construction of new buildings in connection with the naval station at that port.

Mr. C. E. Fowler, M. Am. Soc. C. E., has resigned as chief engineer of the Youngstown Bridge Company, which position he has held for the past six years, and together with his family will spend the winter in Los Angeles, Cal. Mr. Fowler expects to return East in the spring and devote himself to professional work. His address in Los Angeles will be 1023 West Thirty-sixth Street.

OBITUARY.

Mr. Morris P. Janney, a mechanical engineer of Pottstown, Pa., died November 30.

Mr. George W. Ott, a prominent builder of Manayunk, Philadelphia, died November 30.

Mr. Charles Einwechter of Philadelphia, a retired builder, died in that city November 28.

Mr. Thomas Glover, of the firm of Glover Brothers, iron founders, of Philadelphia, died in that city November 28.

Mr. David Campbell, who died in Mount Vernon, N. Y., November 29, was formerly a well-known builder of New York City.

Mr. Seabury Belden of Hartford, Conn., a member of a firm of contractors on government work, died in that city November 28.

Mr. P. J. Carr, a civil engineer in the employ of the Illinois Central Railroad, was accidentally killed at Sioux City, Ia., November 22.

Mr. William Seymour, an architect and builder, and member of the firm of Seymour & Burton of New Orleans, La., died in that city November 23.

Mr. Philip Golay, M. Am. Soc. C. E., assistant United States engineer in charge of locks and dams on the Monongahela River, died at Morgantown, W. Va., October 31.

Mr. Franklin Gardner, who died at Carlisle, Pa., November 18, formerly operated large car and axle works and constructed the first steam engine built in the Cumberland Valley.

Mr. Chalmers Scott, a civil engineer of San Diego, Cal., formerly in the engineering service of the Texas Pacific & California Southern railways, died in San Diego, Cal., November 16.

M. De Meritens, a French electrical engineer, who was best known by his invention of an alternating current dynamo for electric lighthouse service, committed suicide recently in France.

Mr. Charles Hoefinghoff, president of the Hoefinghoff & Lane Foundry Company, died in Cincinnati, O., November 20. His establishment had done much work for water-works and cable railways in the West.

Mr. J. Taylor Gause, President of the Harlan & Hollingsworth Company of Wilmington, Del., died in that city December 1. He had been identified with the enterprise for over half a century. He retired from active business in 1896, but was again elected president in August last.

Mr. James Muirhead of Glasgow, who died recently, was one of the oldest iron founders in the West of Scotland. He was closely associated with all the pioneers of railway engineering in Great Britain of the preceding generation, and much of his work had been in the line of railway equipment.

NOTES.

A Recreation Pier, similar in many respects to those built in New York and illustrated in "The Engineering Record" of July 3, 1897, is to be constructed in Philadelphia. It will be at the foot of Chestnut street, and 580x80 feet in size.

The Traffic on London Streets was recently investigated by Sir John Wolfe Barry, who found that it amounted to 992 vehicles and 6,358 pedestrians on Cheapside during a busy hour, 1,288 vehicles and 5,660 pedestrians on the Strand, 1,497 vehicles and 3,910 pedestrians on Piccadilly, and 661 vehicles and 5,586 pedestrians on Tottenham Court Road.

The Amount of Flushing Water needed with water closets has been investigated by Dr. Charles Porter, health officer of Stockport, England, who conducted upwards of 120 experiments on the lines recommended by the Sanitary Institute in 1893. His results confirm those of earlier investigators, that is, about 3 gallons is the smallest amount which can be relied on for efficient flushing.

Architectural Engineering is to be taught hereafter in a special course at the Massachusetts Institute of Technology. It is an option in the general architectural course and begins with the second term of the third year. In place of academic design and some of the purely artistic courses, others have been substituted which deal with the principles of applied mechanics, the theory of structures and the strength of building materials.

A New Form of Geodesic Level has been made for Dr. T. C. Mendenhall, president of the Worcester Polytechnic Institute, by C. L. Berger & Sons, of Boston, Mass. According to the "Journal" of that school, the most important improvements in the instrument are those to reduce the effects of unequal expansion. The level is made of steel, with the exception of the tubes of the telescope and a few other parts in which temperature changes are least disturbing, and a gain has been effected by reducing the vertical height of the supporting parts. The collars are of hardened steel and turn on agate bearings in Y's.

The Purification of Drinking Water by ozone is discussed in an interesting article by Mr. H. E. P. Cottrell in "Engineering" of November 11, who states that the Ozone General Manufacturing Company's plant at Oudshoorn, near Leiden, was the first to undertake the work on a large scale. The water is drawn from the Old Rhine, a slow-flowing locked canal, and even after repeated filtration through paper, retains the straw color characteristic of supplies from swamps. The water contains an unusually large number of bacteria, including those of the coli group, but after rapid filtration through sand and ozonization it is apparently sterile and is suitable for drinking.

The Accuracy of Topographical Leveling is referred to in a recent report to Major J. H. Willard, Corps of Engineers, U. S. A., by Mr. T. C. Thomas, assistant engineer in charge of surveys of the Ouachita and Black Rivers. The vertical circles of the instruments read to 1 minute and the bubble tubes of the telescopes had a curvature of 49 seconds per division. The country covered by the survey was flat, and it was seldom necessary to use vertical angles. The last 10 closures of each topographer for each field season, 50 closures in all, gave the following results: Average length of stretch leveled, 4.1 kilometers; average of discrepancies, all taken as of one sign, 4 centimeters; number of discrepancies between 0 and 1 decimeter, 46; between 1 and 2 decimeters, 3; between 2 and 3 decimeters, 1.

Some Special Bridge Erecting Cars have been built by Mr. Onward Bates, M. Am. Soc. C. E., for use on the track elevation work of the Chicago, Milwaukee & St. Paul Ry. Over one of the trucks of a flat car of 60,000 pounds capacity he has placed a box tower of riveted angles. A boom of latticed angles is pivoted at the bottom of the tower and guyed to the tops by a tie bar so as to swing with a radius of 16 feet and have a total height above the rails of 22 feet. The car carries a hand winch having two speeds for hoisting, a quick-lowering friction clutch for light loads and a Weston friction clutch for heavy loads. In the latter the handles must be revolved backward during the lowering, which stops if the men let go. The cars have been designed to handle plate girders, trestle bridges and pony trusses up to 125 feet span, and are worked in pairs.

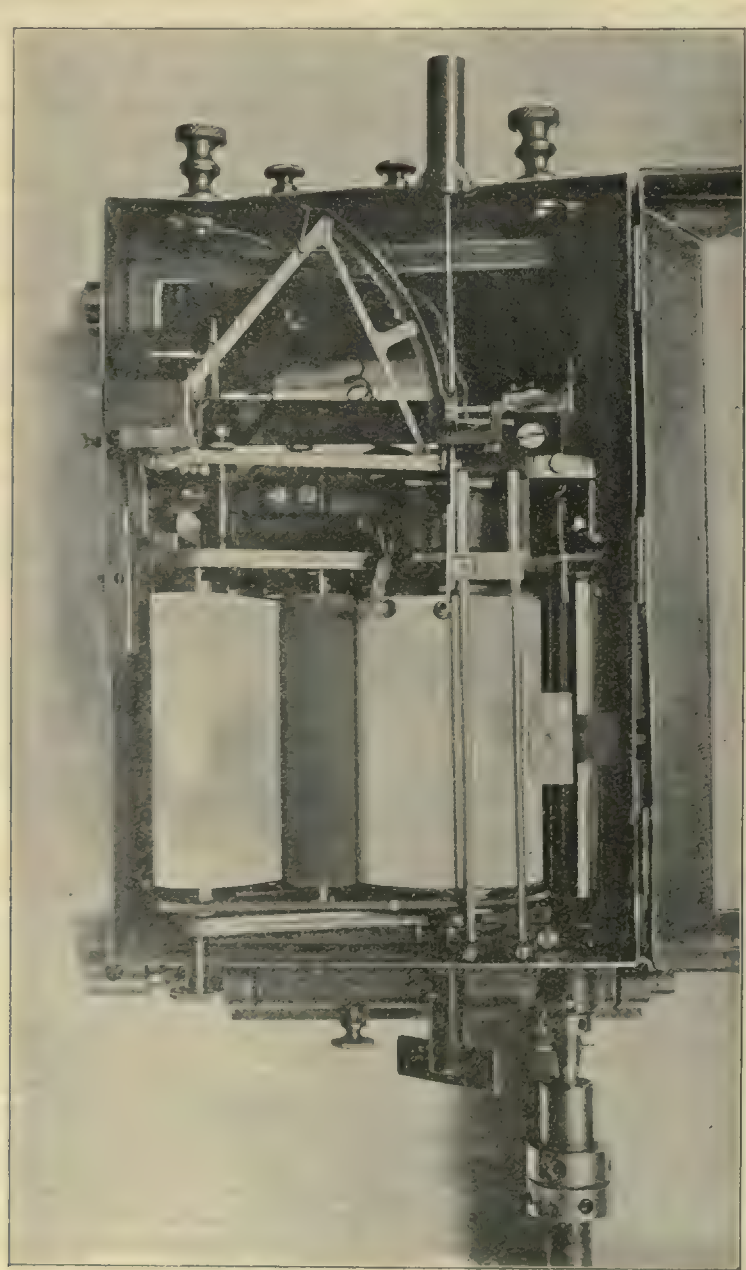
The Streets of St. Louis, Mo., are described in an interesting pamphlet of 84 pages, published by Street Commissioner A. N. Milner, who reports that from 1828, the date of the first paved street in the city, until the present time, $24,500,000 has been spent on construction, repairs and reconstruction. For this expenditure there are now 50.23 miles of granite pavements averaging 36 feet wide, 10.25 of asphalt, 7.93 of wood, 0.57 of clay block, 10.54 of brick, 0.56 of novaculite, 74.86 of telford and 264.38 of macadam, a total of 419.32 miles. In addition, there are 457.07 miles of unimproved streets, 104.23 miles of paved alleys averaging 15 feet wide, and 204.24 miles of unimproved alleys. Block patrol cleaning has been employed on 6.84 miles of streets, and a force of 62 uniformed men have been employed on the work at a cost for labor of $109 a day. Contractors were paid during the year about $78,700 for cleaning 64.49 miles of granite, asphalt and wood pavements with machine sweepers. The cost of removing the dirt and snow from these streets amounted to $1.02 per cubic yard, inclusive of labor.

EXPERIMENTS ON BRIDGES UNDER MOVING TRAINS.

On another page will be found a discussion of certain features of a valuable paper by Professor F. E. Turneaure in the November "Proceedings" of the American Society of Civil Engineers, in which the author describes a large number of experiments to determine the actual effect of moving loads on bridges. The importance of his results and the paucity of similar information makes it desirable to print a review of the paper in this place. The experiments were made with a Fraenkel deflectometer and two extensometers of the Fraenkel-Leuner pattern.

The accompanying illustration shows the deflectometer attached to a plate girder. A wire connects it with a heavy weight placed directly below on the ground. This wire is made fast, through a steel ribbon, to the circumference of a thick disk on the framework, which disk is cast in one part with another of twice its diameter and having the same axis. On the larger disk is fastened a second steel ribbon, attached at its other end to the circumference of a spiral hollow wheel containing a clock spring. By means of a crank the spring may be wound up to produce in the ribbon a sufficient tension to hold the vertical wire taut, while at the same time allowing free movement of the wire relative to the frame of the instrument. The recording pencil is attached to the short steel ribbon, and has a motion relative to the frame of the apparatus twice as great as the motion of the bridge. A spindle is provided for holding a roll of paper, another on which the paper is wound, and a drum over which the paper passes and along which the pencil moves as the bridge moves up and down. The paper is moved about 0.4 inch per second by electrically controlled clockwork placed inside the drum.

The extensometers for measuring strains in the members were also of a form invented by Professor Fraenkel, but greatly improved by Oscar Leuner, of Dresden. The recording part of one of the instruments used is shown in the illustration. The longitudinal distortion of a certain length of a member is multiplied about 140 times by a compound lever, the motion being communicated to a pencil which traces a line on a moving strip of paper. All bearings are knife-edge, and all connections are made by steel ribbons attached to cylindrical surfaces. The levers are mounted in a framework which carries the clockwork for moving the paper and has screws for attaching the apparatus to the bridge member. The pencil is held by a light carriage running parallel to the axis of the drum, on which the paper is stretched. This carriage is moved by two small steel ribbons attached to a sector at the end of the lever system, which arrangement gives rectilineal motion to the pencil. To the short end of the lever system is fastened one end of a long, light rod, clamped at its other end, to the bridge member. These rods were of such a length that the apparatus would measure the distortion of one meter's length of the bridge member. The multiplication of the distortion was such that, assuming the modulus of elasticity to be 29,000,000 pounds per square inch, 1 inch on the diagram corresponds to a stress of 5,600 pounds per square inch. Additional pencils for recording the passage of wheels were attached to these instruments.



RECORDER OF THE FRAENKEL-LEUNER EXTENSOMETER.

In order to make the friction of the pencil on the paper as small as possible metallic paper and aniline pencils were used, these being furnished with the instruments. With this arrangement a distinct mark is made with an exceedingly light pressure, and the pencil does not wear smooth. The speed of the paper in the extensometers was, in one case, about 0.3, and in the other case about 0.5 inch per second. The speed was determined at frequent intervals, and was fairly constant; but, owing to the method of governing the clockwork, it could not easily be regulated to any particular value. The speeds of trains were determined from the records of the additional pencils above mentioned, the speed of the paper and the length of the locomotive wheel-base being known.

The electric track switch used was a rather crude affair, but answered the purpose very well. Some difficulty was experienced in devising an apparatus which would work slowly enough under fast trains. That which was finally successful was made as follows: On a long wooden block a saw-blade was placed and loosely held at its two ends under thin metal straps. This blade was then sprung upward and supported on brass springs along the center, and so arranged that on being depressed about ½ inch an electric circuit would be closed. This contrivance was fastened just outside the rail and parallel thereto, and at such an elevation that a passing wheel would keep the circuit closed while moving a distance of 12 or 15 inches.

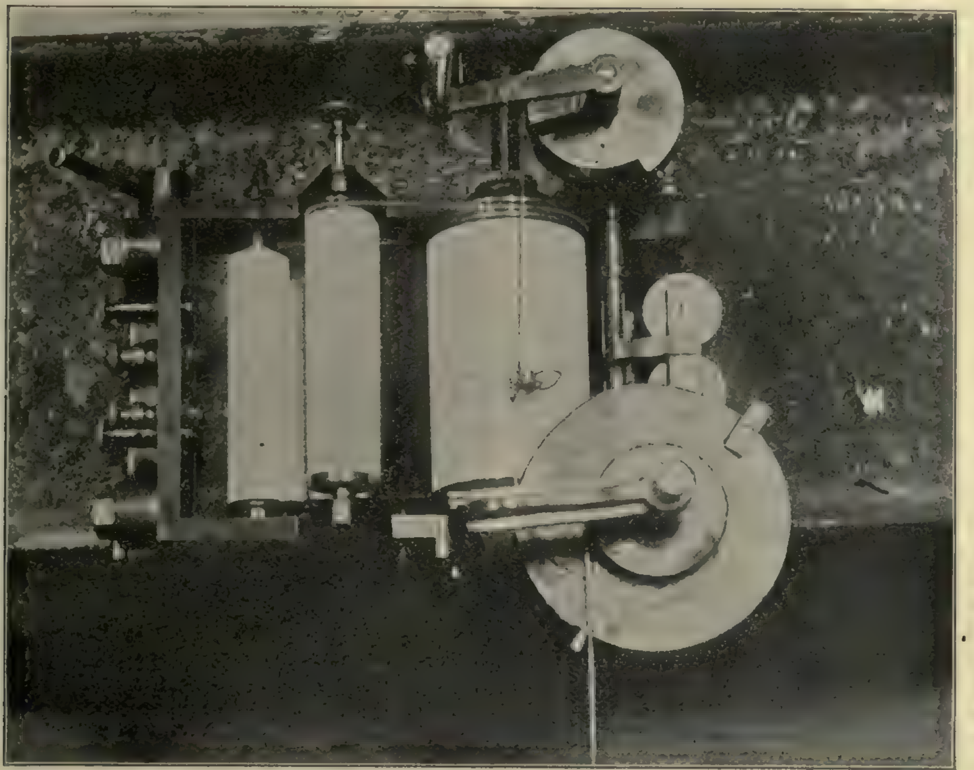
The experiments in question consisted in obtaining records of stress and deflection under moving trains from a number of bridges on the Chicago, Milwaukee & St. Paul and the Union Pacific railroads. Tests were made on 12 plate-girder bridges of spans varying from 25 to 80 feet, and on 11 truss bridges of spans from 100 to 200 feet. All the plate girders are through bridges, and, with two exceptions, the ties are supported on shelf angles. They are somewhat shallower than deck girders of like span and somewhat more flexible. All the girders, however, are of recent construction and represent modern practice. All the truss bridges are of the Pratt type, except two Pegram trusses. Two are light structures, while four are fairly heavy modern Pratt trusses. The two Pegram trusses have long panels and a suspended floor system with plate hangers.

In the testing of girder bridges, the deflectometer was usually fastened to a flange at the center of the bridge, and one or both of the extensometers attached to the flange of the girder as near the center as possible. For the sake of comparison, simultaneous measurements of stress were frequently made, in some cases on the two lower flanges, and in others on the outside lower and outside upper flanges. In general, about 12 or 15 experiments were made on each girder bridge, this being usually a sufficient number to bring out as great a variety of speeds and locomotive effects as would be likely to occur with any frequency. In most of the girders the effect of the locomotives was soon seen to be the feature of chief interest, that of either passenger or freight cars not being of special importance.

In the experiments on trusses the deflectometer was usually attached to the post nearest the center of the bridge, and records obtained from it in that position for all tests on the structure. At the same time the extensometers were attached to various members of the bridge. After a little experience it was concluded that the members from which the most significant curves could be obtained were: A lower chord member, the main diagonal nearest the center, and the hip vertical; and these were, therefore, the members usually experimented upon. By the use of both extensometers determinations

were made, in many cases, of the bending in individual bars and of the relative tension in the various bars of the same member. Such experiments, however, were made of secondary importance, the main object of the work being to secure a reasonable number of diagrams from as many different structures as possible. As a rule, from 30 to 40 experiments were made on each truss.

connection by means of gas pipe. These curves show that the vibration or jarring of the bridge at this rapid rate was really of very small amplitude. In the longer girders and in the truss bridges this jarring action nearly disappeared, and the curves obtained from the deflectometer bring out very clearly the vibration of the structures without interference by instrumental vibrations. If the moving parts of the instrument were made much lighter, it is believed that it would be much more useful for testing very short spans.



THE FRAENKEL DEFLECTOMETER.

In all, about four hundred experiments were made, usually with the trains of the regular traffic. As in most cases there were but 10 or 12 movements during the day, not as many diagrams were obtained as might have been desirable; but it was thought that the work would be more valuable if a number of structures of different span-lengths were tested, than if a greater number of experiments were made on two or three bridges. This idea was strengthened by the fact that in those places where a longer stay was made at a structure, very little which was new was observed in the deflection curves after the first day's work.

On two different occasions, through the kindness of the railroad officials, a short freight train was placed at the disposal of the experimenters. In one case the train consisted of an American locomotive, one lightly loaded car, and three empties; and in the other case it consisted of a 10-wheel engine, four heavily loaded cars and a caboose. The use of a special train in making such tests is obviously of great advantage, both in enabling the tests to be made very rapidly, and in facilitating comparisons. For the tests with special trains, and for many of the others, stress curves were computed, the data regarding weights of locomotives and cars being furnished by the railroad companies. In the computations the influence-line method was used as being the only practicable one for such a large amount of work.

The working of the apparatus was in general quite satisfactory. The deflectometer proved very convenient to adjust, and was very reliable in its working, except for the short-girder spans. With spans less than about 50 feet in length the jarring of the girder agreed so closely in period with that of the moving parts of the instrument (about 20 per second) that the apparatus was set into excessive vibration, and the resulting records in such cases are not of much value. Some reliable curves, however, were obtained from a 25-foot span by placing the instrument on the ground and making the

The moving parts of the extensometers, owing to the high degree of multiplication of the instruments, constitute a rather flexible system, and have, therefore, a rather slow natural rate of vibration, much slower than the deflectometer. This rate was found experimentally to be about 10 per second, and, therefore, where the variation in stress about equals or exceeds this in rapidity, the records of the instruments are not reliable. Since the rates of vibration of the structures, or of individual members, were in most cases much less than this, little trouble was experienced on this score. The jarring action which interfered with the working of the deflectometer appeared to be much too rapid or too small to affect the extensometers, as these instruments invariably gave curves free from such vibrations. The fact that the rates of vibration of the two kinds of instruments were so much different furnished a valuable check to the workings of both.

In general, the curves from plate girders taken from rapidly moving trains show, in the part of the diagram caused by the locomotive, large projections, or vibrations, usually corresponding in period to the revolution of the drivers, and due no doubt to the action of the counterweights. On the shorter spans this action was so sudden and severe that the pencils of the extensometers were often evidently thrown too far. For the longer spans, this effect of drivers diminished very much and the curves from the two instruments agreed better. Where the speeds were less than 15 or 20 miles per hour the vibrations were small. Passenger cars produced no noticeable vibrations in girders other than this jarring action, and the same is true of freight cars on all the girders except two through spans.

Inasmuch as in discussions on impact, greater stress is usually laid upon the feature of the rapidity of application of the load than upon vibrations, and, as impact formulas appear to give emphasis in this same direction, it was thought desirable to discover, if possible, the effects of speed alone, when separated from those of vibration. If a train moves over a bridge on a perfectly smooth track at any given speed, and if all the wheels are truly circular and perfectly balanced, it is evident that there will be produced a smooth deflection curve, which, when compared with the curve made by the same train when crossing at a very slow speed, will bring out clearly the effects of the rapidity of application of the load. In the actual case various elements conspire to cause vibrations, which are, if of any considerable duration, of equal amplitude each side of the imaginary smooth curve previously mentioned. From these considerations it was concluded that curves constructed by drawing middle lines through the sinuous lines of the diagrams, could be fairly compared in studying the effects of speed alone.

In making these comparisons, two methods were used. One was to measure the mean ordinate to the curve of the extensometer at some particular point and then compare with the computed stress. The other was to compare the curves from both the extensometer and deflectometer caused by the same train at different rates of speed. The latter is by far the more reliable and satisfactory, as it eliminates many uncertainties in the matter of weights and dimensions, but it requires the use of a special train for testing, which was had only for a few bridges specially mentioned. The results of these investigations, like those based on theoretical considerations, indicate that the effect of speed alone is of no practical importance unless it be for very short spans.

In discussing vibration, Professor Turneaure treats the girders and trusses separately. As a rule, the girders were of too short length to show cumulative vibration, which was well marked in the truss bridges. This discussion is too elaborate and important to be presented properly in an abstrct, and the reader is referred to the original paper for the information. The main results are:

In the case of girder bridges up to 55 feet in length, the increase in the flange stress due to vibration was found to have a maximum value of about 50 per cent. for speeds of 40 to 50 miles an hour; for spans of 60, 70 and 85 feet, the percentages were 22, 28 and 17 respectively. The chief cause of the vibration was traced clearly to the locomotive counterweights, but the relation of the rate of vibration to the speed of passing trains could not be determined satisfactorily.

In all cases where large vibrations were measured in truss bridges, they were more or less cumulative and due mainly to the locomotive counterbalancing. The tests indicated that the vibration in most of the trusses was likely to be 20 per cent. of the static deflection, and the author therefore says: "Considering the large number of experiments and the variety of trusses, it would seem that the maximum might reasonably be placed at 25 per cent. for trusses of from 100 to 200 feet length, and perhaps for longer spans, as the tests do not indicate any tendency to an increase in vibration with increase in span."

The action of a locomotive on a bridge when cumulative vibration takes place is two-fold, according to Professor Turneaure. First, there is the local effect of each impulse from the drivers, and, second, the effect on all parts of the structure due to vibration. The effect on the chord members is mainly from the latter cause, and that on diagonals from both, while the hip verticals and floor system near the end of the bridge would feel mainly the local effect. The experiments showed that the percentage of increase in the chord stress is usually about the same as in the deflection; in the diagonal stresses the maximum increase is greater than

in the deflection in the ratio of 30 to 19; in the stresses in the hip verticals the maximum increase due to vibration is about 40 per cent.

The conclusions drawn by the author from his experiments and the few made by other engineers are seven in number.

(1) Speeds less than about 25 miles per hour are not likely to result in much vibration.

(2) The increase in deflection due to vibrations, caused by locomotives running at speeds of 40 to 50 miles per hour, is likely to be 40 or 50 per cent. for girder spans of less than 50 feet in length.

(3) This percentage decreases rapidly for longer spans, becoming about 25 per cent. as a maximum for 75-foot spans.

(4) Owing to cumulative effect, the percentage is likely to be a maximum of 20 or 25, for spans from 75 to 150 feet or more in length, but the experiments indicate no increase in percentage for increase in span.

(5) The relative increase in chord stress is about the same as in deflection; that in center diagonal is somewhat more than in the deflection; and in hip vertical it corresponds more nearly to that in girders of 40 to 50-foot spanlengths.

(6) The effect of speed of application of the load on mean deflection was of no consequence in the spans tested (the increase in deflection from live loads being due to vibration), although theory points to an appreciable increase from this cause in very short spans without camber.

(7) Secondary stresses are likely to be high in small girders with shelf-angles, and in some parts of trusses, and the discrepancy between observed and computed stress may be greater from this cause than from the dynamic effect of moving loads.

THE LOUISVILLE EXPERIMENTS WITH MECHANICAL FILTRATION.

For more than a year engineers and others interested in the subject of municipal water supplies have been looking forward to the publication of the results of the experiments with mechanical filters which were begun in October, 1895, by the Louisville Water Company. The well-known thoroughness of the company's chief engineer and superintendent, Mr. Charles Hermany, M. Am. Soc. C. E., and the high reputation of its chief chemist and bacteriologist, Mr. George W. Fuller, formerly in charge of the Lawrence Experiment Station, made it certain that their elaborate and prolonged experiments in the purification of such a difficult water to treat as that of the Ohio River would throw a flood of light on the hitherto little-understood subject of American high-speed filtration with preliminary coagulation. The data hitherto available were practically confined to the report of Mr. Edmund G. Weston, M. Am. Soc. C. E., on experiments at Providence, and that of Mr. Allen Hazen, Assoc. M. Am. Soc. C. E., of his five weeks' investigations for the Ohio State Board of Health of the Jewell filters at Lorain, which were so favorable to high-speed filtration that the more elaborate results of the Louisville experiments have been eagerly awaited. They have just been made public in Mr. Fuller's report to the company, a voluminous document, with many pages of tables, which will be indispensable to all interested in the subject. It would be out of the question for the company to publish such a report for free distribution to those who would apply for it; but, instead of keeping the information in manuscript inaccessible to engineers, it deserves the thanks of the profession for allowing its distribution through a publishing house, D. Van Nostrand Company, New York, which has issued it as a quarto volume of 470 pages, sold at $10. An adequate review of all the valuable data in the book would occupy many columns of "The Engineering Record," but the main facts established by the investigations may be summarized more briefly. The leading fact is that mechanical filtration, well conducted, is a manifest sucess, which will gratify all who have watched its development in the face of the hostile criticisms of those who refused to see any good in any process but the slow-filtration system of England and the Continent.

The experiments were begun in October, 1895, with Jewell and Warren filters, and in December with two Western filters, and daily tests were made until August, 1896. The greater part of that month was spent in the investigation of electrical systems of purification, and the three following months were devoted to a compilation and study of the results. December was given mainly to a study of the corrosive action of the purified water on boilers and pipes, and its scaling properties. Further investigations of electrolytic devices occupied the early part of 1897, and the remainder of the year, to October, was mainly spent on investigations of devices designed by the company's officers and the preparation of the report, although a few weeks' tests of a polarite filter were made during this time. The importance of such investigations, when conducted with scientific precision for a definite engineering purpose, is self-evident.

The Ohio River water changes widely and rapidly in character on account of the remarkable flood and draught fluctuations of the stream. At no time was it free from suspended matter, which varied in amount from 1 to 5,311 parts per million by weight. Sometimes the particles were comparatively large, but occasionally they were less than 0.00001 inch in diameter. smaller than bacteria, in fact, and could be removed only with great difficulty. During the low stages of the river the water is comparatively clear, but its hygienic character is least satisfactory. Unmistakable signs of sewage contamination were repeatedly detected, although all tests for specific germs of disease gave negative results. There are enough dissolved carbonic acid and oxygen gases in the water to cause considerable corrosion of uncoated iron pipes, and for use in steam boilers the water holds a rank between the soft and clear waters of the East and the hard supplies of the West.

The investigations of 1895-96 proved conclusively that the method of purification embodying subsidence. coagulation and filtration is most economical in treating the Ohio River water for use in Louisville. The use of coagulants is imperatively demanded during six to ten weeks in the spring and early summer, when fine silt is carried by the river. The data collected in 1897 showed that the efficiency of plain subsidence depends very largely, so far as any given period is concerned, upon the conditions under which it takes place. Mr. Fuller concludes that, under the given conditions, it is possible to remove economically in this way about three-fourths of the suspended matter in normal muddy water. During freshets, nine-tenths might be removed and during low water a half or even less. The removal of bacteria by plain sedimentation follows the removal of suspended matter in a general way, but the subject is not important, because the subsequent filtration effects the same purpose without extra cost. During the freshets all the evidence goes to indicate that plain subsidence cannot economically remove a sufficient amount of the fine clay to prepare the water satisfactorily for filtration. By March, 1897, it was known that the absence of suitable settling basins in which sedimentation could be carried to its economical limit during periods of muddy water in the river caused one of the experimental filters to become so clogged that it was unable to purify enough water to allow it to be washed properly: and in the case of the best filters lack of settling basins would make it necessary to provide reserve filters with an area of about three-fourths of those in ordinary service. The same omission of facilities for sedimentation would also make it necessary at times to waste a fourth of the water filtered in order to wash the sand beds. Other defects are referred to as follows in the report:

"It was demonstrated conclusively that owing to the very frequent and marked changes in the composition of the water in the Ohio River, it was difficult to give to the systems of purification suitable attention to guard against, on the one hand, an imperfectly purified effluent, and, on the other hand, an unnecessarily large application of coagulating chemicals, with its needless increase in the cost of chemicals, and in certain objectionable results in consequence thereof. With a proper employment of subsidence it would be much easier to operate a large system of purification satisfactorily, independent of the consideration of a large and needless reserve portion of the system."

The information in the report relating to the character, use and effects of coagulants is particularly valuable, and only a brief summary of it can be printed here. It was learned that the amount of coagulant necessary to remove suspended matter varied widely with the size of the particles, increasing as their size decreased. It was also found that different kinds of suspended matter dispose of varying amounts of coagulant by an action which is called absorption for want of a better name. This is most marked in the case of clay, and appears to be largely a chemical action. Hence with the ordinary conditions of the river water the first portions of the coagulant have a low efficiency, and after a certain amount has been applied a very small additional amount causes complete coagulation, provided sufficient time is allowed to elapse after the application of the chemical.

A very important result of this part of the studies is summed up in the following words: "Owing to the fact that with the commercial sulphates (coagulants) the respective hydrates are formed almost instantaneously, the presence of coarse particles which subside quickly cause a waste of chemicals in amounts equal to the quantities of original chemical absorbed, plus a certain amount of hydrate which becomes attached to their surfaces. The attached hydrate is thus removed before it coagulates to its full power the fine particles in the water. The above facts are decisive proof that it is impracticable to apply coagulants to a water which contains suspended matter which may be economically removed by plain subsidence."

So far as the time of adding the coagulant is concerned, it was found that after the water had been partly clarified by the subsidence of the coarse suspended matter, it required, for its most economical and efficient treatment, different periods of coagulation at different times, according to the character and amount of suspended matter. When the chemicals are added at two places two objects are sought, the coagulation of the suspended particles and their removal by sedimentation. "While it is probable that sedimentation might take place more rapidly if the coagulation was completed before the suspended matters began to subside than when these two actions took place simultaneously, experience indicates quite clearly that a saving is made by allowing sedimentation to take place during coagulation. The period of coagulation, being plainly the shorter, becomes therefore unimportant, as the optimum period of subsidence with coagulation would be the controlling factor. The conditions of these investigations were not such as to allow the study of the optimum period of subsidence with coagulation, of a water which had already been partially purified by plain subsidence. It may be stated, however, that as the water after proper preliminary treatment by plain subsidence would contain only relatively fine suspended particles, the optimum period would probably be considerably longer than would be indicated by the results of subsidence with coagulation of a water which had not been properly settled." The amount of coagulant to be added varies widely on account

of the great fluctuations in the amount of suspended matter in the river, already mentioned, but it was found that under ordinary circumstances the water would rarely if ever reach a condition where it would be safe to add, for each gallon, less than 0.75 grain of sulphate of alumina containing about 9.87 per cent. of aluminum.

It is evident from what has been stated that proper coagulation is imperative in the Ohio River water, but to determine what may be the proper degree it is necessary to know what amount of suspended matter can be handled by mechanical filters. On this head the report says: "Much thought has been directed to an expression of this amount by weight in parts per million. We have not succeeded, however, in fixing the limit in this manner, owing to the wide discrepancies obtained in handling equal weights of suspended matter of different character. Thus at times 100 parts per million of fine clay were more difficult to remove than 500 parts of silt. The best way in which we can express this amount is by the statement that by plain subsidence, aided by coagulation when necessary, the suspended matter in this river water should be reduced to a point where, by filtration and the coagulation just preceding it, the remaining suspended matter can be removed by the final application of coagulants not exceeding 1.5 to 2 grains per gallon of ordinary sulphate of alumina or its equivalent."

All the experiments showed that when the amount of coagulant is such as to give at the normal rate of filtration only a moderately satisfactory bacterial efficiency, a reduction of the rate by one-half does not increase the bacterial efficiency, although it slightly lengthens the period between washings of the sand. In Mr. Fuller's judgment it was advisable to construct a plant at Louisville on the basis of 100,000,000 gallons per acre daily, with the knowledge that in all probability the rate could be safely increased to a considerable degree. The sand he advises using has an effective size of about 0.35 millimeter and a depth of 30 inches, and he recommends a total filtering head of about 10 feet.

The effluent from a system of purification works, using sedimentation, coagulation and high-speed filtration has, in the case of the Ohio River water, a greater corroding action on uncoated iron pipes or receptacles than the raw supply. The amount of incrusting constituents in the effluent, which cause trouble in boilers, is also greater, but it is possible that the removal of sediment from the water would more than balance its increased hardness.

The sand layer in the filters should be washed thoroughly with filtered water, and accompanying agitation of the sand layer is an advantage. Surface agitation could be employed profitably to a greater degree than was the case in any of the experimental filters. "In practice the filter tank should be designed so as to allow the water above the sand, together with the surface accumulations, to be flushed off into the sewer during agitation." The occasional use of caustic soda to keep the sand clean is considered advisable.

The degree and kind of attention required by such a system of water purification is, of course, an important subject, and if the experiments yielded nothing more than the information obtained on this head they would have compensated the company for the expense of the investigation. The report states: "The impression which some people have that large systems of water purification by this method will at all times yield an effluent of satisfactory character with merely nominal attendance is wholly incorrect so far as the Ohio River water is concerned. In the first place both efficiency and economy require that very close attention be given to the application of chemicals. Setting aside the question of cost, any excess of the chemical above the optimum is attended with increased amounts of corroding and incrusting constituents in the filtered water, and, under unskilled supervision, chemical in excess of the amount which the water will decompose might be added at times, resulting, of course, in the inadmissible presence of undecomposed chemical in the effluent. On the other hand, a reduction of the amount of chemical by a small percentage below the optimum would cause immediate deterioration in the character of the effluent, a deterioration which at times could not be determined for several days, as in the case of the Ohio River water a clear effluent is not necessarily a pure effluent, especially during the winter months."

The daily cost of the sulphate of alumina required in the operation of a 25,000,000-gallon purification system ranges from $21 to $678, according to the character of the river water. It is easy to see, therefore, how the cost of operation could be run up by attendants without the training or ability to change the dose of coagulant to suit the water. Moreover, the amount of water they would waste in washing the filters would add materially to the daily expense and diminish the capacity of the works, so that from whatever point the subject is approached, it is seen that in the case of a water like that at Louisville skilled attendance is necessary, not only for obtaining the best quality of effluent, but also for economical operation.

A LONG SPAN MOVABLE CABLEWAY.

Lock and Dam No. 2 form part of the United States improvements to navigation in the Mississippi River between Minneapolis and St. Paul, and their design and execution is in charge of Major Frederic V. Abbot, Corps of Engineers U. S. A., M. Am. Soc. C. E. At the lock site the river is about 700 feet wide, with steep, high banks, on one of which the construction materials are stored. Large quantities of concrete for the walls and foundations are to be mixed there and delivered to the work by a traveling cableway substantially corresponding to an immense girder crane commanding a total area of 18 acres, over which about 100,000 tons of materials are to be distributed. This plant possesses some novel features, and is the subject of a paper by Mr. R. D. Seymour, C. E., in the October number of the "Journal" of the Western Society of Engineers, from which a description of some of the principal features is condensed.

The cableway, of the Laurent type, was built from competitive designs by the Trenton Iron Company, and has a span of 1,150 feet, with head and tail towers respectively 55 and 30 feet in height. The head tower is built of 12x12 inch timber and 3x12 inch braces, and is mounted on a platform 56 feet long (in the axis of the cable) and 32 feet wide. The trucks for each tower are rigidly attached to the trussed platform, and move on three standard-gauge trucks 650 feet long, transverse to the direction of the cable. The centers of the two tower tracks at each end of the cable are 18 feet apart, and the counterweight track is 25 feet from the middle track. The 65-pound steel rails are laid on cedar ties 18 inches centers, and the outside rails have braces in the direction of the thrust spiked to every other tie. Every fourth tie extends across the two tower tracks and every sixteenth tie extends across all three tracks. The head tower tracks are on soft, wet ground, drained by a trench cut down 6 feet to solid rock. The main cable is 2 inches in diameter and is anchored at each end by an adjustable tackle consisting of several parts of ⅞-inch wire rope passing over large sheaves. This arrangement was adopted to enable the rope to be moved and distribute the wear due to most of the work being done at one spot on it, and as the tail tower is 30 feet high, nearly that amount of movement is secured, which is expected to considerably increase the life of the rope. An ordinary three-sheave traversing carriage is used, and has a capacity of five tons and a speed of 800 feet a minute. The three-fourths-inch hoisting line is wound on the eliptical drum in the same direction as the three-fourths-inch hauling line. It is arranged with a double swivel, which, when the carriage is within 200 feet of the tail tower, passes around a large, wide grooved wheel on the tail tower. There are no fall rope carriers, tension on the slack of the hoisting rope being maintained by a weight box in the tower. One end of the hoisting rope is attached to the becket of this fall block, thence the line is reeved through the fall block and carriage sheaves and from the carriage around a sheave on the tail tower, thence over a sheave on the head tower and down around the hoisting drum. From the drum it leads around a sheave at the top of the head tower, down around the weight box sheave and back over another sheave at the top of the tower, and to its swivel attachment to the part of the hoisting line that runs from the fall block to the tail tower. The hoisting engine is a double tandem friction drum engine, with reversible link motion and 10x12-inch cylinders, working at 100 pounds steam pressure. It is operated by a 60 horse-power Scotch marine boiler with internal firebox. The cableway will be traversed by a wire rope tackle at each tower, anchored to its platform and at both ends of the track. At the head tower the tackle will be operated by a small double drum hoisting engine on the platform, and at the tail tower by a hand winch. The total cost of the plant is about $11,500.

CORRESPONDENCE.

ENGLISH VIEWS OF TECHNICAL EDUCATION.

Morgantown, W. Va., November 26, 1898.

To the Editor of "The Engineering Record":

Your remarks on the presidential address of Mr. William H. Preece on Technical Education, as published in the issue of "The Engineering Record" of November 19, appear both timely and proper. Of course, all comparisons are more or less odious in any case. But we do not understand that you are comparing English and American practice in this direction so much as to note certain chief characteristics of technical education in the two countries. This topic is much like many others in engineering fields, ever and anon bobbing up serenely, to the discomfiture of one and the satisfaction of another. In itself it is as much an art as the varied applications of engineering science. It is therefore no nearer the finishing touch than other works of art. It will not be put down. It is ever reaching outward and upward toward some final end.

The pendulum must be kept swinging. It cannot always be moving in one direction. Perhaps Mr. Preece thought to elicit discussion by taking extreme, if not opposite, views to those held by some of his countrymen. Things are really, we hope, not quite so bad in the matter of the progressive growth of technical education in England as he would have us believe. The writer has visited several of her most important technical schools and believes that they fulfill their mission as much as it is practicable for them to do, under the existing conditions of education in general and of the engineering trades in particular in that country. Many of the greatest engineering teachers of England are able practitioners, whose reputation has reached this side of the Atlantic. Technical education in either country has been a matter of organic growth quite as much as an adaptation of means to ends. There is nothing so good but that it may be improved by cultivation and a more thorough study of the environment under which it must exist.

Engineering education in this country is eclectic. It is bound down by no custom nor traditions. Perhaps the most that it is ever influ-

enced by its environment is in the State and federally-endowed institutions. Here, to carry out the provisions of the State or federal grants, courses of instruction must be so shaped as to be of some intrinsic value to the young graduate intending to practice in the State or Territory in which his alma mater is located. This is the only purely local coloring that we know of. Engineering education has here received an unprecedented stimulus from the inception and growth of the national society organized for its promotion at the World's Engineering Congress, 1893. There is no training for a profession so thoroughly organized and which carries on such a systematic propaganda as that represented by this Society. It reaches out into all grades of technical instruction. It gathers and disseminates information upon all of the most pressing topics of such educational work. Its influence is every year widening and deepening. It represents the most progressive, as well as the most conservative elements, and is withal full of signs of life and of healthy growth.

In the United States we do not have that "charming personage . . . the ideal professor of pure abstract science," who, at the same time, is permitted to be "a sort of little monarch in his own laboratory." Such a combination is here impossible. In this country general education is not even conducted on the monarchial system, much less technical and professional. Even if it were, you may rest assured we should not be content with little monarchs. As it is, the greatest teachers are ever anxious to get the beginners in any science. Thus, the first concepts are rightly formed by the young pupil. There is such a thing, too, as engineering science; and the application of similar methods is not beneath the dignity of most American teachers who recognize this affiliated field.

Technical education is not in the hands of the few, nor of the privileged, in this country of republican institutions. Its teachers are, for the most part, college-trained men, who have had considerable practical experience in various lines before attempting to impart instruction. Many of them keep up this happy alternation of theory with practice by acquainting themselves with current practice between the periods of their work of instruction. Their summer and other vacations are often spent in practical work. The hard-earned Sabbatic years granted by the representative institutions are spent in engineering establishments.

We are teaching both master and man. No harm has come of it so far. We are developing a strong and intelligent artisan class, and not training too many unemployed leaders. There are very few engineering teachers who to-day send out their graduates as missionaries. The result is that the college-bred engineer begins at the bottom—a learner and not a teacher of his associates. There are perhaps fewer false hopes held out to the young man in engineering education than in any other kind. He understands quite early in his course that it means business. It is not all brain work, either; and this country recognizes no traditions that would ostracize him because he must work with his hands before and after graduation. Wm. S. Aldrich.

"A STUDY OF PAVING MATERIALS."

New York, November 28, 1898.

To the Editor of "The Engineering Record":

Sir: Everyone connected with paving will be interested in Mr. George W. Tillson's table showing in percentages the various values pertaining to pavements and the deductions drawn therefrom, as in your issue of November 26. But Mr. Tillson would be disappointed and possibly unhappy if there was a unanimous and substantial agreement with his figures, and in fact with his method of reasoning.

With this conviction the following criticisms are ventured: In comparing granite A with granite B not enough weight has been given to the fact that in many soils it is impossible to restore granite of the B class when a deep ditch has been opened along a street without relaying the entire street, i. e., if the transverse profile is to be retained. It is also thought that too high a value has been given to granite A. Under the heavy traffic of New York, on such streets as West, Front and Hudson or under the mixed traffic of Broadway and Fifth Avenue, granite pavement is badly dilapidated at the end of eight or nine years, and then two-thirds or three-quarters of the surface will have been relaid, with an addition of from 15 to 25 per cent. of new or recut stone to the area mentioned.

Thinking that durability and maintenance should be under one head, reference is made to p. 91 of the Report of Department of Public Works, City of New York, for 1896, where it is stated that the average cost of asphalt pavement with 15 years' guarantee was $2.75 and the cost of 10 additional years' maintenance was 9 cents per annum, making the cost of the pavement for 25 years, without interest, $3.65 per square yard, or, with interest at 3½ per cent. on the payments, as contracted, $7.74—a sum that would be extinguished by 25 annual payments of 19.9 cents each, with 3½ per cent. interest, which, I take it, is the cost of asphalt pavements in the city of New York on streets of average traffic. On streets of heavy traffic the cost might be 10 per cent. higher.

It is not necessary to say granite pavement cannot approximate to this cost. But I would like to go further and state my conviction that neglecting both 25 and 15 years' guarantees, there is no town or city in this country in which there are two asphalt plants, where on a street of heavy traffic a contractor will lay and guarantee a granite pavement for over five years at as low a price as an asphalt pavement.

Favorability to travel might also be revised. The engineers having charge of the streets of Paris have stated that the cost of repairs to vehicles (including both horses and harness, I believe), on asphalt is only one-half that on stone. If this statement is approximately correct and the relative values of the pavements and vehicles using them are considered, possibly Mr. Tillson might wish to alter his percentages.

Lastly, I wish to protest strongly against giving a sanitary value of only 13 in 100 in the general makeup of values. However the disciples of Malthus may regard the fearful infant mortality still obtaining in our tenement house districts, I have not mediated in or influenced any act that has given more satisfaction than the increase of asphalt pavements in those districts, from 36 to 51 per cent. of the total asphalt laid, which occurred during my charge of the pavements in what is now the Borough of Manhattan, followed as it has been by the decrease in the death rate mentioned by Mr. Tillson. There has also been a possibly equal decrease in the sickness and want which so generally accompany sickness in the homes of those who labor for daily wages.

For these reasons I think the figures adopted in the admirable paper under discussion should be modified. Edward P. North.

WIND PRESSURES ON SURFACES OF DIFFERENT AREAS

Quebec, Canada, November 20, 1898.

To the Editor of "The Engineering Record."

Sir: In a recent publication there was an editorial reference to Sir J. W. Barry's remarks at the meeting of the British Association at Bristol concerning the lack of agreement between the results of experiments on a small scale and the workings of nature on a larger basis, special reference being made to wind pressures. While at the Forth Bridge 58 pounds to the square foot was assumed as a maximum pressure in the calculations, the result of an experiment on a 300-foot surface under like conditions showed a falling off of very nearly 40 per cent. At the Tower Bridge in London the readings of anemometers indicated a pressure of 69 pounds per square foot, while experimental data obtained from the bascules of the bridge 5,000 square feet in area showed only from 1 to 1½ pounds per square foot of wind pressure under absolutely similar conditions. (See "The Engineering Record" of October 15, 1898.)

These differences may be accounted for on the assumption that a gale of wind presents areas of maximum pressure far in excess of the average pressure. For example, in a gale at Quebec the galvanized iron roof sheeting of four of the octagonal kiosks on Dufferin Terrace remained untorn, while a fifth kiosk, in the midst of the other four, had its sheeting bent, twisted and torn off, while the entire roof framing of cast and wrought iron, well bolted together, was wrenched from its eight supporting columns. The whole roof, weighing 2½ tons, was raised to a height of some 40 feet, and carried a distance of about 300 feet, where it was dropped in a broken condition on the glacis in the rear of the terrace. It is evident that in this case there was within the general stream of wind blowing up the St. Lawrence against the terrace an intensified current which struck the demoralized structure. I reduced the subject to figures at the time, some 10 years ago, and found that while the anemometer indicated only 59 pounds' pressure, the stress on the roof of the kiosk which tore it away and hurled it such a distance must have amounted to at least 100 to 120 pounds to the square foot. The same thing occurred in the United States a few years ago, when I showed in a letter in "The Engineering Record" of January 13, 1894, that while the general force of the wind was insufficient, there must have been within the general stream of air a more intensified current which struck and overturned two of the 500-foot spans of the Jeffersonville Bridge, each of at least 1,000 tons weight.

But this does not explain in any way the difference previously alluded to of the effect of wind current on surfaces of different areas. It may be remembered that some months before general attention had been drawn to the apparent paradox of the so-called ball nozzle, I explained its operation by showing that the circumferential jet of water carried with it by friction the water in the rear of the ball, thus creating a vacuum against which the pressure of the air reacted to keep the ball in place. Precisely the same thing happens to the anemometer; the wind passing around its periphery sucks out the air behind it, thus creating a vacuum against which the atmospheric pressure on the opposite side reacts. It will be noticed that while in the case of the Forth Bridge the surface experimented upon, 300 feet, gave a wind pressure only 40 per cent. less than that indicated by the ordinary anemometer, in the case of the Tower Bridge the 5,000 square feet of the bascule reduced the anemometrical pressure from 69 pounds down to 1 and 1½ pounds. This difference was due to proportional peripheries of the surfaces experimented upon in comparison with the areas; the peripheries varying only as the linear dimensions, while the areas varied as the square dimensions. For instance, if the anemometer was a foot square the ratio of the circumference to the area would be as 4 to 1. With a surface of 10x10 feet the area would be 100 square feet and the periphery 40 feet, and the ratio of the circumference to the periphery would be 4 to 10. In these two instances the wind acts around peripheries of 4 and 40 feet, respectively, while the atmosphere presses against areas of 1 and 100 square feet, which explains the fact that the greater the area acted upon by the wind pressure the greater the reduced percentage of pressure indicated by the larger surface. Nevertheless, when dealing with long, narrow surfaces, such as those of bridges, anemometrical pressures should be relied on.

C. Baillargé, City Engineer.

COLUMN AND GIRDER CONSTRUCTION IN DUN BUILDING, NEW YORK CITY.

Among the descriptions of the design and construction of the numerous tall office and other buildings which have appeared in the columns of "The Engineering Record," embracing the essential features of progress in the application of structural steel to city architecture, frequent illustrations have been given of the typical details of rectangular columns. There have, however, been important buildings in which hollow cylindrical steel columns have been used, and while theoretically most advantageous in resisting compressive strains, they have been generally considered as presenting difficulties to forming satisfactory connections. In several instances the Phœnix column, composed of four, six or eight segmental flanged sections, with or without reinforcing bars, have been adopted, and special forms of connections have been devised that dispense with castings for making the column splices practically continuous, and afford convenient opportunities for the connection of beams and girders at any point and in any direction. One of the most recent examples of this construction is in the Dun Building, New York. The erection of the substructure and foundation work in this building was illustrated and described at length in "The Engineering Record" of February 5, 1898.

The building is a modern fireproof steel cage office building, containing a basement, cellar and sub-cellar and 15 upper stories. The columns are carried by a series of distributing box-girders, supported on grillages set in concrete that incloses the tops of clusters of piles driven deep in the fine sand which overlays the rock, over 100 feet below. The foundation plan of this building was given in Figure 1, page 211, Volume xxxvii. Figure 2 is a part section and elevation of one of the heavy multiple web distributing girders and is typical of the others. The columns are supported directly from the top plates of the flanges of these girders, and the heavy bottom section of one of them is shown in Figure 3, which illustrates the fundamental principle of column connections made with vertical cruciform interior diaphragm plates, which are extended as necessary beyond the edges of the column to afford web connections for other members. The same principle is applied to give riveted gussets for bracing the extended baseplate and easily distributing the concentrated load of the column over the larger area of the surface of a pier or supporting girder. The diaphragms are set between adjacent segments of the column section, and take the place of the flange reinforcement plates where the latter occurred, or fill in the interstices reserved by spacing pieces where reinforcement plates are not requisite. In the eight section column, here shown, where it is not convenient to use more than two continuous diaphragms the intermediate ones are not carried through the axis of the column, but are simply riveted through the flanges of their segments, like an ordinary gusset plate. At the top of the column section the diaphragms are extended to a considerable distance on four sides, so as to project much farther than is requisite for ordinary floor beam connections, in order to serve as continuous full-webbed knee braces to stiffen the panels of the framework and take up wind strains, vibrations, etc. These plates are continuous beyond the milled upper end of the column and provided with open holes, A A, etc., to serve as splices for the bottom of the next upper section of the column, which is made to fit over these diaphragms, the other open holes in the plates being made for the ordinary connection. This system is characteristic of the construction, and is essentially repeated at all column splices. As it was foreseen that it would be necessary to erect two rows of the columns to the full height of the building before the remainder could be set, it was considered advisable to provide special temporary diagonal bracing between them, so as to form with the floor beams vertical trusses to resist the wind pressure and insure stability during erection. Open holes, B B, etc., were bored in the gusset plates to receive the pin connections of 1½-inch adjustable diagonal rods.

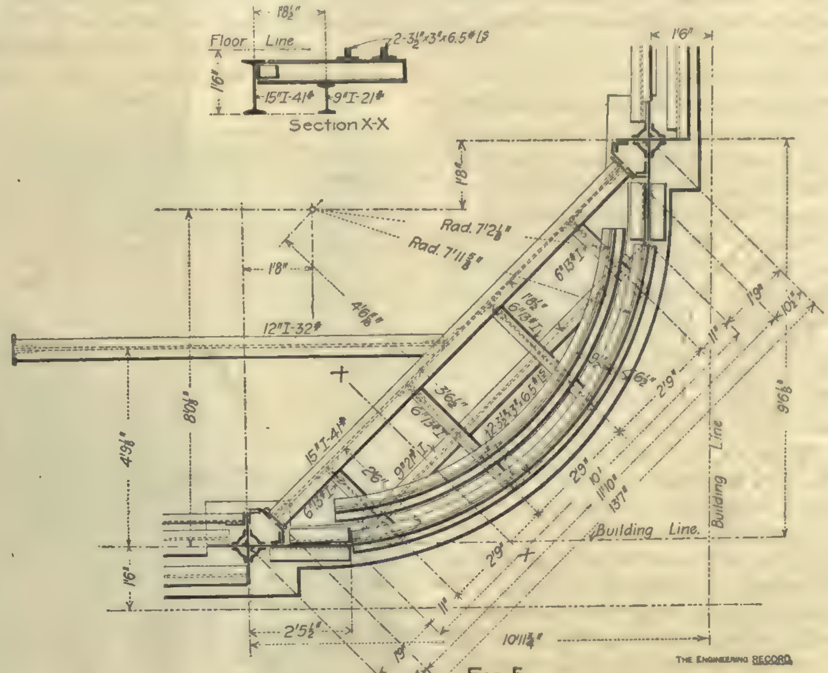


FIG. 5

The construction of an upper section of one of the interior columns, composed of four segments and provided with a horizontal diaphragm at the top to receive the flange connection for a reduced section of an upper column, is shown in Figure 4. The arrangement of the lower part of the column provides open spaces between the flanges to receive the ends of the projecting diaphragms, as is clearly shown. Figure 5 shows the curved cantilever framework, supported from a special cross-girder, carried on two columns in adjacent sides of the building, so as to form a platform to sustain the overhanging curved wall at the corner of the building without necessitating the use of a corner column at the street angle in a lower story, which would obstruct the main entrance. This arrangement is notable for the simplicity and rigidity with which a difficult construction had been connected to the columns, and shows the convenient opportunities which the diaphragms, or pintles, as they are technically called, afford for various uses. Figure 6 is a view of one of the typical main columns in the front wall, and shows the connections by which it supports a heavy plate girder over the portal entrance, besides the floor beams and the independent offset girders carrying the wall masonry.

In one of the intermediate stories there is a heavy projecting belt course, or sub-cornice, of terra cotta and ornamental stonework, which is carried on cantilever brackets anchored against upward reaction in their inner ends by connections at their inner ends with the web of a longitudinal girder fastened to adjacent columns. Each bracket is supported at an in-

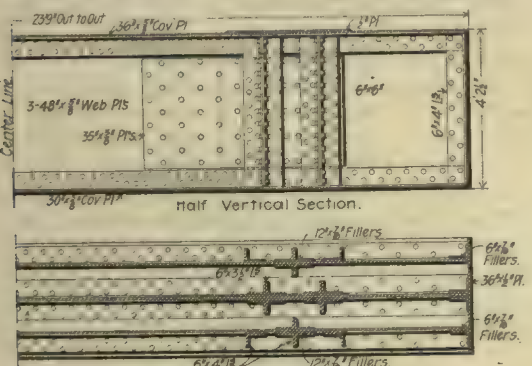


FIG. 2

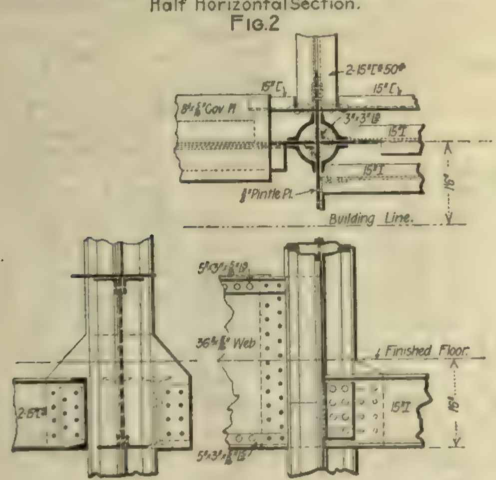


FIG. 6

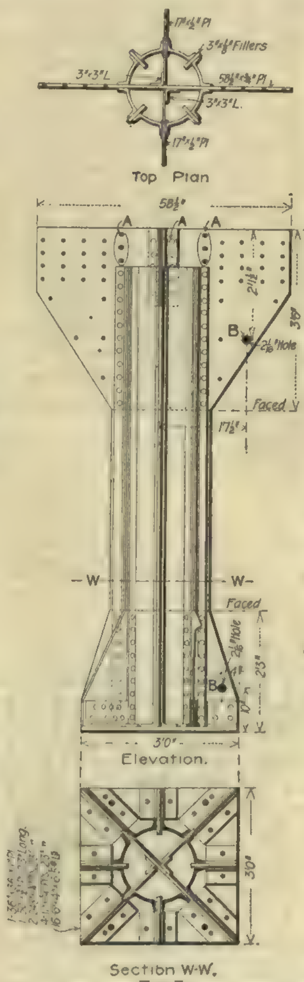


FIG. 3

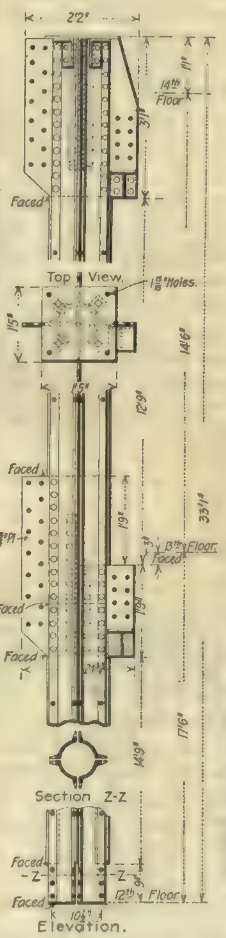


FIG. 4

COLUMN AND GIRDER CONSTRUCTION IN THE DUN BUILDING, NEW YORK CITY.
GEORGE EDWARD HARDING & GOOCH, ARCHITECTS.

termediate point by a connection to a heavy plate girder, which has openings cut in its web to permit its intersection. The roof cornice of the building is built of ornamental terra cotta blocks, supported on cantilever brackets anchored to the roof beams. Messrs. George Edward Harding and Gooch are the architects of the building, and the structural ironwork was built and erected by Milliken Brothers, all of New York City.

AN EXAMPLE OF A MODERN FLAT HOUSE.

A new block of flat houses just completed by the Hoboken Land & Improvement Company, on Washington Street, Hoboken, N. J., extending from Twelfth to Thirteenth Street, is an interesting example of the general tendency which there seems to be, of recognizing the needs of that class of the population in the large cities which has good taste but a small pocketbook. In the present case, the buildings have been designed for the comfort of the man who can afford about $18 or $20 per month for his home, and who appreciates the attempt to provide abundance of air, light and water. The project is not philanthropic, however, the special problem being to supplant the ordinary 28-foot double tenements by a group of buildings which would in no way involve too great an expenditure of capital, or decrease the money return; and at the same time, the purpose has been to provide for thorough lighting and ventilation of the flats by following as nearly as possible the room arrangement of a country house, where passage between distant rooms takes place through hallways and not through intermediate bedrooms, as is necessary in the usual flat. The work was carried out from the plans of Messrs. Frank E. Wallis and William B. Bigelow, who were associated for the work in accordance with the wishes of Messrs. E. A. and Robert Stevens, of the Hoboken Land & Improvement Company.

The completed plan comprehends a five-story and basement building on the four streets bounding the block, Washington, Hudson, Twelfth and Thirteenth Streets, the rectangle so formed inclosing a large central court to be planted with grass and trees for a playground. At present but one-half of the structure has been erected. The reproduction in Figure 1 of a recent photograph will give a good idea of the exterior. The arrangement of the upper floors is shown in the left of Figure 2. The right half of the drawing is a plan of the first floor, differing only as necessitated by the entrance halls. Figure 3 is a plan of part of the basement, showing the coal and store bins and the janitor's quarters. The structure virtually comprises 16 different double-flats, most of which accommodate two families per floor. Each flat consists of a parlor, dining room, kitchen, two bedrooms and bathroom, with the exception of two or three of the first floor flats, which lack one sleeping room on account of the greater hall area necessary for entrance. One-half of each house is connected with the adjoining half of the next house by a stairway, and it is by locating the stairway between every two houses in the manner shown that light and air are secured for the halls. While window light is thus obtained for the stairways, a feature of the floor plans is that all the rooms, including the bathroom, open either on the street or the court, the result being attained by several rather large minor courts which indent the building from construction, following the New York City building laws in this respect. The building is of brick, the front being finished in buff and cream. The foundations are brick, faced with ashlar. The first floor is built of steel beams, with the expanded metal system of construction by the Manhattan Concrete Company, and those above are of wood. The walls are plastered throughout with rock plaster, making them semi-fireproof, and in the halls all partitions are constructed of expanded metal and plaster. In all

FIGURE 1.—MODERN FLAT HOUSES, HOBOKEN, N. J.

the main court. Additional building front, with an accompanying break in the monotony of straight walls, is also secured by an extensive use of bay windows. In the economy of floor space the architects assert that there is a great saving in hall area, there being over 70 per cent. rentable floor area, not including public and private halls, while figures for tenements in New York City show less than 60 per cent. The total contents of the buildings is 1,500,000 cubic feet, and they were erected for a cost of 16.7 cents per cubic foot.

The conveniences of the building are quite numerous. Gas may be used for light or cooking, the owners being willing to install gas stoves where they are preferred to the coal range. In the halls, incandescent lights are provided. The whole building is heated by steam, direct radiation being placed in the lower halls and in parlors and dining rooms. The bath rooms are floored with cement and furnished with enameled iron bath tubs and basins. Hot water is furnished throughout. Dumbwaiters are also installed, opening into the kitchens and protected with iron doors.

In its construction, the first floor is of fireproof cases, metal fire stops are placed in the floor beams to prevent spread of fire. In the bathroom, to protect the building from water leakage, the space between the beams is filled with cement, forming the cement floor already mentioned. The floors of the kitchens are one-inch maple, and the other floors one-inch selected yellow pine. The trim is in selected Gulf cypress. Mantels are of cypress with carved caps and shelf molding, specially designed for the buildings in colonial style. A sideboard is provided for each dining room of the same style. There are closets in the bed rooms, dining rooms, halls and kitchens. Wall papers of cheerful design and old-brass gas fixtures add much to the appearance of the rooms.

The building is heated by exhaust steam, furnished under contract by the Hudson Electric Company, of Hoboken. The plant of the company is situated about 1,200 feet distant, and the steam is carried to the building by means of the Webster system of vacuum return. The steam main enters a "boiler room," located in the cellar near the center of the block on Washington Street. Two heating mains are carried in opposite directions from this room for the

FIGURE 2.—FLOOR PLANS OF A NEW FLAT HOUSE, HOBOKEN, N. J.
FRANK E. WALLIS AND WILLIAM B. BIGELOW, ARCHITECTS.

two parts of the building. Two corresponding smaller mains supply steam to heating coils of steam clothes dryers. In addition to these, steam is used to heat the water which is supplied throughout the building. Two Berryman feed-water heaters are used for this purpose, with a total heating surface of 285 square feet. Figure 4 shows the heater and connections. The water supplied to the heater is metered and may pass, as shown, through one or both of the heaters. Under the present conditions, as the building is being gradually filled with tenants, the demand for hot water is not very great and the small heater is capable of furnishing the requisite amount. Cold water coming through the meter is allowed to enter the one heater only, and passes from this to the other, which may thus be used as a reservoir. The water is kept in circulation in order to furnish hot water to the more distant parts of the building, by means of a system of return or circulating pipes. The circulating main returns the water to a small Deane triplex power pump driven by a 2-horse-power electric motor in the boiler room. When the hot-water circulating system was first installed, it was supposed that there would be a tendency for a slower circulation of water in the more distant risers, on account of the increased friction presented to the flow of water in the longer lines of pipes. To overcome this, valves were placed at the foot of every riser, so that the friction of all parts could be equalized. From the top of the various hot water risers, half-inch galvanized-iron pipes drop to the circulating main, so that hot water is always pres-

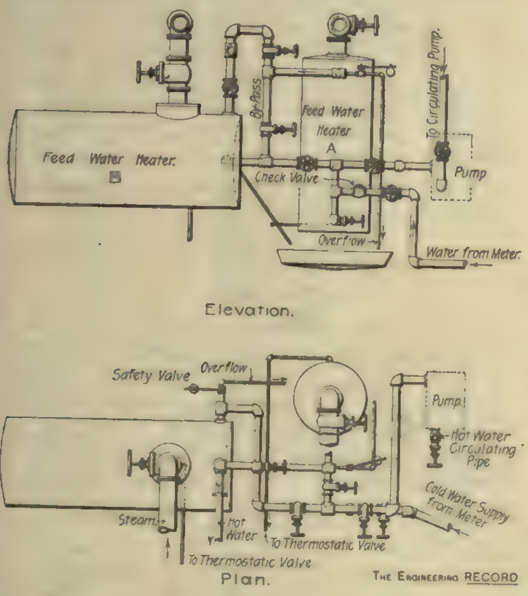


FIGURE 4.—WATER HEATING APPARATUS.

ent at any faucet. As shown in the figure, each heater is supplied with a safety valve to permit an outflow of water from the system should the pressure rise from any mismanagement of the plant. The water pressure on the Hoboken mains is about 55 pounds, and the valves are set at 85 pounds. The steam connections are made at the top of both heaters, and the water of condensation is drawn off through traps returning the condensation to the street return. Five mains leading from each side of the boiler room and passing through the basement of the buildings are suspended from the ceiling, with the exception of the return from the heating system in one-half of the building, this having been laid underground so as to come below the water line of an initially-proposed isolated boiler plant. From these mains, branches follow in general the middle line of each house, suspended likewise from the ceiling, and connecting with shorter horizontal branches leading to risers near the outside walls. The only special provision for expansion in the large mains is made with the heating pipes, horizontal U-shaped bends being made at four points in each half of the building. Radiators on the first floor are supplied with short independent

FIGURE 3.—FLOOR PLAN OF BASEMENT.

connections from the basement, but those on the floors above are connected with long risers. These are provided with expansion bends, similar to those in the large main, the pipes extending horizontally between the wooden beams of the third floor.

The clothes dryers were made by the Chicago Clothes Dryer Company. A circulation of air is effected through the dryer casings by a circular galvanized-iron duct, which connects the top of the casing with openings in the cellar windows. The heating and hot-water plant was installed by the Crossley & L'Hommedieu Heating Company of New York City.

COOLING TOWER AND CONDENSER INSTALLATION.

In a paper with the title above quoted read befor the American Society of Mechanical Engineers, the author, Mr. J. H. Vail, described the application of a cooling tower and condensing apparatus to an electric plant which was suffering with an overload. The electric light station was equipped with 27 boilers, 48 inches in diameter, 20 feet long, with 22 5-inch tubes. These boilers were set two to a furnace, grate surface 8 feet 6 inches by 5 feet, the odd boiler being set to a single furnace. The engine capacity and the load on the station already taxed all the boilers to the limit of their steaming capacity. After a preliminary investigation of the existing conditions, the author recommended that by putting in a cooling tower and a condensing system, the engine capacity of the station could be increased, leaving the boiler capacity the same, thus saving the cost of adding more boilers and enlarging the building, and at the same time obtain better economy, as well as a greater capacity for production. To determine the steaming capacity of the boilers, two tests were made with one pair of boilers, which showed that with Shenandoah pea coal and a feed temperature of 206.5 degrees Fahr., each boiler would evaporate into steam 4,281 pounds of water per hour, with an economy of 8.24 pounds of coal, from and at 212 degrees. Coincident with the boiler test, one 18½x30 inch Buckeye engine was using steam at a rate of 46.8 pounds per horse power hour.

The author recommended that the Buckeye engine should be converted into a 14¼ and 25x30 inch tandem compound condensing engine. Also that an additional 750 horse power tandem compound condensing engine should be installed in the station, together with a cooling tower and the necessary condenser equipment, and that the only change in boilers should be to raise the working pressure. No increase of boiler capacity has been made. After investigation, the Barnard type of cooling tower was selected.

The tower is of the twin type, having two chambers, with a pair of fans supplying a strong draught of air to each chamber. The interior dimensions are 12″3′x18″x29″6′ high. The hot water from the condenser discharge is delivered through a 10-inch wrought iron pipe, extending the whole length of each chamber, slotted on top, and perforated at the bottom, giving equal distribution to a series of 96 distributing pipes, extending across the tower, each pipe being slotted and perforated, thus insuring a uniform distribution of water.

Means are provided for cleaning these pipes, which is found very necessary in cold weather, when the cylinder oil from the exhaust steam is liable to clog the pipes and interfere with uniform and free distribution of the water.

The hot water falls from the distributing pipes over galvanized wire mats, made of No. 19 steel wire, woven to No. 5 mesh. Each mat is 12 feet x 15 feet 6 inches, affording a total of 8,064 square feet of cooling surface. Each mat is suspended by galvanized iron hooks, and is easily removed for cleaning or repairs. The circulation of air is furnished by two pairs of 8-feet diameter fans, each pair of fans being mounted right and left on a shaft, and the four fans are capable of delivering 360,000 cubic feet of air per minute when driven at a speed of 150 revolutions per minute. The rated capacity of each section of this cooling tower is to cool the circulating water needed to condense 12,500 pounds of exhaust steam, from an initial temperature of 132 degrees Fahr. to 80 degrees Fahr., when the atmospheric temperature does not exceed 75 degrees Fahr., nor the humidity 85 per cent. The total elevation from the condenser to the discharge opening at the top of the tower is 58 feet. This places more duty on the circulating pump than is desirable, but it was unavoidable. The circulating water is handled by a Blake vertical twin air pump and jet condenser. As it is very important to have facilities for drving the fans at variable speeds, this flexibility has been obtained by using a small vertical engine, direct connected to the shaft of each pair of fans. As direct current was not available it was not thought advisable to use electricity. Under varying conditions of temperature, the speed of the fans must be increased or decreased, according to high or low atmospheric temperatures. The following table, extracted from the log records for many months, shows details as to temperatures, speed of fans, reduction of temperature of condenser discharge, etc.:

	1898.					
	Jan. 31.	Feb.	June 20.	July.	Aug. 26.	Nov. 4.
Time	9 P.M.	8 P.M.	8 P.M	8 P.M.	8 P.M.	5.35
Temperature atmosphere	30°	36°	78°	96°	85°	59°
Temperature condenser discharge.	110°	110°	120°	130°	118°	129°
Temperature condenser suction returned from tower to tank	65°	84°	84°	93°	88°	92°
Degrees of heat extracted through tower	45°	26°	36°	37°	30°	37°
Speed of fans at tower, R. P. M	36	0	145	162	150	148
Vacuum at condenser	25½	26	25	24½	25½	25
Strokes of condenser pump	30	30	37	44	43	28
Lbs. boiler pressure.	110	110	120	120	120	112
Temperature boiler feed	212°	212°	210°	211°	213°	213°

After the Buckeye engine was changed to a tandem compound condensing engine by bolting new tandem cylinders on the existing frame and making necessary alterations in valve rods, etc., the following data were obtained. Revolutions, 137; steam pressure, 113 pounds; mean effective pressure, 50.16 pounds; vacuum per gauge, 26 inches; horse-power developed in high pressure cylinder, 163.42; horse-power developed in low pressure cylinder, 168.48—total, 331.9 horse-power, and of this 90.52 horse-power is below the atmospheric line. It will be noted that the work is divided almost equally between the high pressure and low pressure cylinders; all cards show similar results.

This engine was fitted with a receiver and reheater between the high and low pressure cylinders; several tests have been made and repre

sentative cards were analyzed to determine whether the reheater is of value, and as a result of these tests the author found that the reheater condensation amounts to 63 pounds of steam for each horse-power gained in the low pressure cylinder. The reheater was therefore abandoned as an expensive luxury. In addition to the tandem Buckeye engine a tandem compound condensing engine 20 and 36x42 inches, 120 revolutions per minute, Corliss type, built by Pennsylvania Iron Works, was installed to drive a direct connected Stanley 500 kilowatts two-phase A. C. generator. The usual work required from the cooling tower and condenser varies from 7 to 17 hours per day. A notable record was made on August 2, 1898, when the run was from 7 A. M. till 12 midnight, and from the daily records, the following data are extracted:

	Max.	Min.
Temperature, atmosphere, deg.	103	83
Temperature, condenser discharge to tower, deg.	128	106
Temperature, condenser suction, deg.	98	91
Degrees of heat extracted, through tower, deg.	32	21
Speed of fans, revolutions per minute	160	140
Vacuum at condenser	26	20
Strokes of condenser pump	50	38
Pounds boiler pressure	121	100
Temperature, boiler feed, deg.	212	200
Horse-power developed	900	400

A continuous heavy load was carried during the entire 17 hours' run. This was not a test record, but simply daily service. The pump and fan engines were indicated and they were found to indicate 13.75 and 13.5 horse-power, respectively, which if deducted from the work done below the atmospheric line in the low pressure cylinder, 185.1 horse-power leaves a net gain of 157.85 horse-power from the use of the condenser and cooling tower.

There are two feed water heaters in connection with the condensing plant. First, an intermediate tubular heater in the line of exhaust between the low pressure cylinders and the condenser. Second, an auxiliary feed water heater was also attached, receiving the exhaust from the condenser and boiler feed pumps, and any other auxiliaries.

THE DOW STEAM ENGINE.

A steam engine possessing some points of novelty was recently described by Mr. Josiah Dow before the Engineers' Club of Philadelphia, and material has been taken from Mr. Dow's paper to prepare the following description of the machine: The engine is of the vertical compound type, arranged on the Woolf principle. As shown in Figure 1, a sectional view of the cylinders and connecting steam passages, the cylinders are placed as closely together as possible, with all valves and steam passages between the cylinders, to avoid loss of heat from them, and to facilitate the transfer of steam from one cylinder to the other and for compactness' sake. The first cylinder exhausts through short passages directly into the second, the up-stroke of the first coinciding with the down-stroke of the second. The valves are placed as closely as possible to the interior of the cylinders, but there are only two to each cylinder, the steam and exhaust valve for each end being combined in one. All valves are actuated by one wrist-plate. The events of the valves are so arranged that the exhaust from the high-pressure cylinder immediately enters the low-pressure, the valve in the second cylinder being always open in time to permit its free passage. The work in each cylinder at normal load and pressure is exactly the same, and the weights of the reciprocating parts are balanced against each other by means of the pistons being cast hollow so that the smaller one may be filled with sufficient lead to make its weight equal to that of the larger. The high-pressure valves are cylindrical in shape and so constructed that the steam passes entirely through them from end to end. Figure 2 is a vertical section through the axis of the high-pressure valves, and Figure 3 is an enlarged cross section.

The steam jackets part of the high-pressure cylinder and then passes through the cylindrical valves to the steam ports. The valves are packed with rings to prevent leakage between the valve and its seat.

The valve always receives the same degree of movement, regardless of the point of cut-off, so that ridges cannot form in the seat. Exhaust is effected by the valves through a depression in their sides, formed to complete the passage which connects the cylinders at the proper time.

The valves in the low-pressure cylinder have no cut-off, its steam expansion being a continuation of that begun in the first. They close the connecting passage before expansion is completed, to leave the steam within the port of higher pressure than the terminal pressure of the low-pressure cylinder. These valves also control the exhaust and compression of the low-pressure cylinder, but, as one valve controls both inlet and outlet, the volume of the steam and exhaust ports is reduced one-half.

Figure 4 is a view of the valve gear of the engine. The cut-off movement, which is taken from the cross-head, is communicated to a vertical lever which has a slot through its upper limits, in which is carried a sliding block, having connection with the governor. From the center of the block links are attached leading off at either side to rocker-arms, which also carry connecting rods leading on one side to the upper, and on the other side to the lower valve-gear. The position of the block determines the point of cut-off, which may occur from no admission of steam at all to about seven-eighths stroke. The block is moved up and down in its slot by the regulating efforts of the governor, and is, with its connections, balanced to reduce its resistance to movement in either direction.

Two views of the mechanism operating the valves are shown in Figure 5. The gear is set upon a bonnet as in the Corliss engine. The gear comprises a crank A, keyed to the valve stem and connected by a pair of links in the form of a toggle-joint to the crank B cast on a collar mounted and revolving upon a bearing at the end of the bonnet. A second crank C is also cast on this collar, and it is connected to the wrist-plate. Back of this collar, and also mounted upon the bonnet, is the cut-off

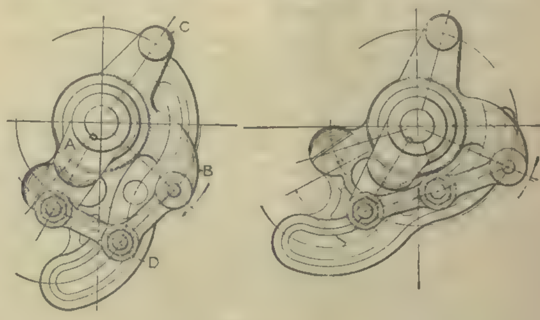


FIG. 5.

plate, the angular position of which is under control of the governor. The middle pin, D, in the toggle, is long enough to fit in a groove cut in the cut-off plate. For a part of its length this groove follows a path concentric with the valve stem, so that the two cranks move through equal angles. A continuation of the groove in the cut-off plate changes its direction gradually, so as to be concentric with the pin in the end of the crank A when the valve is wide open. When the pin D is in this part of the groove the motion, one way or another, of the crank B, which is connected to the wrist-plate, will produce no motion in the valve. The position of the cut-off plate, of course, determines the point of cut off. The valve motion is designed to give a quick opening and closure of the valves. Figure 6 shows a sample indicator diagram of the Dow engine.

THE GENERATION AND UTILIZATION OF STEAM IN A COLLIERY.

"The Generation and Utilization of Steam by the Lykens Valley Coal Company and Summit Branch Coal Company, Dauphin County, Pa.," was the title of a paper read before the New York meeting of the American Society of Mechanical Engineers, by Mr. R. Van A. Norris, who was engaged by the Pennsylvania Railroad Company, which owned the mines, to discover

FIG. 3.

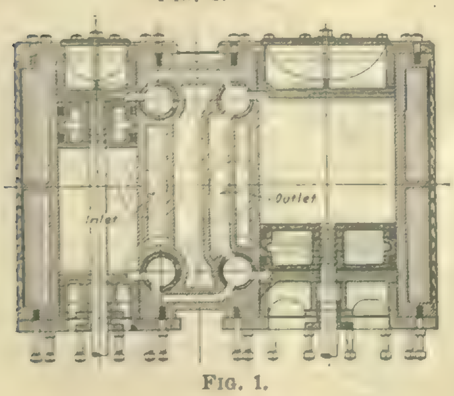


FIG. 1.

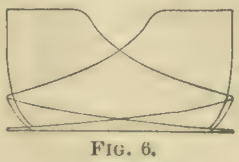


FIG. 6.

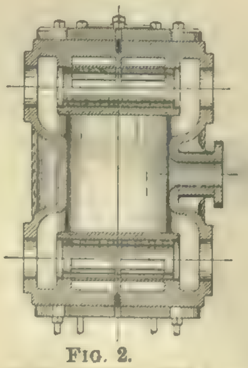


FIG. 2.

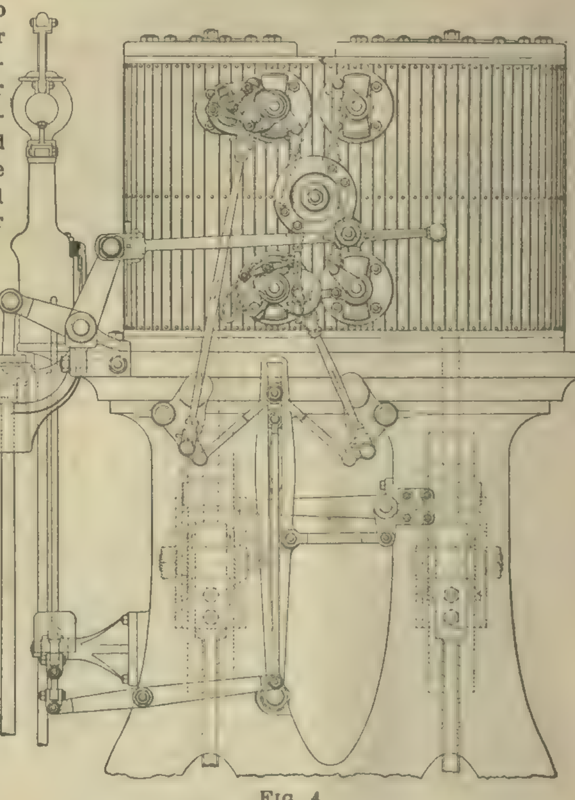


FIG. 4.

THE DOW STEAM ENGINE.

and, if possible, to remove the cause of the poor economy with which the steam plants of the mines had been operating. The paper was long and contained many tables and cuts. The fuel used under the boilers was Lykens Valley red ash buckwheat coal, a semi-anthracite, with excellent steaming properties. The results of the investigation have been the shutting down of 26 boilers, representing the saving of steam due to repairing steam lines, setting valves in the pumps and engines, etc. The boiler plants examined and tested comprised in all 56 cylinder boilers and 540 horse-power of Babcock & Wilcox boilers, belonging to the Lykens Valley Coal Company, and 66 cylinder boilers, 300 horse-power of return tubular and 2,300 horse-power of Babcock & Wilcox boilers, belonging to the Summit Branch Coal Company. Extended tests, each of several days' duration, were made. The feed water was either measured in tanks or metered in calibrated Worthington and Trident meters. The fuel and ashes were measured in full cars struck off level and the weight per cubic foot determined by samples of 10 to 27 cubic feet, dried and packed under the same conditions under which the measurements were made.

From the boiler tests the cost of steam per boiler horse-power was found to be as follows, estimating the cost of the buckwheat coal at 75 cents per ton, including the labor of firing and removal of ashes, and the interest, depreciation and repairs to the boiler plants at 15 per cent. on a cost of $10 per horse-power:

Plant.	Type of Boiler.	Evaporation from and at 212° per lb. coal.	Cost per boiler H. P. per year 275 days, 10 hours per day.	Cost per boiler H. P. per year 365 days, 24 hours per day.
		Lbs.	$	$
Williamstown.	B. & W.	7.51	5 81	14.98
	Cylinder.	6.13	6.68	18.01
Bear Valley Shaft.	B. & W.	8.15	5.40	13.97
	Cylinder.	6.71	6.24	16.59
Bear Valley Slope.	Return Tubular.	7.70	5.63	14.64
Lykens.	B & W.	7 48	5.75	15.03
	Cylinder.	6.33	6.52	17.49

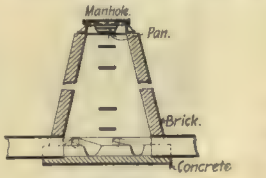
The author calls attention to the fact that the Babcock & Wilcox boilers at Williamstown and Lykens, gave exactly the same evaporations during tests of several days' duration, though the Lykens boilers were worked 18 per cent. over and the Williamstown 18 per cent. under their rating.

The author applied indicators to the steam cylinders of all of the pumps and engines and estimated the steam consumption from the cards. An allowance was made for cylinder condensation. Numerous tables showed the steam consumption thus calculated of the engines and pumps, also the steam used in heating buildings, the condensation of the steam lines, the steam used by steam jet blowers under the boilers and in safety valve leakage. The totals were footed up and it was found that from 60 to 90 per cent. of the total steam generated in the different plants was accounted for. The author based the steam pipe condensation upon the recent experiments of Prof. C. S. Norton. The steam jet blowers were found in a previous test to consume 830 pounds of steam per ton of coal burned.

All the hoisting engines, except two or three new ones, showed very poor economy and they were in a generally bad condition. The mine pumps, which used from 50 to 80 per cent. of the steam generated in the different plants, were also in bad shape. The author recommended that the water be hoisted from the mines rather than pumped, on account of the better economy of a hoisting engine in good condition. The steam pipe lines were examined and were generally found to be well covered. Of five leaks noticed in one system of pipes, three were at expansion joints. In the Williamstown plant many of the lines were leaking badly. Most of the leaks were through the threads of flanges, and the author recommended that the threaded flanges should be removed as soon as possible. The Williamstown steam lines were not provided with traps, the condensation being blown off from tees and partly open valves, causing a great loss of steam.

PLUMBING IN THE LONG ISLAND STATE HOSPITAL.

The Long Island State Hospital at Kings Park is located in large grounds near the north shore of Long Island, about 40 miles from New York City. The hospital was established many years ago by Kings County, and a number of buildings had been provided before the property was turned over to the State of New York. The situation is isolated, and all provision for the inmates and attendants is complete and independent. A direct pressure pumping station, with a capacity of about 1,000,000 gallons a day, operated at a pressure of 100 pounds at the pumps, furnishes the water supply. A system of separate collection and combined outlet sewers has been constructed, and a large battery of steam boilers has been installed to furnish power for pumps and dynamos, and to provide steam for general domestic and heating purposes. Steam is distributed throughout the grounds through several thousand feet of an accessible subway, which for the greater part of its course is carried under the main boulevard. The old buildings were mostly frame cottages two stories high, and these, together with four large brick cottages, provided wards, offices, residences, kitchens, laundry, etc., for about



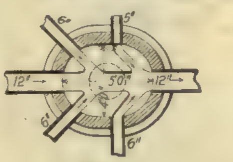


FIG.2

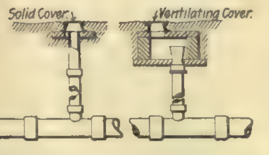


FIG.3

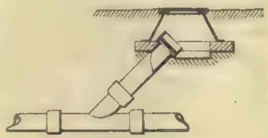


FIG.4

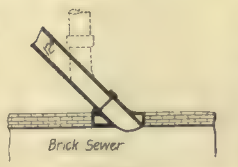


FIG.5

2,000 persons, including both patients and attendants. The original buildings were separate and detached, and as they were built at intervals as required, are to a considerable degree independent structures and do not conform to any symmetrical arrangement or harmonious plan.

In 1897 the construction was begun of a new group of buildings, intended to accommodate 900 patients, besides the medical staff, attendants and employees. Seven of the eight wards are in the form of cottages, four of which are connected by corridors with the central and administrative buildings, while the other three are detached. All of them have the first story devoted to living and sitting rooms, the second story to sleeping rooms, and the basement to storage, heating apparatus, etc. One of the connected cottages, built on lower ground, is made three stories in height, so as to secure a uniform roof line. In the main group the cottages are arranged approximately in a semi-circle of about 600 feet outside diameter, and connected by one-story covered corridors. In the center of the sector is a large ward, and in the continuation of its axis, intersecting the middle of the semi-circle, are the buildings for kitchen, dining-room and bathroom service for the entire group of cottages, a large sun parlor with sloping skylight roof on the south side, and the administration building, which contains the residence of the physician in charge and the main entrances and offices, extending the center line of buildings to about 480 feet in extreme length. The buildings are all of uniform design, with red brick walls and heavy red brick tile roofs, steeply pitched, and have an abundance of large windows. The interior finish is uniformly of white hard plaster and yellow pine, oiled and varnished, and all apartments are heated by the hot blast system and have exhaust fan ventilation. Separate and independent apparatus for heating, ventilating, water supply, plumbing and sewerage is provided for each cottage and other distinct buildings in the group, practically 10 in all. Steam and water from the central plant are delivered to the group of buildings at nominal pressures of about 50 and 40 pounds, respectively.

The general water distribution for the new group of buildings is effected by an 8-inch main, which feeds 6-inch cast-iron sub-mains that surround the connected cottages in the form of a double horseshoe, one line in the front and a parallel line in the rear of the buildings. The two lines are joined at both ends so as to form a continuous belt system, and are cross-connected and valved as indicated in Figure 1, to allow of supplying any building independently, and in order that water may be drawn from either side of the circuit, at the same time obviating dead ends and promoting a constant circulation. The pipes are coated by the Angus Smith process, and are buried at least 4½ feet below the surface. There are 24 4-inch branches, each serving an outdoor fire hydrant, and there are 3 and 4-inch branches for the house connections. The thicknesses and weights per foot of the different pipes are respectively 3-inch, ⅜-inch and 14.8 pounds; 4-inch, 7/16-inch and 21.16 pounds; 6-inch and ½-inch and 34.47 pounds; 8-inch, 17/32-inch and 49.94 pounds. All pipes are tested to 200 pounds, by hydrostatic pressure after coating. All hydrants are 4 inches in diameter, with sliding post case and a single hose outlet. All valves are accessibly set in cast-iron valve boxes, with a cover at grade.

The sewer system comprises lines of 12, 10, 8 and 6-inch vitrified salt glazed pipe, connecting the house drain systems with the public brick sewers, and includes flush tanks, manholes, lampholes, inlet connections for the foundation tile drains, and lateral branches for rain water pipes. The specifications for vitrified pipe required its thickness to be ¾ inch for 6 and 8-inch sizes, 1 inch for 10-inch and 1⅛ inch for 12-inch sizes, and the hubs to be 3 inches deep, and wide enough to have a ⅝-inch annular space around the spigots for the cement joints. Pipes having more than one transverse or two longitudinal fire cracks, or having pieces more than 1 inch long broken out of the hub were rejected. Slight irregularities in the interior surface were permitted only when they occurred within 45 degrees each side of the center line of the top of the pipe. The trenches were excavated with minimum slopes, and a bottom width of 1½ feet greater than the pipe diameter. The bottom was accurately cut to the grade and shape of the lower half of the pipe, which was securely and evenly bedded. The pipes and specials were accurately fitted together in line on the surface alongside the trench before they were lowered to place. In making joints an oakum gasket was first inserted to keep the mortar out of the interior of the pipe, then the sections were turned so as to bring all admissible irregularities and defects on the upper side, and the annular space between spigot and hub was adjusted to be concentric and entirely filled with mortar, one part Portland cement and two parts sand, mixed dry in wooden mortar boxes, and pressed into the joints with the fingers. The outer edges of the joints were beveled off, and the mortar, supported by sand or fine earth, was packed against it. No joint was cemented until at least three joints in advance were gasketed, and no deviation of more than ½ inch from grade

or alignment was allowed. Manholes were built of hard burned sewer brick laid in mortar, two parts Rosendale cement and five parts sand, mixed dry, and of concrete made of one part Portland cement and four parts sand, mixed dry, moistened with the minimum amount of water and incorporated with four parts of coarse gravel or 2-inch broken stone. All manholes have walls at least 8 inches thick, plastered inside and outside with Portland cement mortar, and are fitted with locked cast-iron ventilating covers and suspended pans, set in cast-iron frames, flush with the surface, as shown in Figure 2. The sewer lines are equipped with five 250-gallon brick flush tanks, with 5-inch automatic syphons, each supplied with water through a ¾-inch galvanized iron pipe to the nearest building and regulated by a ⅜-inch brass stop-cock, set for a flush every 12 hours. The flush-tanks have concrete bottoms and arched tops, with manhole frame and locked cover. Lampholes are provided between manholes at distances of about 100 feet, and are made of 6-inch vertical branches with tee connection and solid or ventilated iron cover and frame as shown in Figure 3. Cleanouts are made with Y-fittings and glazed pipe branches in vertical planes, and have cast-iron frames and tight covers set flush with the surface of the ground, as shown in Figure 4. All connections between the pipe sewers and the brick sewers are made through the sides of the latter, about halfway between the top and the bottom, with a terra cotta fitting, into which the pipe is cement jointed, as shown in Figure 5.

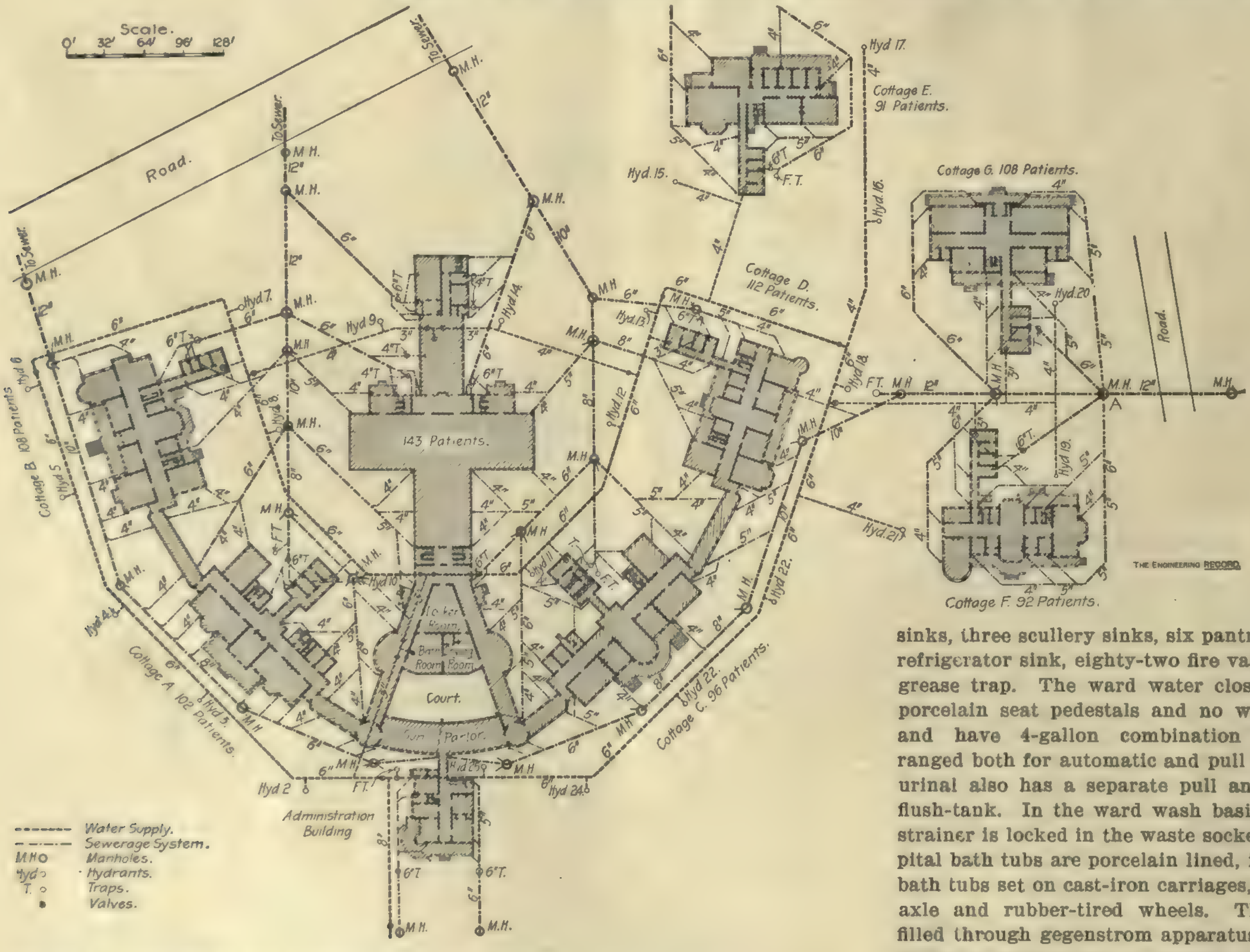


FIGURE 1.—PLUMBING IN THE LONG ISLAND STATE HOSPITAL, KINGS PARK, N. Y.

The inside plumbing work includes the hot and cold water supply and drainage throughout the administration building, seven cottages, the dining-room and central dormitory building, large congregate bathing apartment, sun room and connecting corridors. Underground drain and leader connection pipes are of cast-iron tested to 40 pounds pressure, and are of the following weights per lineal foot: 2-inch, 5½ pounds; 3-inch, 9½ pounds; 4-inch, 13 pounds; 5-inch, 17 pounds; 6-inch, 20 pounds. They were all heated and dipped in hot coal tar pitch. Soil pipes are of steel, asphalted, and connected by recessed screw jointed drainage fittings and long bends. Waste and vent pipes less than 4 inches in diameter are of galvanized wrought iron pipe. Branch waste pipes for the short connections of water closet, slop sink, bath tub, kitchen, scullery, pantry and refrigerator sink wastes are of

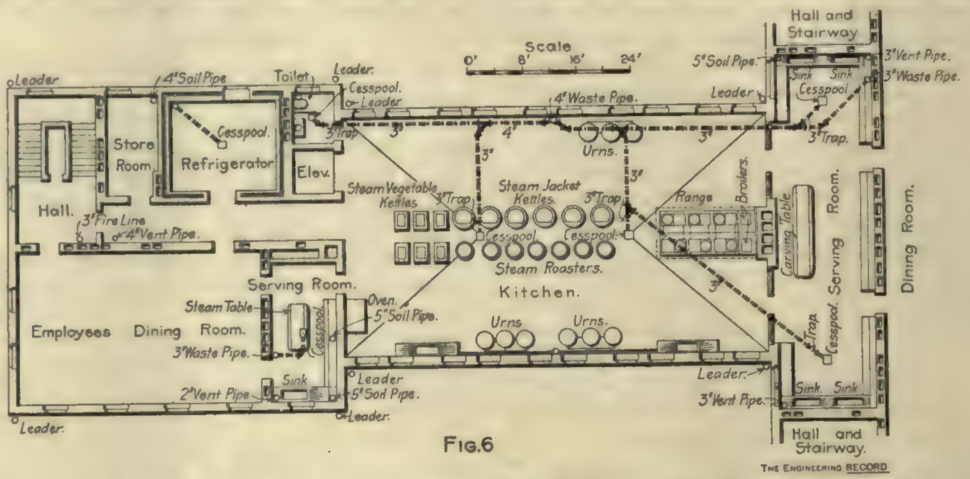


Fig. 6

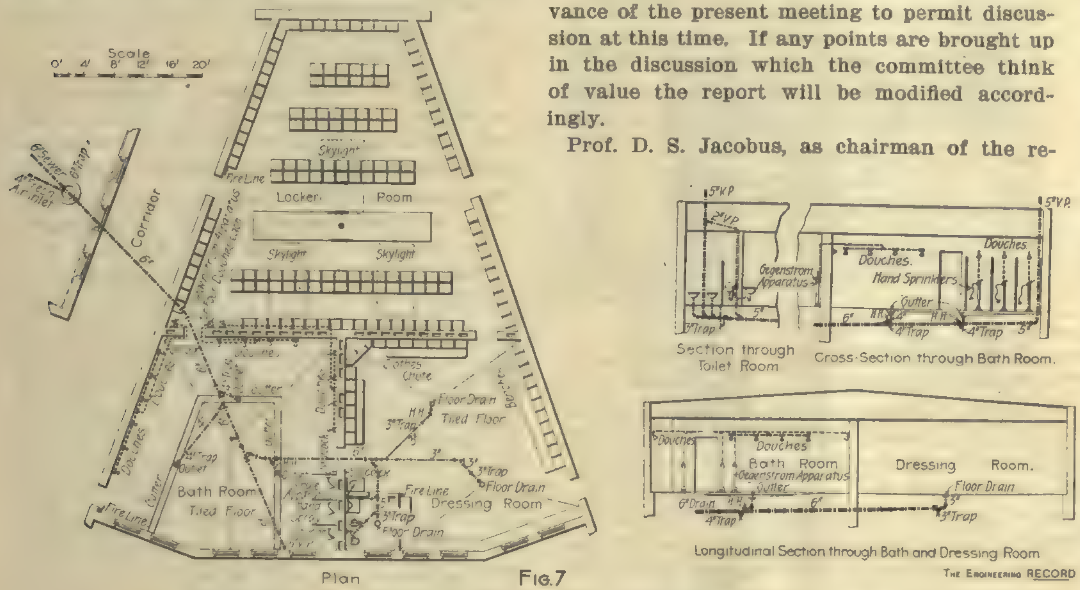
heavy "D" lead pipe. Exposed branch waste pipes for urinals, spray baths and for the administration building wash basins are of polished drawn brass tinned pipe. Water closet and urinal flush pipes are of seamless drawn brass pipe, finished in dark steel color. All main lines of hot and cold and circulation water supply and distribution are of standard lap-welded galvanized, screwed wrought-iron pipes, tested to 300 pounds, except in the large bathing apartment, and at exposed fixtures in the administration building, where tinned or plated brass pipe is used. All valves below the cellar floor are set accessibly in cast-iron covered boxes, all valve wheel handles are detachable, and all valves, except those at fixtures and cisterns, are tagged. All ward wash basins have self-closing cold water faucets, and their hot water faucets are fitted with detachable key handles. Each building has a separate water supply system, and the distribution is made as much as possible on the basement ceiling, and each riser and lateral branch is provided with a shut-off gate valve and emptying drip valve above it. In each of the seven cottages there are on the first floor five wash basins, three water closets, one slop sink and one spray bath, and on the second floor one hospital bath tub and supply, two water closets, one slop sink and three wash basins.

Each cottage has two fire lines, having eight fire valves, hose, reels, etc., and in the central building and bath apartment there are fixtures, as shown in Figures 6 and 7, making a total equipment of forty-four ward water closets, four attendants' water closets, two administration building water closets, seventeen slop sinks, five urinals, ten spray baths, nine bath tubs, six large bath room apparatuses, with seventeen douches, seventy wash basins, three kitchen sinks, three scullery sinks, six pantry sinks, one refrigerator sink, eighty-two fire valves and one grease trap. The ward water closets have all porcelain seat pedestals and no wooden seats, and have 4-gallon combination tanks, arranged both for automatic and pull flush. Each urinal also has a separate pull and automatic flush-tank. In the ward wash basins the loose strainer is locked in the waste socket. The hospital bath tubs are porcelain lined, iron roll rim bath tubs set on cast-iron carriages, with swivel axle and rubber-tired wheels. The tubs are filled through gegenstrom apparatuses, connected up to 1-inch water and ¾-inch high pressure steam pipes. Each tub is provided with a 1½-inch outlet pipe and down bend at one end that is commanded by a gate valve and emptied directly into a special trapped floor drain in the lavatory room through a large funnel with removable strainer. It is characteristic of the arrangement of the plumbing that the fixtures throughout are located so that their soil pipes are generally close to the outer walls, and are carried through them in the basement so as to discharge immediately into the separate iron and tile pipe sewer branches through running traps about 10 feet outside the walls.

The plumbing in the administration building corresponds essentially to an ordinary residence installation, except for the absence of basement horizontal sewer pipes. These leaders and soil pipes are branched, outside the foundation walls, into two main sewer lines on opposite sides of the house, that have traps and fresh air inlets in brick manholes, as indicated in Figure 1.

Each cottage has all its plumbing isolated by location in a wing about 22x40 feet, with a 6-foot wide corridor running down the long way on one side. The water wing, as it is called, separates the lavatory, closet and spray bath installation; at the same time it concentrates all the apparatus and pipe lines, and in it the system has been reduced to its lowest terms, and a standard arrangement developed that is duplicated in every ward of the group. Opening out of this corridor on the first floor is an open lavatory alcove, 8 feet wide and 13 feet long, containing one marble slab with five wash basins. Next to this room is the closed toilet room, 8x12 feet, containing one slop sink and three unenclosed water closets. Finally, there is an 8x12-foot bath room, containing one spray bath apparatus with fixed overhead inclined shower, a bidet and a movable hand douche. The apparatus is enclosed in an Alberene stone stall, and has a stone floor slab with large strainer plate in the middle. On the second floor an open alcove directly above the lavatory room contains two water closets and a slop sink behind an inner partition in the front part, and three wash basins and a gegenstrom apparatus for filling the bath tubs in the rear. The different toilet, bath and lavatory rooms have tiled floors, Alberene stone partitions and wainscoats 5 to 6 feet high, with doors and other cabinet work of quartered white oak. Each separate room has a 3-inch trapped floor drain, and there are two of these in each of the second-story rooms. The water closets have porcelain traps, made integral with their bowls, the slop sinks have iron enameled trap standards, and the arrangement of soil pipes, waste and vent line traps and cleanouts below the ceilings is everywhere accessible and entirely exposed, and is notable for its neatness, symmetry and simplicity.

(To Be Continued.)



PLUMBING IN THE LONG ISLAND STATE HOSPITAL, KINGS PARK, N. Y.

AMERICAN SOCIETY OF MECHANICAL ENGINEERS.

The opening session of the New York meeting of the American Society of Mechanical Engineers was held at the Society rooms on Tuesday evening, November 29, and the session was devoted to the delivery of the annual address by the President, Mr. Charles Wallace Hunt. Mr. Hunt's address is editorially referred to in this issue.

On Wednesday morning the business of the meeting was first taken up, after which professional papers were read and discussed. The report of the Council showed that the Society now has a total membership of 1,881 and that its affairs are in a healthy condition. The Committee on Revision of the 1895 Code for Conducting Boiler Trials reported, through Mr. William Kent, that its work was practically finished. The report which was handed in did not differ greatly from the preliminary report submitted a year ago. Those parts of that report which relate to the points of recent controversy were printed in "The Engineering Record" of December 4, 1897. The present report was not accepted, as it will be printed in the volume of the Transactions, which will include the proceedings of the next summer meeting. It was thought best to bring the report up for discussion at that meeting, as it had not been distributed sufficiently in advance of the present meeting to permit discussion at this time. If any points are brought up in the discussion which the committee think of value the report will be modified accordingly.

Prof. D. S. Jacobus, as chairman of the recently appointed committee to draw up a standard code for conducting engine tests, reported what work had been done. It is proposed, for convenience, to divide the code into two distinct portions, that relating to the data which it is absolutely necessary to obtain in making an engine test and that in which the additional data necessary for a scientific test are discussed. The committee consists, besides Professor Jacobus, of Messrs. Francis H. Boyer, George H. Barrus, Bryan Donkin and George H. Richmond.

During the business session Mr. William Kent objected very strongly to the character of two of the papers presented at the meeting, and was instrumental in having a motion passed that the method of selecting papers for the Transactions be investigated by the Council. Mr. Kent made the suggestion that if the Publication Committee was a little larger it might include members familiar with a greater number of branches of engineering likely to be made the subject of a paper, and thus could be more sure of keeping out papers of inferior quality. The discussion led to some lively remarks on the part of the committee, but the motion was passed.

The report of the tellers of election showed that the following officers had been elected to take the places of those whose terms had expired: President, Commodore George W. Melville, U. S. N.; Treasurer, William H. Wiley; Vice-Presidents, E. D. Meier, G. R. Stetson and B. H. Warren; Managers, E. C. Felton, R. H. Soule and A. M. Goodale. Commodore Melville was then escorted to the chair, after which Messrs. G. C. Henning and Daniel Ashworth paid tribute to the work of the new president, whose labors as Chief of the Bureau of Steam Engineering were productive of such wonderful results in the recent war with Spain.

The professional papers were then taken up. "A Note on the Strength of Wheel Rims" was the title of a brief paper by Mr. A. K. Mansfield. A certain part of Reuleaux's "Constructeur" calls attention to the strengthening effect of ribs in the construction of wheel rims, and Mr. Mansfield's purpose was to show that the use of ribs does not always increase the strength and that they may weaken the rim. He showed one or two conditions in which the strength was believed to be less than with a rim of rectangular section. The author believed that the practice of casting ribs on the inner edges of the rim did not produce as strong a construction as to use the same weight of metal in a rim of rectangular section. He had recently designed a rim section with a very deep rib in the middle, the cross section of the rim resembling the section of a T bar, which he believed to fill the requirements of a safe construction.

Professor Denton, through Professor Jacobus, stated that while the addition of ribs to the rim of the wheel might, in certain instances, decrease the strength, yet the ribs made the rims stiffer and better able to prevent the pulsations or changes in stress that tend to break the wheel.

Mr. Supplee said that Mr. Mansfield had misquoted Reuleaux.

A paper, "The Bursting of Small Cast-Iron Fly Wheels," by Professor C. H. Benjamin, described some experiments made by the author on small cast iron wheels with the idea of obtaining some light on the causes of fly-wheel failures that would lead to more rational formulas for their design than are now used. Wheels 15 and 24 inches in diameter, each a scale model of actual fly wheels used by reputable engine builders, were tested.

To give the wheels the speed necessary for destruction a Dow steam turbine was used, and the speed was determined by the musical note given by the wheel in motion, which was compared to tuning forks, the revolutions corresponding to each note, quarter and half note having been calibrated previously and found to be subject to an error of less than 5 per cent. A shield of 12x12 inch oak timbers was necessary to prevent the wheels from doing damage when they burst. In some instances the speed was obtained by attaching a tachometer to a countershaft.

Four 15-inch, six-armed solid rim wheels with rims 2 inches wide and 0.7, 0.65, 0.615 and 0.52 inches deep broke at rim speeds of 430, 430, 395 and 380 feet per second respectively. Two wheels similar to them, except that the rims were 0.4 and 0.34 inches deep, broke at rim speeds of 365 and 361 feet per second respectively, showing that as the segments of the rim between the arms become weaker as beams, either through increase of length or decrease of thickness, there is a falling off in the bursting speed.

Tests were made upon four 24-inch wheels, with the internal flange joints on opposite ends of a diameter and midway between the arms. The flanges were joined by steel bolts. All of the wheels burst at rim speeds of from 184 to 196 feet per second, failure occurring at the joints. In one experiment the action of centrifugal force upon the rim was clearly shown in that the bending of the rim bent the bolts, the inner edge of the flange acting as a fulcrum. The rim speeds in these experiments were about one-half those with the solid rim. At a rim speed of 100 feet per second the larger wheels would have a factor of safety of about 3 6/10, which, the author thought, was altogether too small.

Two 24-inch wheels with two rim joints made by shrinking steel links over lugs in the rims, were tested. One wheel with three links in each joint broke at a rim speed of 320 feet per second, and another, with two links to a joint, broke at 290 feet per second. At 100 feet per second the factors of safety of these wheels are 10¼ and 8 4/10 respectively. The author's conclusions are as follows:

"Fly-wheels with solid rims, of the proportions usual among engine builders and having the usual number of arms, have a sufficient factor of safety at a rim speed of 100 feet per second, if the iron is of good quality and there are no serious cooling strains. In such wheels the

bending due to centrifugal force is slight, and may safely be disregarded

"Rim joints midway between the arms are a serious defect and reduce the factor of safety very materially. Such joints are as serious mistakes in design as would be a joint in the middle of a girder under a heavy load.

"Joints made in the ordinary manner, with internal flanges and bolts, are probably the worst that could be devised for this purpose. Under the most favorable circumstances they have only about one-fourth the strength of the solid rim and are particularly weak against bending. In several joints of this character, on large fly-wheels, calculation has shown a strength less than one-fifth that of the rim.

"The type of joint with the link connection is probably the best that could be devised for narrow-rimmed wheels not intended to carry belts, and possesses when properly designed a strength about two-thirds that of the solid rim."

After the presentation of Professor Benjamin's paper, Mr. James McBride showed a drawing of a fly-wheel in which the rim was cast in sections, and on the inner face of the rim four ribs were cast. In the middle of each section and cast on to the two inside ribs was a square plate, to which the outer end of the arm was bolted. The wheel was examined recently, and it was found that the ribs had cracked in over 30 places. He wanted an explanation of the cause. One speaker advanced the theory that the wheel was as good as it ever was, as the cracks made it possible for the rim sections to bend slightly under the action of centrifugal force as he believed they ought to do. Others present believed that fly wheels ought to be so stiff they could not bend. Mr. John Fritz was prominent among the latter class. He had built many wheels for rolling mill engines and had never had one fail. The wheels he designed had the arms cast on to the rim segments. Both the rims and arms were hollow and the arms were planed and fitted to the hub. He did not believe in ribs on account of trouble in shrinkage. He thought that wheels for a belt could also be made with a hollow rim. Mr. Henning also spoke of the need of designing for rigidity.

Mr. Albert A. Carey discussed the cause of fly-wheel accidents. Of 67 accidents of which he had a record, 19 were in electric stations, 10 in rolling mills, 8 in textile mills, the others being in miscellaneous kinds of plants.

After the close of the discussion the meeting adjourned.

On Wednesday evening, President and Mrs. Charles Wallace Hunt and Secretary Hutton received the guests of the convention at Sherry's. Those who were fortunate enough to attend spent an enjoyable time, and dancing was indulged in through the early morning hours.

The first paper on Thursday morning was presented by Mr. C. V. Kerr, treating in an entirely mathematical paper the "Theory of the Moment of Inertia." Mr. Kent, in his criticism of the paper, believed that it was founded upon erroneous assumptions.

In a paper entitled "Improvements in Steam Boilers, and the Brick Settings of the Same," Mr. W. B. LeVan described a new form of boiler designed by him. The boiler was of the shell type, and the principal difference between it and the horizontal return tubular boiler was in the addition of a superheating drum over the main shell, which made it possible to put more tubes in the shell than in the horizontal tubular boiler; also a special form of furnace intended to produce a more perfect combustion. Figure 1 shows a cross section of the boiler. A division wall, shown broken in the cut, on a vertical panel passing through the axis of the shell, divides the space under the shell as far as the back of the bridge wall into two furnaces intended to be fired alternately to insure the complete combustion of the gases. In the rear of the bridge wall is a division wall separating the usual combustion chamber into two parts. This wall is pierced with numerous openings and the gases are supposed to become thoroughly mixed and consumed in passing through this highly heated wall. The combustion chamber over the grate bars is continued up to the water line of the boiler, leaving a space between the side of the boiler and the side walls of 6 inches. Thirty or 40 inches separate the bottom of the shell from the grate bars, so that the flames will not be chilled by coming in contact with the boiler and be extingushed before combustion is complete. Air is admitted through openings in the fire doors, and also to the ash pit. The air for the latter enters registers in the boiler fronts, and then passes through an air flue or space built

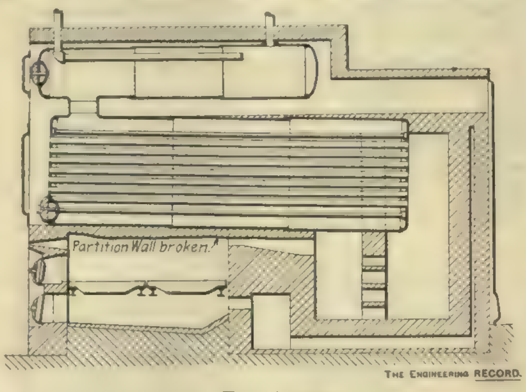


FIG. 1.

in the side and rear walls of the setting, finally leading to the ash pit. In transit the air is warmed by the heat that would radiate from the setting if it were not absorbed by the current of air, and by it returned to the furnace. In considering the area of passages for gas travel in steam boilers the author showed that when burning 12 pounds of coal per square foot of grate per hour, and with the products of combustion traveling with a velocity of 40 feet per second, that an area of opening over the bridge wall of 24 inches was required for each square foot of grate surface.

In the discussion of Mr. Le Van's paper, Mr. W. H. Bryan objected to the transverse wall dividing the combustion chamber, as the firebrick absorbed considerable heat that was given off after the boiler was shut down. Mr. Dean and Mr. Kent strongly criticised the statements made in the paper, and the latter said that there was little new in it.

The next paper was on "The Generation and Utilization of Steam by the Lykens Valley Coal Company and Summit Branch Coal Company, Dauphin County, Pa.," by Mr. R. Van A. Norris, which is presented in abstract on another page. In the discussion which the paper elicited, Mr. F. M. Wheeler called attention to the value of compounding steam pumps, and stated that the steam consumption of a compound pump was less, by one-half, than of a simple pump. Mr. Henry G. Snell spoke of the advantages of fan draft over the steam jet, and believed that their relative steam consumption was about as 1 to 8. It was brought out in the discussion that the figure assumed by the author for the condensation in steam pipes allowed for partly covered pipes.

The next paper was "A Cooling Tower and Condenser Installation," by Mr. J. H. Vail. An abstract is printed on another page. In the author's absence, Mr. Wheeler explained some of the details of the apparatus, which included an air pump of two cylinders, one for removing the air and vapors to maintain the desired vacuum, and the other for elevating the discharge from the jet condenser chamber to the distributing pipes in the cooling tower. Talking of condensers, the question arose of the trouble experienced with oil when the surface type of condenser is used. This led Mr. Wheeler to state that no trouble would be experienced with a sand or gravel filter, but he was not an advocate of the smaller cloth filters except where space was of prime importance, as in marine practice, as they would require constant attention. He believed that if fresh water were fed to boilers once a week no trouble would result with a proper filter. He mentioned also in connection with the use of oil-laden feed-water that where the plant is new the discharge from the condenser should be wasted, owing to the excessive quantity of oil used with new engines.

A paper by Professor D. S. Jacobus on the "Methods of Testing Indicators" was then read. The author described the methods in use at the Stevens Institute, in the expectation that those interested would study the paper and send suggestions upon the subject to the committee drawing up the code for testing engines.

A paper by Professor W. S. Aldrich upon "The Variation of Belt Tension with Power Transmitted" was read, and the discussion was almost entirely theoretical in character.

TRADE PUBLICATIONS.

The Buffalo Forge Company, Buffalo, N. Y., has issued an eight-page folder of the down-draft forges, which are typical of the latest development of forge-shop equipment. Smoke and fumes are carried away through a system of underground piping connected with an exhauster. A separate blower may furnish the blast, or a combined blower and exhauster may be employed.

"Enclosed Arc Lamps" is the title of a handsome 60-page pamphlet just issued by the General Electric Company. It is a description in non-technical language which the lamp buyer can comprehend, of the different types of enclosed arc lamps made by the General Electric Company for direct and alternating currents, power circuit lamps, series enclosed lamps and miniature lamps. Each type is well illustrated. This handsome book will be sent to persons interested on application at any of the company's sales offices.

The Westinghouse Machine Company, and Westinghouse, Church, Kerr & Co., have issued a 20-page pamphlet, "A Bird's-eye View of Our Business." It is a little circular which can be glanced through in a few minutes, but it furnishes a comprehensive index to the resources which are equipped to meet every requirement of power users. The manufactured products are illustrated by small well-printed half-tones and accompanied by a few words of description. Two pages are devoted to the concerns' facilities for undertaking general engineering and contracting.

ENGINEERING SOCIETIES.

The Civil Engineers' Society of St. Paul had invited the members of the Minneapolis Engineers' Club and others to meet on the Selby Avenue hill to inspect the working of the car-raising device, under the direction of Mr. David Curtin. This meeting was held November 23, and was followed by a meeting in a parlor of the Hotel Windsor, where Mr. Curtin explained the device, and the drawings were submitted for inspection. This is the M. H. Bronsdon device, the same as designed and first constructed for the College Street hill in Providence, R. I. The two societies took supper together, and a social session followed, at which resolutions commending the counterweight system were passed. The St. Paul Society elected Mr. C. A. Winslow secretary *pro tem.*

The Engineers' Club of Philadelphia met November 19, President Schermerhorn in the chair, with an attendance of 95. The secretary announced the death of Mr. Leighton Lee. Professor H. W. Spangler presented the paper of the evening upon engine and boiler testing, and illustrated his remarks with diagrams projected by the electric lantern. He described methods and apparatus that should be used, and precautions which must be taken to obtain the greatest possible degree of accuracy in the results of engine and boiler tests. At the conclusion of

the paper, the subject was discussed by Messrs. James Christie, Francis Schumann, Josiah Dow and Wilfred Lewis.

The American Society of Heating and Ventilating Engineers will hold its fifth annual meeting January 24 to 26, next. Secretary S. A. Jellett, in a circular announcement, calls attention to the desirability of a better representation of the membership, in papers presented and topics for discussion are also requested.

The New York Engineers' Club enjoyed a pleasant diversion from technical matters Thursday evening, when Mr. Arthur C. Humbert exhibited a number of views of scenery and of large game in South Africa. Some remarkably true instantaneous photographs of the game were exhibited. Mr. Humbert accompanied the stereopticon by entertaining reminiscences of his adventures and accounts of the country and its customs. Many prominent engineers who were in New York in attendance on the Convention of the American Society of Mechanical Engineers were the guests of the club, and the evening concluded with an enjoyable smoking concert and collation.

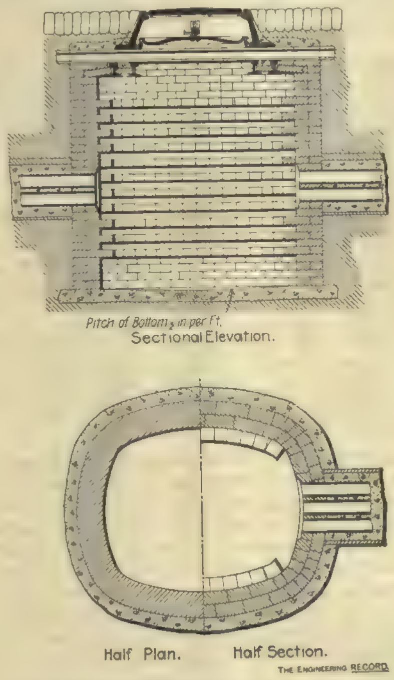
The Engineers' Club of St. Louis held its 479th meeting November 16, with President Bryan in the chair. The paper of the evening was by Professor J. B. Johnson and was entitled "The Engineer as the Guardian of Public Health." The paper was brought out mainly by the recent development of the new theory of infectious diseases, whereby the engineering field has been greatly widened. It dealt with the various means by which the injurious bacteria found their way into the human system, and stated that it is very largely the scope of the engineer to supply means of prevention of such infection, such as the proper building and cleaning of streets, removal of sewage and the supplying of pure drinking water. Referring to the purification of the local water supply the paper stated that: As we are provided with surface water from the Mississippi River, itself a great natural sewer, and as we are soon to have the sewage from a great city turned into this river, it will be an absolute necessity to provide a filtration plant for our water supply. The paper concluded with a brief statement of the duties of engineers in the preservation of public health and happiness. The discussion, participated in by Messrs. Colby, Moore, Johnson and Dr. Ravold, was very interesting.

ELECTRICAL SUBWAYS, PROVIDENCE, R. I.

The work now in progress in Providence, R. I., in the building of electrical subways, marks the adoption in that city of underground conduits for electrical currents for lighting and power service. Heretofore, such conduits have been used for telephone wires only, and hence the Providence installation, which is being made at a time when it is possible to profit by the difficulties encountered in similar work elsewhere, presents a number of points of interest aside from its considerable magnitude. The subways are being constructed by the Central Engineering Company of New York for the Narragansett Electric Lighting Company, which was granted the right by the city. The work is being done under the direction of Mr. Mark Lowd, but the contractor is the American Vitrified Conduit Company of New York, which has sublet the contract for excavating, pipe laying, etc., to Mr. F. E. Shaw, of Providence.

Much of the business of the lighting company is on Westminster and Weybosset Streets, but wires will be carried to all parts of the city where there is liable to be a sufficient demand to warrant the construction. On the completion of the present contract, it is estimated there will be about 900,000 feet of ducts laid in 19½ miles of trenches. At the power station, a trunk line of 60 ducts will radiate in the various directions, and the smallest distant trench will carry two ducts. Manholes are located at varying distances apart, usually about 300 feet, and hand holes for tapping individual circuits are provided at alternate building lines, so as to control the connections to four buildings. The piping throughout the conduits will be vitrified clay ducts. The style of duct used most extensively is the single, self-centering type, furnished in sections 18 inches long, but about 90,000 feet of two-way and four-way multiple-duct, vitrified clay pipe conduit, in 30-inch sections, has already been laid in the smaller lines. All of the ducts are 3 inches inside diameter, and are made by the American Vitrified Conduit Company, a branch of the Standard Fireproofing Company of New York.

Before any of the piping is put into position, the sides of the ditch are boarded up with 1-inch pine boards, and a 3-inch layer of cement-concrete is placed in the bottom. The width and depth of the ditch vary according to the size of the conduit, but the distance between the board



PLAN AND ELEVATION OF MANHOLES.

sidings is always such as to leave a space of 3 inches on each side of the ducts. This space is also filled with the cement-concrete, and another 3-inch layer of concrete is placed on top of the ducts, so that the latter are everywhere protected with concrete 3 inches in thickness. On top of the concrete is a layer of 2-inch kyanized spruce plank. The cement-concrete used in the work is composed of 1 part of Hoffman-Rosendale cement, 1½ parts sand and 3 parts screened gravel or crushed stone, small enough to pass through a 1½-inch ring. The ducts are laid compactly together, the top of each layer being smoothed with a bed of cement mortar made of one part cement and two parts sand. At the manholes the ducts terminate 1 inch back of the inside face of the brick wall. After the conduit work and manholes are completed, the contractor is required to rod all ducts, and this is accomplished by first pushing through the ducts sections of rod 4 feet long, provided with threaded ferrules fitting one with the other, and then drawing through by this means a galvanized iron wire, to which a rope may be attached for pulling in the cables when desired.

A plan and elevation of the manholes is shown in the accompanying drawing. They are built of brick, with rounded corners and arched sides, and the bricks are laid so as to project in alternate layers on the inside of the manhole, forming shelves for carrying the cables. The cables in the manholes do not, therefore, hang in loops in the more or less confused tangle frequently observed in ordinary manhole construction, but are carried around on the shelves in a neat and convenient fashion, enabling the workman to handle them with greater facility and less danger of damaging the insulating coverings.

The manholes vary from 6 to 8 feet in depth, with their walls 8 and 12 inches thick respectively. The walls rest on a 6-inch bed of concrete, which is of the same mixture used in the conduit construction, and extends about 4 inches beyond the outside of the walls. Within the manhole, the concrete is plastered to make a smooth bottom, grading toward the center. The ironwork construction at the top of the manhole is clearly shown, and covering this as well as the flange of the manhole frame is an annular ring of concrete 2 inches thick, sloping toward the outer edge of the manhole.

The contractor is expected to lay, weather permitting, an average of 1,000, 2,000, 3,000 or 5,000 feet of 4-duct, 8 to 12-duct, 15 to 18-duct, or 20 or more duct conduit respectively per day. About 125,000 feet of duct have already been laid.

In connection with the new conduit, a new storage battery station will be erected on Dyer Street, near the foot of Hay Street. Its dimensions will probably be about 135x50 feet on the ground floor, and the height of the battery room will be about 21 feet. The station will cover the supply of incandescent and arc lights of the underground system, and, it is asserted, will be the second in capacity in the United States. A system of wiring controlling the power distribution is also promised, which will be novel to this country.

NOTES.

The Cost of Reconstructing Sewers cannot be assessed on abutting owners, according to a recent decision of the Supreme Court of Pennsylvania, 41 Atl. Rep. 476, even though it was originally constructed at the expense of the city.

An Engineer's Compensation has been considered by the Pennsylvania Supreme Court, as a sort of pendant to the Beaver Falls water-works case reviewed in "The Engineering Record" of October 1. When that borough attempted to evade the State law concerning water-works it retained under a contract the services of an engineer to prepare plans for new works and superintend their construction. Afterward the Supreme Court enjoined it from building the plant, and the borough declined to pay the engineer's fees. The same court has just declared, 41 Atl. Rep. 533, that the contract with the engineer was valid, and his fees must be paid, although the actual execution of his plans, or any others, by the borough would have been illegal.

Bridge Testing by Artillery was the basis of awarding prizes for designs of an important structure in 1865, according to the following interesting note by Mr. Octave Chanute in the "Railroad Gazette": The North Missouri Railroad appointed a commission to award the premiums. This consisted of two engineer officers, General W. T. Sherman, General John Pope, and of a civilian, Thomas C. Fletcher, Governor of Missouri. These gentlemen were greatly puzzled how to decide on the merits of the 15 or more designs submitted, and consumed a week in discussions. The award was finally put at rest by General Sherman, who stated that when disabling Confederate railroads he had several times occasion to destroy bridges. This he did with artillery, and he remembered distinctly that upon coming to a Fink bridge the very first cannon-ball struck the center post (cast-iron) and the bridge tumbled down into ruin, while many shots had been fired at Bollman bridges, striking the ties and lower chords without bringing them down. The first prize was therefore awarded to the Bollman bridge, thus making, for that occasion, cannon-balls the measure of the merits of bridges.

CONTRACTING NEWS

OF SPECIAL INTEREST TO

CONTRACTORS, BUILDERS, ENGINEERS, AND MANUFACTURERS

OF ENGINEERING AND BUILDING SUPPLIES.

For Proposals see page 'x.

WATER.

Cripple Creek, Colo.—Mayor Pearce has refused to sign the ordinance for the purchase of the water-works system from the Michigan Pipe Line Co. at a cost of $250,000.

Memphis, Tenn.—Local press reports state that the City Council has under consideration the purchase of the water-works plant.

Wamego, Kan.—It has been voted to issue $25,000 bonds for water-works.

Chillicothe, Mo.—See "Fires."

Caffney, S. C.—It is stated that bids are wanted Jan. 3 for water-works.

Whittier, Cal.—Walter E. Butler, City Clk., writes that it was voted on Nov. 22 to issue $40,000 bonds for water-works improvements.

Lewiston, Me.—It is stated that the Water Board has under consideration the installment of a filtration plant to cost $40,000.

Bermidji, Minn.—It is stated that on Dec. 6 a vote will be taken on the issue of $7,000 water bonds.

Huntingburg, Ind.—The Huntingburg Light & Water Co. has been incorporated; capital, $4,500. Directors: H. C. Knight and M. L. Polhamus.

Allison, Ia.—It is stated that the proposition to build water-works is under consideration.

Little Falls, Minn.—Bids are wanted Dec. 16 for $60,000 water and light bonds. F. E. Hall, City Clk.

Somerville, Tenn.—Bids are wanted Dec. 15 for water-works and an electric light plant, as advertised in "The Engineering Record."

Lestershire, N. Y.—M. S. Squires, Village Pres., writes that it has been voted to issue $14,000 bonds for a new pumping station.

Belleville, Ill.—The Belleville Deep Well Water-Works Co. has been given a franchise to lay an entire new pipe system to supply the manufacturing plants, sprinklers and florists with water from Lake Christine.

Cambridge, Mass.—Water bonds amounting to $50,000 have been sold.

Greeneville, Tenn.—An election is to be held to vote on the proposition to purchase the water-works.

Montgomery, N. Y.—The Greene County Water Co. has been incorporated, with a capital of $20,000. The directors are W. H. Cowan, George Keesler of Montgomery, W. R. Brock of Almeda and others.

Yuma, Ariz.—The Cibola Canal Co. has been incorporated to build a canal for the irrigation of 20,000 acres. The incorporators are C. O. McCarroll, M. Morris and E. G. Morris.

Chestertown, Md.—The question of municipal ownership of the water-works is under consideration. Cost, $23,000.

Winnipeg, Man.—Local press reports state that the City Council has purchased the water-works plant for $237,000.

Cleveland, O.—The following bids for furnishing 4 new water cylinders and rebuilding Worthington pumping engine No. 4 at the Division St. pumping station were opened Nov. 25: H. R. Worthington Co., N. Y. City, $10,000; Snyder-Hughes Co., $16,800.

Norristown, Pa.—The Finance Committee has been authorized to employ an engineer to secure a suitable location for sinking an artesian well.

Sacramento, Cal.—M. J. Desmond, City Clk., writes that nothing will be done until after Jan. 1 in regard to water works improvements to cost $130,000, or the building of a sewerage system to cost $120,000.

Sheridan, Ind.—The Sheridan Light & Water Co. has been incorporated; capital, $9,500. Incorporators: C. S. Knight, H. C. Knight and M. L. Polhamus.

Goshen, Ind.—It is stated that specifications are being prepared for the extension of water mains.

Corsicana, Tex.—It is stated that the Council has under consideration the establishment of a municipal water supply.

Montgomery, Ala.—It is stated that the Council has decided that the work of extending city water-works shall be done under the direction of the City Engineer and Water-Works Committee. It is estimated that more than 19,000 ft. 16-6-in. mains will be required. J. T. May, Chmn. of Water-Works.

Saginaw, Mich.—The Common Council has passed a resolution to replace wooden water pipe in the Western Taxing district, with 6-in. iron pipe.

Canby, Minn.—It is stated that the village Recorder may be addressed in regard to water-works construction.

Amesbury, Mass.—It is stated that the Powow Hill Water Co. has purchased land for a new reservoir.

Hill City, Tenn.—It is stated that a water-works plant is to be built.

Dunkirk, N. Y.—We are informed that C. E. Hequembourg, Wm. Bookstaver and C. J. Carney have been appointed as a committee to look into the advisability of putting in new machinery, probably a 6,000,000 or 8,000,000-gal. engine.

Macon, Mo.—The City Council has decided to order a special election for Dec. 6 to vote on the proposition to build a sewer system, estimated to cost $23,000.

Oxford, Idaho.—The Interstate Canal & Power Co. has been incorporated to build a dam and canal on Bear River, for irrigation purposes, at a probable cost of $1,000,000 to $5,000,000. Geo. C. Parkinson, Pres., Preston, Idaho; James L. McMurrin, Secy., and Erastus G. Farmer, Treas., Clifton, Idaho. John D. McAllester, Salt Lake City, Utah, is the engineer in charge.

Allegheny, Pa.—Bids are wanted Dec. 7 for one 250-h.p. water tube boiler, at Howard St. pumping station. Robert McAfee, Dir. Dept. Pub. Wks.

Norfolk, Va.—The Board of Water Commissioners has under consideration propositions to build filter plant from the Continental Filter Co., and from the N. Y. Filter Co., both of New York City.

Watervliet, N. Y.—William G. Raymond, Consulting Engr., of Troy, N. Y., reports in reference to the proposed plan for a new water supply that a mechanical filtration plant can be installed in connection with present system for $10,000 for each million gallons to be filtered in 24 hours. Approximate cost for present needs $15,000; he estimates the total cost of new plant at $254,842, instead of $234,493, as estimated by the Board of Water Commissioners.

Savannah, Ga.—The Water Commissioners have asked for an appropriation to lay a 12-in. main on River St.

Newport, Ky.—Superintendent Hornung, of the Water-Works, reports that the proposed improvement of distributing mains will cost $15,312.

Colton, Cal.—It is stated that an election will be held Dec. 12 to vote on the issue of $20,000 bonds for water and light plants.

Oregon, Wis.—It is stated that the citizens have voted to issue bonds for a water plant.

Denver, Col.—Articles of incorporation have been filed by the McElmo Water Supply Co. for the purpose of building irrigating ditches throughout Montezuma County, and constructing three reservoirs. The directors are Morris B. Colt, John H. and Ernest Knaebel, of Colorado, and others; capital stock, $500,000.

Lakeport, Cal.—It is stated that an election will be held Dec. 20 to vote on the question of issuing $15,000 water-works bonds.

Lake Providence, La.—An election is to be held Dec. 15 to vote on the issue of $17,500 bonds for water-works and electric lights.

Wynne, Ark.—The following bids for a water and electric light plant were opened Nov. 10 by M. Jolly, Secy. Bd. of Pub. Imp.: G. Jaeger, Batesville, Ark., $15,490; Rees Bros., Fayetteville, Ark., $15,685; C. H. Jenks, St. Louis, Mo., $15,750.

New Whatcom, Wash.—The contract for improving water mains has been awarded to J. H. Thomas for $19,808.

Panama, Ia.—It is stated that a water-works system is to be constructed.

St. Paul, Minn.—Local press reports state that Robinson & Cary have secured a contract to furnish Como Park with an extension of its water pipe system for about $2,000.

Ritzville, Wash.—It is stated that the Council is about to grant a franchise for a water and light plant.

Seattle, Wash.—It is stated that Gahan & Byrne, of Chicago, have secured the contract for building the Cedar River gravity water-works at $1,238,622.

Youngstown, O.—It is estimated that the contemplated change in the source of the water supply, from Mahoning River to Mill Creek, will cost the city approximately $300,000. The proposition for the issuance of bonds for same will be submitted to the voters at the Spring election.

Osage, Ia.—It is stated that G. H. Merridith, City Engr., of Cedar Rapids, has completed plans for water-works to cost $28,000. The system will include a 1,000,000-gal. pump, run by gasoline; a 250,000-gal. reservoir, and an 80,000-gal. tank, set on a steel tower 110 ft. high. There will be 1,420 ft. 10-in., 4,320 ft. 8-in., 17,290 ft. 6-in. and 6,000 ft. 4-in. pipe.

Gallipolis, O.—Local press reports state that the contracts for water-works have been awarded as follows by the Trustees of the State Hospital for Epileptics: For pumps, to Henry R. Worthington, New York City, at $4,864; for air compressors and for air lifts, to Ingersoll-Sargeant Co., New York City, at $785 and $940; to George M. Snyder, of Columbus, for the 800,000-gal. reservoir, at $7,997.85. The estimated cost of the water-works is $20,000.

SEWERAGE AND SEWAGE DISPOSAL.

New York City.—Frederico Bergmann, Peruvian Consul General, 25 Whitehall St., has on exhibition plans and specifications for sewerage works at Callao, for which bids will be received until Jan. 15 by the Municipal Council of that city. The work comprises 4,820 ft. of main collectors 3.6 ft. high, 5,945 ft. of secondary collectors, 64,291 ft. of smaller sewers, 160 manholes and a cast-iron outfall supported on screw piles. The works are estimated to cost $126,000, and must be finished in 3 years; a bonus will be paid for their earlier completion, and a forfeit required if the stipulated period is exceeded. Materials for construction will be admitted free of duty, and payment will be made in three annual instalments, secured by the whole revenue and property of the municipality.

Saginaw, Mich.—The Common Council has adopted resolutions to construct sewers in Howard and Ninth Sts.

Sacramento, Cal.—See "Water."

Seattle, Wash.—Local press reports state that the City Engineer's Department is preparing plans and specifications for two sewerage systems to drain that part of the city lying north of Denny Way and south of Roy St., and between Pontius Ave. and Fifteenth Ave. North. Estimated cost, $29,000 and $44,000.

St. Peter, Minn.—It is stated that M. B. Haynes, of Mankato, is preparing plans for a complete sewerage system.

Williamsport, Pa.—The ordinance providing for a storm sewer along Spring Run has been passed.

Toledo, O.—The lowest bid received for main sewer in Paine Ave. was from Thos. Kelly, as follows: $7.64 a ft. on 84-in. sewer with a 13-in. shell, and $6.25 on a 60-in. sewer with 19-in. shell.

Little Rock, Ark.—Bids are wanted Dec. 12 for 8,400 ft. of sewers. Wm. Murphy, Chmn. Commrs. Sewer Dist. No. 25.

Grass Valley, Cal.—Bids are wanted Jan. 10 for $40,000 sewerage bonds. W. D. Harris, City Clk.

Sadorus, Ill.—Bids are wanted Dec. 10 for 5,961 ft. of 8-in. to 16-in. tile. J. T. Roberts, Chmn. Commrs. Kaskaskia Special Drainage Dist.

Philadelphia, Pa.—Bids are wanted Dec. 13 for main and branch sewers. Thomas M. Thompson, Dir. Dept. Pub. Wks.

Albany, N. Y.—Bids are wanted Dec. 5 for a vitrified stoneware pipe sewer. Thos. J. Lanahan, Clk. Bd. Contract and Apportionment.

Findlay, O.—Bids are wanted Dec. 8 for a sewer in Frazier St. A. W. Ray, Clk. Bd. Improvements.

East Cleveland, O.—Bids are wanted Dec. 30 for sewers. H. B. Chapman, Village Clk.

Independence, Mo.—Bids are wanted Dec. 13 for $75,000 sewer bonds. S. A. Sullivan, City Clk.

Moline, Ill.—Bids are wanted Dec. 5 for an 8-in. sewer in Sixth Ave. Gustaf Swensson, Pres. Bd. Local Improvements.

Jamaica (L. I.), N. Y.—It is stated that the purchase of land and construction of chemical sewage disposal works are under consideration. Estimated cost, $50,000.

Newark, N. J.—County Engineer Owen has submitted a report in regard to the proposed drainage of the lowlands near Broad St., from Park Ave. to James St., recommending the construction of a storm sewer, at an estimated cost of $5,500.

Washington, Pa.—A committee, composed of Messrs. Clark, Chalfant and Davis, has been appointed by the East Washington Borough Council to confer with the South Washington Borough authorities in regard to a sewerage system.

Steelton, Pa.—A committee has been appointed to inquire about a loan for the construction of the contemplated sewer system.

Wilkinsburg, Pa.—Bids are wanted Dec. 8 for 900 ft. of 20-in. and 300 ft. of 8-in. pipe sewers. Frease & Sperling, Boro. Engrs.

St. Louis, Mo.—According to local press reports Sewer Commissioner Colby has prepared plans for a sewer for Baden 24x18 ft. inside diameter, 1 mile in length. Estimated cost, $300,000.

Richmond, N. Y.—The Borough Board has passed a resolution recommending that the Board of Public Improvements issue bonds for sewers in Clove Road and Arietta St., Richmond. Estimated cost, $280,000.

Columbus, O.—The proposition to issue bonds for remodeling the entire sewage system of the West Side will probably be submitted to the people at the spring election.

Syracuse, N. Y.—Bids are wanted Dec. 5 for 12-in. and 15-in. pipe sewers. M. Z. Haven, City Clk.

Allegheny, Pa.—Bids are wanted Dec. 6 for a lateral sewer on Hamlin St.; also for paving Valley St. Robert McAfee, Dir. Dept. Pub. Wks.

St. Cloud, Minn.—It is stated that the construction of the lower town sewerage system to cost about $8,750 is being considered by the Board of Public Works.

East Liverpool, O.—It is stated that bids will soon be called for sewers for sewer district No. 2; 8 miles of 12-4-in. pipe will be required.

Pittsburg, Pa.—Tenders for pipe sewers were opened Oct. 6 by E. M. Bigelow, Director Pub. Wks., in which the highest and lowest bids were as follows: 15-in., 84 cts. and $1.38; 18-in., $1.20 and $1.86; 20-in., $1.01 and $2.50; 24-in., $1.30 and $2.75; 30-in., $2.52 and $3.49; drops, $38 and $68; manholes, $22 and $45. Other bids for similar work opened Nov. 25 ranged somewhat higher. The tenders were from Ott Bros. of Allegheny and the following Pittsburg contractors: Sweeney & Houston, J. H. McQuade, Evan Jones, Cronin & O'Herron, J. A. Ranson, C. D. Bausemer & Co., Keeling & Ridge.

BRIDGES.

Cumberland, R. I.—It is stated that Engineer Judson has completed plans for the superstructure of the bridge at Ashton.

Valatie, N. Y.—See "Railroads."

Norfolk, Va.—Bids are wanted Dec. 28 for a steel highway and draw bridge across Smith's or Glebe Creek, as advertised in "The Engineering Record."

Trenton, Mo.—Bids are wanted Dec. 6 for a bridge, approaches to 2 bridges, abutments, etc. P. S. Kannatta, Chmn. Bridge Com.

Carthage, Miss.—Bids are wanted Dec. 5 for a bridge over Lobutcha Creek. J. L. McMillon, Chancery Clk.

Philadelphia, Pa.—Bids are wanted Dec. 13 for bridges. Thomas M. Thompson, Dir. Dept. Pub. Wks.

Minneapolis, Minn.—Bids are wanted Dec. 9 for steel and iron work for widening the stone arch bridge over east channel of Mississippi River. L. A. Lydiard, City Clk.

Lafayette, La.—It is stated that plans and specifications are invited for the construction of an iron bridge. Address R. C. Greig, Secy. Police Jury.

Media, Pa.—It is stated that an iron bridge will be built over Chester Creek, near Wawa.

Nevada, O.—It is stated that an iron bridge will be built across the Rhine River by the County Commissioners to replace the present wooden structure.

Fort Scott, Kan.—It is stated that bids are wanted Dec. 9 for the stonework, excavation and fill for a bridge in Osage township. H. Frankenburg, Co. Clk.

Grand Island, Neb.—The construction of a bridge across the Platte, between Hall and Hamilton counties, is stated to be under consideration.

Crookston, Minn.—It is stated that the County Commissioners have ordered a bridge across Clearwater River in Wyandotte township.

Decatur, Ala.—The Canton Bridge Co., Canton, O., is stated to have secured the contract for a steel bridge over Town Creek for $5,000.

Champaign, Ill.—Press report states that a bridge will be constructed in Kerr township over the Middle Fork.

Jackson, Mich.—It is stated that the Michigan Central R.R. has accepted plans for a bridge between Van Dom and Linerty Sts. Estimated cost, $2,700. W. S. Kinnear, Asst. Ch. Engr., Detroit.

Conneaut, O.—The construction of a steel swing bridge, to accommodate the Bessemer Railway, is stated to be under consideration.

Harrisburg, Pa.—It is stated that the building of bridges over Market St. to avoid grade crossings is under consideration.

Toronto, Ont.—The City Council has under consideration the issue of $62,500 bonds for an iron bridge over the Don at Queen St.

Sarcoxie, Mo.—It is stated that bids are wanted Dec. 5 for a stone bridge on Center St. A. T. Houghton, City Clk.

Darlington, O.—It is stated that the County Commissioners will construct a bridge across Steel Run.

Victoria, B. C.—E. A. Wilmet, City Engr., recommends the construction of an arched bridge, to cost about $115,000, as a permanent roadway across James Bay flats.

Lewiston, Idaho.—The construction of a bridge across Snake River by the Lewiston Water Power Co. is stated to be under consideration. W. E. Moore, Engr.

Mamaroneck, N. Y.—J. C. Fairchild, Town Clk., writes that on Nov. 28 it was voted to approprite $3,000 as the city's share toward a bridge, to be built over the railroad tracks at Rye Neck portion of the town.

Chicago, Ill.—Local press reports state the Sanitary Drainage Trustees have decided to build 2 bascule bridges at an estimated cost of $314,000 to replace the Taylor St. city swing bridge and the Northern Pacific Ry. swing bridge. The Scherzer Rolling Bridge Co. will sell designs for the 2 bridges and superintend their construction for $38,000. When designs are completed bids for the structures can be advertised.

New York, N. Y.—The Board of Estimate and Apportionment has appropriated $100,000 to be expended under the direction of Bridge Commissioner John L. Shea, in making preliminary surveys and borings for 2 bridges over the East River. Of this amount $50,000 will be spent on the proposed bridge to Astoria and the other $50,000 on the bridge which the Mayor recommends to be built between the New York and Brooklyn Bridge and the new East River Bridge on which work has already been begun.

Charlemont, Mass.—The following bids were opened Nov. 17 by the Mass. Highway Commission, Boston, for the abutments of a bridge over Mill Brook (300 cu. yds. cement masonry): W. N. Flynt Granite Co., Monson, Mass., $3,270; Jarvis Eng. Co., Boston, *$2,601; Wm. D. Cass, Boston, $2,991; M. A. Culbert, Boston, $3,525; Tuttle & Edgerly, Swampscott, $3,000.
*Contract awarded.

Cincinnati, O.—Local press reports state that the following bids were received by the County Commissioners for the superstructure of the New Baltimore bridge: Pennsylvania Bridge Co., Beaver Falls, N. Y., $53,000 and $50,075; Wrought Iron Bridge Co., Canton, O., $54,000; Youngstown Bridge Co., Youngstown, O., $62,000; Toledo Bridge Co., Toledo, O., $59,000; Variety Iron Wks., Cleveland, O., $72,000; Oregonia Bridge Co., Oregonia, O., $60,300; Bellefontaine Bridge Co., Bellefontaine, O., $59,800; Cincinnati Bridge Co., $49,900; New Castle Bridge Co., $68,000; Massillon Bridge Co., Massillon, O., $53,000; Champion Bridge Co., Wilmington, O., $79,000; G. E. King, $51,990; New Columbus Bridge Co., Columbus, O., $74,910; Brackett Bridge Co., Cincinnati, O., $49,400 and $46,400; King Bridge Co., Cleveland, O., $49,900; Pittsburg Bridge Co., Pittsburg, Pa., $61,000; Lafayette Bridge Co., Cincinnati, O., $59,200 and $50,000. The Fort Pitt Bridge Co., Pittsburg, Pa., submitted bids on eleven plans.

PAVING AND ROADMAKING.

Yonkers, N. Y.—The Common Council is reported to have approved plans and specifications for regulating and grading Riverdale Ave. from Culver St. to the city line. Bids for the work will be opened Feb. 27, according to press reports.

Omaha, Neb.—The City Council has passed preliminary ordinances for repaving Farnam St. with asphalt.

Kingsville, Md.—It is stated that the County Commissioners will purchase a stone crusher, to be used at Kingsville.

Chatham, Mass.—At a special town meeting held Nov. 21 it was voted to raise $20,000 for road improvements and the purchase of a stone-crushing plant.

Syracuse, N. Y.—It is stated that the contract for paving Seymour St. with asphalt has been awarded to the Asphaltina Construction Co. for $19,458.70.

Rockville, Md.—The County Commissioners have sold $25,000 bonds for the construction of a turnpike road between Rockville and the District of Columbia.

Moline, Ill.—Petitions are being circulated for paving in numerous streets.

Cleveland, O.—Local press reports state that the County Commissioners have awarded the Berea road contract to J. E. Asling for $7,471.

Orleans, Mass.—Press reports state that the town has voted to appropriate $20,000 for road improvements and for a stone crushing plant.

Kewanee, Ill.—A petition is being circulated for brick paving in several streets.

Danville, Ill.—The Board of Local Improvement has voted to reject all bids received for paving South and West Main Sts. New bids are to be asked, according to local press reports.

Chicago, Ill.—The Park Commissioners have adopted plans for the proposed additions and improvements to Lincoln Park, estimated to cost from $3,000,000 to $5,000,000. The work consists of filling in along the lake for a distance of 1,200 ft. for driveway.

Hoboken, N. J.—It is stated that bids are wanted Dec. 21 for improving Court St. M. V. McDermott, City Clk.

Decatur, Ind.—It is stated that bids are wanted Jan. 5 for macadamizing 17½ miles of roads in Washington township. W. E. Fulk, Co. Surveyor.

Beaumont, Tex.—Bids are wanted Dec. 15 for 12,000 sq. ft. of brick and asphalt paving. D. P. Wheat, Mayor.

Indianapolis, Ind.—Bids are wanted Dec. 14 for gravel road construction in Brazil, Jackson and Posey townships. Thomas Philips, Co. Aud.

Rochester, N. Y.—City Engineer Fisher has about completed plans for asphalt paving and sewering So. Fitzhugh St., estimated cost $11,000.

Pittsburg, Pa.—The Council has under consideration an ordinance to widen Diamond alley to a 50-ft. street; estimated cost $499,067.

Waukegan, Ill.—Patterson & Streffler, of Springfield, are stated to be the lowest bidders for brick paving. Aggregate amount, $6,000.

Allegheny, Pa.—See "Sewerage and Sewage Disposal."

Georgetown, Ky.—Bids are wanted Dec. 29 for $46,000 turnpike bonds. J. J. Yates, Co. Judge.

Newton, Mass.—J. F. Kingsbury, City Clk., writes that $40,000 is the amount proposed in the budget for 1899 for special reconstruction and repair of streets. The appropriation has not yet been passed. Chas. W. Ross, Street Commr., P. O. West Newton, Mass.

Saginaw, Mich.—The Common Council has adopted resolutions to pave four streets during the season of 1899. Alfred Davies, City Clk.

Salem, O.—Morris French, City Engr., writes that he has been ordered to prepare plans and specifications for brick paving as follows: 5,000 sq. yds. on Garfield Ave., 15,000 sq. yds. on W. Main St., 11,000 sq. yds. on E. High St., 13,500 sq. yds. on Franklin Ave. and 5,000 sq. yds. on Mill St.

Indianapolis, Ind.—Bids are wanted Dec. 7 for paving Bird St. with brick. M. A. Downing, Chmn. Bd. Pub. Wks.

Brooklyn, N. Y.—Bids are wanted Dec. 8 for 31,785 sq. yds. macadam pavement on Fort Hamilton Ave., 250 sq. yds. brick pavement on 86th St. railroad tracks and keeping the same in repair for one year. George C. Clausen, Chmn. Commrs. of Parks, New York, N. Y.

Philadelphia, Pa.—Bids are wanted Dec. 13 for repaving. Thomas M. Thompson, Dir. Dept. Pub. Wks.

Baltimore, Md.—Bids are wanted Dec. 6 for paving Gay St. O. W. Connet, Acting City Commr.

Richmond, Ky.—Madison Co. turnpike bonds, amounting to $70,000, have been sold.

Lowell, Mass.—The resolution to borrow $30,000 for Aiken St. extension has failed to pass the Board of Aldermen.

Quincy, Ill.—The Board of Local Improvements proposes to lay 8½ miles of pavement next year.

Toledo, O.—It is stated that contracts for block paving have been awarded as follows to H. P. Streicher, of Toledo, for Michigan St., at $2,929; to G. H. Bodette, Toledo, for Eastern Ave., at $4,719, and to W. J. & J. J. McMahon, Toledo, for 21st St., at $2,832.

Reading, Pa.—The following bids have been received and rejected by the Board of Public Works for 1,600 sq. yds. of asphalt resurfacing on Sixth St.: Penn. Asphalt Paving Co., Philadelphia, Pa., at $2.29 per sq. yd., and The Barber Asphalt Paving Co., New York City, at $2.49.

Atlanta, Ga.—It is stated that the following bids were opened Nov. 21 for paving Mitchell St. viaduct: W. W. Griffin, cement, $1,564.64; Atlanta Tile Co., tile, $2,094.40; C. D. Murphy, asphalt, $3,104.6; granolithic, $2,605.68; cement, $2,162.16; Warren-Scharf Asphalt Paving Co., New York City, asphalt, $1,774.08 and $6,726.72.

Pittsburg, Pa.—Tenders for asphalt paving were opened Oct. 6 by E. M. Bigelow, Director Dept. Pub. Wks., in which the prices for the asphalt alone were as follows: Alcatraz Paving Co., Philadelphia, $1.70 per sq. yd.; Pennsylvania Asphalt Paving Co., Pittsburg, Pa., $1.74; Sloan & McIlvain, Allegheny, Pa., $1.70.

Terre Haute, Ind.—It is stated that the County Commissioners received the following bids Nov. 22 for new gravel roads: *a*, 16 miles in Nevins; *b*, 14 miles in Linton: W. C. Dorsey, Terre Haute, *a*, $37,555; *b*, $29,500. Joseph E. Hart, Vevay, Ind., *a*, $47,100; *b*, $29,000. Keegan & Fitzpatrick, Brazil, *a*, $41,700; *b*, $30,980. J. C. Smith, Cincinnati, *a*, $39,955. Kennedy, Patterson & Co., *a*, $45,591; *b*, $33,889.

POWER PLANTS, GAS AND ELECTRICITY

Winnipeg, Man.—The Council is considering the question of calling an election Dec. 20 to vote on issuing $50,000 bonds for an electric light plant, and $20,000 for a library.

Red Lake Falls, Minn.—The Red Lake Electric Light Co. has been incorporated; capital, $8,000. Incorporators: M. Johnson of Atwater and L. C. Stone of Red Lake Falls.

Somerville, Tenn.—See "Water."

Gainesville, Ga.—J. P. Edwards of Augusta, Ga., Engr. in charge, writes that a franchise is about to be granted to local parties for an electric light plant to cost $8,000.

Little Falls, Minn.—See "Water."

Mt. Pleasant, Mich.—Bids are wanted Dec. 20 for an electric light plant for the Indian Industrial School. W. A. Jones, Commr. Indian Affairs, Washington, D. C.

Wynne, Ark.—See "Water."

Kokomo, Ind.—Plans are stated as being prepared for the improvement of the electric light plant recently damaged by fire.

Hoboken, N. J.—The People's Heat, Light & Power Co. is stated to have applied to the Council for permission to lay subways and conduits for furnishing heat, light and power.

Huntingburg, Ind.—See "Water."

Owenton, Ky.—W. B. Arnold, of Dayton, O., is reported to be arranging to establish an electric light plant.

Ritzville, Wash.—See "Water."

Winona, Minn.—H. S. Youmans is stated to have received a franchise for an electric light plant.

Galesburg, Ill.—The Street Lighting Committee and the City Clerk are stated to have been instructed to investigate the cost of constructing and operating an electric light plant having a capacity of not less than 250 arc lights and 3,000 incandescent lights, and report to the Council in February.

Bellefontaine, O.—The Big Four Railway Co. is stated to have decided to erect their own electric light plant here for lighting shops, depots, etc. General office, Cincinnati.

Perkasie, Pa.—H. F. Groff, Borough Clk., writes that the taxpayers have voted to own and operate an electric light plant.

Perrysville, O.—E. H. Vanderslice is reported to be interested in the building of an electric light plant.

Sheridan, Ind.—See "Water."

Oneida, Ill.—It is reported that a company is being organized to establish a lighting plant.

Woodsfield, O.—Bids are wanted Dec. 27 for an electric light plant. T. A. Way, Mayor.

Everett, Mass.—Perry D. Blackden is stated to have applied for a franchise to build and operate an electric light plant; probable cost, $60,000.

Waukegan, Ill.—Bids are wanted Dec. 5 for 100 or more electric lights of 2,000 c. p. each for a term of 1, 3 or 5 years, beginning May 15, 1899. H. Shacker, City Clk.

Sturgis, Mich.—John Farrow, City Clk., writes that the city has voted to issue $15,000 bonds for an electric light plant.

Oxford, Idaho.—See "Water."

Wichita, Kan.—The County Commissioners are stated to have granted right of way to W. E. Hutchinson, of Carthage, Mo., to lay pipes for gas across Sedgwick County.

Elroy, Wis.—It is stated that the citizens will probably vote on the question of constructing an electric light plant at the spring election.

Winthrop, Mass.—See "Government Work."

Chicago, Ill.—It is reported that plans are being prepared for an electric plant for the packing plant of Armour & Co.

Clinton, Ky.—The Clinton Water & Light Co. is reported to be considering the question of putting in an electric light plant.

Danville, Ill.—The following bids are stated to have been receved Nov. 21 for an electric light plant: Western Electric Co., Thames and Greenwich Sts., New York City, $30,000; D. C. Frazier, $29,785; Robert Holmes & Bro., $32,218.

Carthage, Mo.—R. Lundy, City Clk., writes that the proposition to issue $25,000 bonds for an electric light plant carried at the election held Nov. 22.

Oconto, Wis.—See "Fires."

Colton, Cal.—It is stated that bids are wanted Dec. 19 for lighting fixtures in the courthouse. J. B. Parazette, Co. Clk.

Pasadena, Cal.—It is reported that the City Trustees are figuring on owning their own electric plant, and have called for bids on six different sets of specifications. All bids to be in by Jan. 1.

Lake Providence, La.—See "Water."

Philadelphia, Pa.—The Board of Directors of the Southern Electric Light & Power Co. are stated to have decided to make extensive additions to the plant located at Gray's Ferry Road and Carpenter St.

Fredericksburg, Va.—It is stated that the following bids were received Nov. 22 for an electric light plant: Kingsbury, Samuels & Co., Baltimore, Md., $11,944, and the Ft. Wayne Electric Corporation, Ft. Wayne, Ind., $11,649.

No award will be made until after the election, which will shortly be held to vote on the issue of $11,600 bonds.

Jamaica (L. I.) N. Y.—The Board of Estimate and Apportionment is said to have approved the appropriation of $344,091 for public lighting in the Borough of Queens.

Humboldt, Ia.—It is stated that the citizens will vote, Dec. 9, on granting a franchise to the Humboldt Electric Lighting & Power Co.

Cambridge, Mass.—The Massachusetts Pipe Line Co. is stated to have petitioned the Council for permission to lay two 36-in. gas mains.

Colton, Cal.—See "Water."

Asheville, N. C.—M. W. Robertson, City Clk., writes that no bids having been received Nov. 22 for electric lighting, the city has contracted with the Asheville Electric Co. at $85 per light, for one year, hoping in the meantime to buy plant or make a contract for a number of years.

Central Islip, N. Y.—The Fitzgibbons Boiler Co., Oswego, N. Y., has received the contract for the boilers for the Central Islip cottages; the amount of contract said to be $30,000.

ELECTRIC RAILWAYS.

Wheeling, W. Va.—An ordinance granting the Wheeling & Elm Grove Ry. Co. a franchise to extend its line, is stated to have been introduced in Council.

Kansas City, Mo.—It is stated that the Northeast Electric St. Ry. Co. will rebuild its line, at a probable cost of $250,000. E. G. Vaughan, Secy., New York Life Bldg., Kansas City.

Niles, Mich.—The Michigan & Indiana St. Ry. Co. is stated to have received a franchise.

Sandusky, O.—It is stated that surveys are being made for the construction of the Pittsburg, Lake Erie & Chicago Ry. from Sandusky to Pittsburg. John McKelvey, Pres., Sandusky.

Alliance, O.—Chas. S. Keith, of Alliance, is stated to be interested in the construction of an electric line between Akron and Alliance.

London, Ont.—U. A. Boucher is stated to have applied for a franchise.

Ware, Mass.—The Palmer & Monson St. Ry. Co. is stated to have received a franchise.

Chattanooga, Tenn.—S. W. Divine, Pres. Chattanooga Rapid Transit Co., writes that about 5 miles of extension are to be built in the near future.

Alton, Ill.—The Mississippi Valley Ry. Co. is stated to have been granted a franchise to enter the city, and the Alton Ry. & Illuminating Co. is said to have received permission to extend its line.

Carrollton, Ky.—It is stated that a company has been formed to construct an electric railway from Warsaw to Milton, and from Carrollton to English Station; capital, $50,000. Myron O. Baxter, Pres.; Martin L. Downs, Secy.

Harrison, N. Y.—The Highway Commissioners are stated to have granted the Port Chester Electric Ry. Co. a franchise.

Irvington, N. J.—The North Jersey St. Ry. Co. is stated to have petitioned for a franchise to extend its lines. The application will be considered Dec. 13.

Montpelier, Vt.—F. C. Kennedy, Pres., writes that the Montpelier & Mad River Traction Co. has secured a franchise to build and operate an electric railway. Preliminary surveys have been made and construction will begin early in April. Probable cost, $400,000. V. K. Nash, Engr. in Charge, Woonsocket, R. I.

Madison, Ind.—A proposition is under consideration to build an electric railway through Madison, North Madison and Hanover, connecting Vevay with some point on the B. & O. Southwestern Railway, a distance of about 40 miles. B. Johnson, C. E. of the R.R. Co., estimates the cost of the road at $560,000. J. K. Weyer, Chmn. Special Com. of M. & M. Club on Electric R.R., Madison.

RAILROADS.

Valatie, N. Y.—Bids are wanted Dec. 15 for railroad work, including 220,000 cu. yds. of earth, 11,800 cu. yds. of rock and 5,300 cu. yds. of masonry, 40 miles of track laying, 9 steel girder bridges, 1 steel viaduct 1,900 ft. long, and 60 miles of wire fencing, as advertised in "The Engineering Record."

Des Moines, Ia.—The Minnesota & Southern Ry. Co. was incorporated here Nov. 19 to build a line from Sauk Center, Minn., south through Iowa. Directors: John S. Thompson, New York; S. A. Robertson, Des Moines; John K. Brown, Jackson, Minn.; Chas. W. Thompson, Tacoma, Wash., and others.

Pittsburg, Pa.—Drake & Stratton of Pittsburg are stated to have received the contract for improvements on the Pennsylvania Railroad; contract said to be $212,000.

Winnipeg, Man.—See "Power Plants, Gas and Electricity."

Norfolk, N. Y.—The St. Lawrence River & Adirondack R. R. Co. has been formed to construct a railroad about 100 miles long; capital, $300,000. L. S. Putney, Pres. H. G. Atwater, Secy.

Baraboo, Wis.—The Baraboo, Kilbourn & Devils Lake Electric Ry. Co. is stated to have received a franchise.

Wasco, Ore.—The Columbia & Klickitat Ry. Co. has been incorporated to construct and equip a railway and telegraph line from a point on the Columbia River at or near Lyle, Wash., to Goldendale, Wash. Principal office will be located here; capital, $300,000. Incorporators: E. E. Lyttle, D. C. O'Reilly and A. E. Hammond.

Ottumwa, Ia.—A committee of 25 citizens is stated to have been appointed, with T. D. Foster as chairman, to make the necessary survey and organize a company to construct a line to connect with the Iowa Central at Wright, a distance of about 17 miles.

Lockport, N. Y.—It is reported that the Lehigh Valley R. R. Co. will construct a branch in Niagara County. E. P. Wilbur, Pres., South Bethlehem, Pa.

Washington, Pa.—Bennett & Talbott, of Greensburg, are reported to have received the contract to build about 5½ miles of railroad for the Washington Run R. R. Co.; probable cost of work said to be $175,000.

Oskaloosa, Ia.—The Iowa Central & Western R. R. Co. has been incorporated to construct a road from a point on the Iowa Central Railway at or near Oskaloosa, westward to Des Moines; capital, $3,000,000. Incoporators: L. M. Martin, Geo. W. Severs and others.

Chester, Va.—The Chester & Farmville R. R. Co. is said to have in contemplation the extension of its line from Chester to Manchester.

NEW DEPOTS.

Des Moines, Ia.—Chas. A. Frost, Pullman Bldg., Chicago, is reported to be preparing plans for a $200,000 station, to be erected here by the Rock Island R.R. Co.

Brunswick, Me.—The Maine Central R.R. Co. is stated to have decided to erect a $25,000 station. Wm. A. Allen, Ch. Engr., Portland.

Albany, N. Y.—Norcross Bros., of Worcester, Mass., are stated to have received the contract for the union station.

Council Bluffs, Ia.—It is stated that the Chicago, Rock Island & Pacific R. R. Co. will erect a $25,000 depot here. W. G. Purdy, Pres., Chicago.

PUBLIC BUILDINGS.

Morgantown, W. Va.—The congregation of the Methodist Church is stated to have decided to erect a $25,000 edifice.

Chicago, Ill.—It is stated that Armour & Co. are about to expend $135,000 in buildings on the grounds of their packing establishment at the stock yards.

Atlanta, Ga.—See "Government Work."

Phoenix, Ariz.—Bids are wanted Jan. 10 for a State Capitol. E. B. Gage, Chmn. Capitol Grounds and Bldg. Commission.

Charleston, S. C.—Bids are wanted Dec. 23 for an auditorium. Samuel Lapham, Chmn. Auditorium Com. of Council.

Albany, N. Y.—Plans and estimates for a public bath-house are wanted Jan. 3. Thos. J. Lanahan, Clk. Bd. Contract and Apportionment.

Cleveland, O.—Bids are wanted Dec. 27 for a ventilating and heating apparatus and one horizontal tubular boiler for the Children's Hospital at City Infirmary. William J. Akers, Dir. of Charities and Correction.

Brooklyn, N. Y.—All bids received Nov. 22 by the Commissioners of Public Charities, New York City, for work at Kings County Hospital have been rejected. New bids will be opened Dec. 13. J. W. Keller, Chmn. Commrs. See our issue of Nov. 26 for bids received Nov. 22.

Pittsburg, Pa.—We are informed that Marlin & Co. (mfgrs. galvanized iron work), Liberty Ave. and 24th St., are receiving bids for a steel frame building to be used as a shop.

Philadelphia, Pa.—Thos. Little & Son, 223 Pear St., have received the contract for a residence for Dr. Jayne. Furness, Evans & Co., Archts., Provident Bldg.: cost, $15,000.

Chas. McCaul, 10 N. 11th St., will build at 4-story manufacturing building at 10th and Spring Garden Sts. for Geo. B. Evans; cost, $20,000.

Lestershire, N. Y.—The proposition to erect a fire station and municipal building, at a cost of $24,000, carried at the recent election. M. S. Squires, Village Pres.

Anamosa, Ia.—Bids are wanted Dec. 6 for a complete steam heating apparatus for the county offices and courtroom. W. S. Barker, Co. Aud.

Cedar Rapids, Ia.—G. H. Merriditb, City Engr., writes that a vote will be taken Dec. 19 on the proposition to issue $125,000 bonds for a city hall.

Wellington, Kan.—The proposition to issue $20,000 bonds to build a jail in Sumner County is reported to have been carried.

Harlem, Ill.—It is stated that the Lutheran Society will erect a $50,000 church. Wesley Arnold, of Oakpark, Archt.

Atlanta, Ga.—The Presbyterian Society is reported to be arranging to build a $30,000 church. Walter P. Inman, 478 Peachtree St., is said to be interested.

Cincinnati, O.—The plans of S. Hannaford & Sons, Hulbert Blk., Cincinnati, are stated to have been accepted for the Saengerfest building.

Savannah, Ga.—T. J. O'Brien, 143 Whitaker St., Savannah, is stated to have received the contract for plumbing in the government hospital at $18,181.78.

Peru, Ind.—The Presbyterian Society is stated to have under consideration plans for a $15,000 church. Rev. Harry Nyce.

Cincinnati, O.—It is stated that the Building Committee of the Masonic Temple will expend about $100,000 on improving the temple. Two stories will be added.

Washington, D. C.—The following bids are stated to have been received, Nov. 26, by the District Commissioners for an isolating building for Providence Hospital. Bids given below are on plans one and two for the building, with separate bids for heating: Geo. W. Harrison, $29,650, $30,153, $3,400; Owen Donnelly, $29,200, $29,600, $2,800; Andrew Gleeson, $26,990, $27,300, $2,500; Melton & Watts, 319 Elm St., N. W., $26,538, $27,000, $2,800; Henry F. Getz, 802 F St. N. W., $26,275, $26,800, $2,380; Richardson & Burgess, 1421 F St. N. W., $25,284, $28,757, $2,681; Chas. S. Denham, 820 19th St. N. W., $25,573, $26,512, $2,350; Pavarini & Greer, 814 18th St. N. W., $24,824, $24,900, $2,840; W. E. Spier, 1417 F St. N. W., $22,217, $22,430.

Decorah, Ia.—It is reported that the citizens have voted to issue $75,000 courthouse bonds.

Danbury, Conn.—The following bids are stated to have been opened by the County Commissioners Nov. 30 for a court house: D'Esope Bros., Hartford, $35,649; Tracy Bros., Waterbury, $37,678; Norwalk Building Co., Norwalk, $38,899; Casey & Hurley, Bridgeport, $39,190; C. C. Crossley, Danbury, $39,600; J. L. Bunnell, Danbury, $40,362.60; Dowling & Bottomley, Bridgeport, $41,974; Foster Bros., Danbury, $43,118; Norcross Bros., Worcester, Mass., $44,245.

FIRES.

New York, N. Y.—The car house of the Union Trolley Co. in Bronx Borough has been destroyed by fire; loss said to be $150,000.

Des Moines, Ia.—The plant of the Des Moines Brick Co. has been destroyed by fire; loss said to be $50,000.

San Francisco, Cal.—The Baldwin Hotel has been destroyed by fire; loss about $1,500,000.

Oconto, Wis.—The electric light plant and the planing mills of the Citizens' Water, Light & Fuel Co. are reported to have been burned Nov. 24; loss about $60,000.

Chillicothe, Mo.—The water-works pump house is reported to have been destroyed by fire Nov. 17.

NEW FACTORIES.

The Aultman & Taylor Machinery Company, Mansfield, O., is building an addition to its foundry 100x125 feet and putting in an 18-ton cupola.

The Niles Tool Works, Hamilton, O., is just completing an addition to its works 200x70 feet in size.

The Chattanooga Brewing Company, Chattanooga, Tenn., will install a 200-ton ice machine to replace two 75-ton machines at present in use.

Messrs. Fraser & Chalmers, Chicago, Ill., have either recently erected or have now in course of construction the following buildings: Perforating shop, 99 feet 3 inches by 57 feet 2 inches; main machine shop and erecting shops, 319 feet by 103 feet, with 44-foot galleries; office and drafting room building, 209 feet ¼ inch by 36 feet 6 inches; stock room, 78 feet 10 inches by 36 feet 11¼ inches; tool room, 78 feet ¼ inch by 47 feet ¾ inch; shipping room, 138 feet 9¼ inches by 56 feet 10¼ inches.

The Berlin Iron Bridge Company, of East Berlin, Conn., is erecting for the Waterbury Manufacturing Company, Waterbury, Conn., a new blacksmith shop two stories high. The building is to be of fireproof construction throughout. The floor consists of concrete on corrugated iron arches, carried by steel beams and columns. The roof has steel trusses supporting the covering of corrugated iron lined with the Berlin Iron Bridge Company's patent anti-condensation lining.

The New York "Times'" financial supplement in an article on the steel trade quotes an officer of the Addyston Pipe & Steel Company of Cincinnati as saying: "Nearly all the pig iron we use at Addyston and Newport comes from Birmingham. The freight we pay on the pig is roughly about $2.25 a ton, and the return freight is about $5 a ton on our pipe and other castings. Therefore, our products at Addyston cost about $7 a ton additional laid down in Birmingham. That additional cost we desire to avoid, and we intend to avoid it. To do so we will build a shop here in Birmingham, for the local conditions are conducive to a profitable business."

The Botany Worsted Mills, Passaic, N. J., states that press reports of additions to its plant refer to a small addition, but that it will probably build a larger structure in the spring.

The Reading Iron Company, Reading, Pa., has dismantled an old rolling mill and is now erecting in its place two steel buildings 80x140 feet, one to contain two gas furnaces for the manufacture of boiler tubes and the other to be a finishing shop.

J. W. Doon & Son, Natick, Mass., will rebuild their flour mill, 50x70 feet. There will be a four-story storage building. Engine and boiler of 75 horse-power will be used.

The City Planing Mills, J. H. Walraven, proprietor, Temple, Tex., will early next year double the capacity (25 horse-power engine and 30 horse-power boiler) of its present plant, and will also build a corn mill.

Davis Brothers, Union, Ore., write that they contemplate building next season a grain elevator of 50,000 or 75,000 bushels capacity.

MANUFACTURING NOTES.

The Otto Gas Engine Works Incorporated, Philadelphia, Pa., has received the award of a gold medal at the Omaha Exposition, for the Otto gasoline engine.

The Baltimore & Ohio Railroad has just put into service two new trains between New York and Washington, known as the Royal Limited. These trains, one of which was recently exhibited in the Jersey City train shed, are composed of observation, parlor, café, smoking and dining cars. The equipment was especially made for this service by the Pullman Company and comprises the latest advance in the car builder's art. The inlaid work of the interior decoration is remarkably fine. The cars have wide platforms and vestibules with the anti-telescoping device, steam heat, gas light, air pressure water service, etc. The dining cars "Waldorf" and "Astoria" have ranges and a fully equipped kitchen.

BUILDING INTELLIGENCE.

NEW YORK, N. Y.

109-111 Ludlow st, br stores and flat; cost, $35,000; o, Harris Maran; a, Horenburger & Straub.

7th st, n w cor ave C, br stores and flat; cost, $30,000; o, Mrs. Bessie Ruth; a, Schneider & Herter.

61-63 E 3d st, br stores and flat; cost, $35,000; o, William Wirth; a, Kurtzer & Rohl.

145-153 E 54th st, 4 br flats; cost, $12,000 all; o, Rosamund Herter; a, F W Herter.

8 E 109th st, br tenem't; cost, $18,000; o, Goldstein & McDermott; a, Sam Sass.

S s 92d st, 100 w Boulevard, br flat; cost, $75,000; o, Emilio Vigna; a, Neville & Bagge.

N s 95th st, 95 e Boulevard, br flat; cost $90,000; o, Kate C Brown; a, C Steinmetz.

Boulevard, s w cor 102d st, br flat; cost $300,000; o, David R Todd; a, Neville & Bagge.

3d ave, n e cor 171st st, br flat; cost, $27,000; o, Louis Lutjens; a, R Werner.

S s 142d st, 275 e Brook ave, br flat; cost, $22,000; o, Max Walther; a, Harry T Howell.

S s 160th st, 98 w Courtlandt ave, 2 br flats; cost $30,000 all; o, Margaret Redican; a, Ward Cunningham.

N s 152d st, 110 e Robbins ave, 3 br flats; cost, $46,500 all; o, Martin Smith; a, W C Dickerson.

E s Webster ave, 48 n 174th st, 2 br flats; cost, $36,000 all; o, Vegliante & Le Medico; a, C A Millner.

BROOKLYN, N. Y.

Marcy ave, s w cor Hope st, br store and tenem't; cost $12,000; o & b, Brown estate; a, C J Perry.

S s Atlantic ave, 100 e Carlton av, br factory: cost, $12,500; o, J M Horton Ice Cream Co; a, J G Glover.

S s Myrtle ave, 165 w Lewis ave, 2 br tenem'ts: cost, $22,000 all; o, Th Berlenbach; a, Herman E Funk.

MISCELLANEOUS.

San Antonio, Tex.—Cor Commerce and Navarro sts, 5 story fireproof bank and offices; cost, $40,000; o, San Antonio Loan & Trust Co; a, Alfred Giles.

St. Paul, Minn.—West of Fish Hatching, 1 story round house: cost $15,000; o, C, B & N R R Co; b, Geo J Grant.

PROPOSALS OPEN.

Bids Close.		See Eng. Record.
	WATER-WORKS.	
Dec. 5.	West Tampa, Fla.	Nov. 12
	Adv., Eng. RECORD, Nov. 19, 26.	
Dec. 5.	Pumping engine, Oil City, Pa.	Oct. 29
	Adv., Eng. RECORD Oct. 29 to Nov. 12.	
Dec. 5.	Pipe, etc., Toronto, Ont.	Nov. 26
Dec. 6.	East Grand Forks, Minn.	Nov. 26
Dec. 7.	New Richmond, O.	Nov. 19
	Adv., Eng. RECORD, Nov. 19, 26.	
Dec. 7.	Allegheny, Pa.	Dec. 3
Dec. 8.	Water pipe, etc., New York, N. Y.	Nov. 26
Dec. 15.	Somerville, Tenn.	Dec. 3
	Adv., Eng. RECORD, Dec. 3.	
Dec. 16.	Bonds, Little Falls, Minn.	Dec. 3
Jan. 1.	Crisfield, Md.	Nov. 12
Jan. 3.	Gaffney, S. C.	Dec. 3
Mar. 15.	Belem, Para, Brazil	Nov. 26
——	Pump, Austin, Tex.	Sept. 10
——	Tempe, A. T.	Nov. 5
	Adv., Eng. RECORD, Nov. 5, 12.	
	SEWERAGE AND SEWAGE DISPOSAL.	
Dec. 5.	Toledo, O.	Nov. 26
Dec. 5.	Pipe, Toronto, Ont.	Nov. 26
Dec. 5.	Albany, N. Y.	Dec. 3
Dec. 5	Moline, Ill.	Dec. 3
Dec. 5.	Syracuse, N. Y.	Dec. 3
Dec. 6.	Allegheny, Pa.	Dec. 3
Dec. 6.	St. Louis, Mo.	Nov. 26
Dec. 8.	Findlay, O.	Dec. 3
Dec. 8.	Wilkinsburg, Pa.	Dec. 3
Dec. 10.	Washington, D. C.	Nov. 5
	Adv., Eng. RECORD, Nov. 5.	
Dec. 10.	Tile, Sadorus, Ill.	Dec. 3
Dec. 12.	Little Rock, Ark.	Dec. 3
Dec. 13.	Philadelphia, Pa.	Dec. 3
Dec. 13.	Independence, Mo.	Dec. 3
Dec. 19.	Newburgh, N. Y.	Nov. 19
Dec. 30.	East Cleveland, O.	Dec. 3
Jan. 10.	Bonds, Grass Valley, Cal.	Dec. 3
Jan. 15.	New York City	Dec. 3
——	Pittsburg, Pa.	Nov. 5

BRIDGES.

Dec. 5. Leavenworth, Kan....................Nov. 26
Dec. 5. Carthage, Miss......................Dec. 3
Dec. 5. Sarcoxie, Mo........................Dec. 3
Dec. 6. Bridge, etc., Trenton, Mo...........Dec. 3
Dec. 6. Onslow, Ia..........................Nov. 26
Dec. 6. Milan, Mo...........................Nov. 26
Dec. 6. Rensselaer, N. Y....................Nov. 26
Dec. 7. Chicago, Ill........................Oct. 15
Adv., Eng. RECORD, Oct. 15, Nov. 5.
Dec. 8. Substructure, Zanesville, O.........Nov. 12
Dec. 9. Minneapolis, Minn...................Dec. 3
Dec. 9. Fort Scott, Kan.....................Dec. 3
Dec. 13. Philadelphia, Pa...................Dec. 3
Dec. 15. Valatie, N. Y......................Dec. 3
Adv., Eng. RECORD, Dec. 3.
Dec. 22. Lorain, O..........................Nov. 5
Dec. 28. Chicago, Ill.......................Nov. 5
Adv., Eng. RECORD, Dec. 3.
Dec. 28. Norfolk, Va........................Dec. 3
Adv., Eng. RECORD, Dec. 3.
Jan. 1. Cathlamet, Wash.....................Nov. 26
Jan. 2. Quebec, P. Q........................Oct. 1
Adv., Eng. RECORD, Oct. 1, 8.
Jan. 3. Brookhaven, Miss....................Nov. 19
——— New Kensington, Pa....................Oct. 22
——— Plans, Lafayette, La..................Dec. 3

PAVING AND ROADMAKING.

Dec. 5 Brick, Toronto, Ont..................Nov. 26
Dec. 5. Toledo, O...........................Nov. 26
Dec. 6. Cincinnati, O.......................Nov. 26
Dec. 6. Bonds, Springfield, O...............Oct. 29
Dec. 6. Bonds, East Liverpool, O............Nov. 12
Dec. 6. Allegheny, Pa.......................Dec. 3
Dec. 6. Baltimore, Md.......................Dec. 3
Dec. 7. Indianapolis, Ind...................Dec. 3
Dec. 8. Brooklyn, N. Y......................Dec. 3
Dec. 12 Dayton, O...........................Nov. 19
Dec. 13. Philadelphia, Pa...................Dec. 3
Dec. 14. Indianapolis, Ind..................Dec. 3
Dec. 15. Beaumont, Tex......................Dec. 3
Dec. 15. Jacksonville, Fla..................Nov. 26
Dec. 17. Crownpoint, Ind....................Nov. 26
Dec. 19. Hamilton, O........................Nov. 26
Dec. 20. Cincinnati, O......................Nov. 26
Dec. 21. Hoboken, N. J......................Dec. 3
Dec. 29. Bonds, Georgetown, Ky..............Dec. 3
Jan. 5. Decatur, Ind........................Dec. 3
Feb. 27. Yonkers, N. Y......................Dec. 3

POWER, GAS AND ELECTRICITY

Dec. 5. Syracuse, N. Y......................Nov. 26
Dec. 5. Waukegan, Ill.......................Dec. 3
Dec. 6. East Grand Forks, Minn..............Nov. 26
Dec. 7. New Richmond, O.....................Nov. 19
Adv., Eng. RECORD, Nov. 19, 26
Dec. 8. Litchfield, Ill.....................Nov. 26
Dec. 13. Stockton, Cal......................Nov. 26
Dec. 15. Somerville, Tenn...................Dec. 3
Adv., Eng. RECORD, Dec. 3.
Dec. 16. Bonds, Little Falls, Minn..........Dec. 3
Dec. 19. Colton, Cal........................Dec. 3
Dec. 20. Electric Light Plant, Mt. Pleasant, Mich.....Dec. 3
Dec. 27. Woodsfield, O......................Dec. 3
Jan. 1. Pasadena, Cal.......................Dec. 3
Jan. 1. Bonds, Lawton, Mich.................Nov. 26
Jan. 2. Vincennes, Ind......................Oct. 22
Adv., Eng. RECORD, Oct. 22, Nov. 12, 26.
Jan. 6. Johannesburg, So. African Repub.Oct. 22
Mar. 31. Telephone, Shanghai, China.........Nov. 19

GOVERNMENT WORK.

Dec. 5. Wreck, Philadelphia, Pa.............Nov. 12
Dec. 6. Canal work, Chicago, Ill............Nov. 12
Adv., Eng. RECORD, Nov. 12 to Dec. 3.
Dec. 6. Wharf, etc., San Francisco, Cal.....Nov. 12
Dec. 7. Wilmington, N. C....................Nov. 12
Adv., Eng. RECORD, Nov. 12 to Dec. 3.
Dec. 10. Crane, New York, N. Y..............Nov. 5
Dec. 10. Storehouse, New York, N. Y.........Dec. 3
Dec. 15. Dikes, etc., Portland, Ore.........Dec. 3
Dec. 20. Revetments, Duluth, Minn...........Nov. 26
Adv., Eng. RECORD, Nov. 26, Dec. 3.
Dec. 23. Metal work, etc., Tompkinsville, N. Y.....Nov. 19
Dec. 23. Cement and gravel, Mobile, Ala.....Nov. 26
Adv., Eng. RECORD, Nov. 26. Dec. 3.

BUILDINGS.

Dec. 5. Schools, New York, N. Y.............Nov. 26
Dec. 5. Garner, Ia..........................Nov. 12
Dec. 5. School bonds, Youngstown, O.........Nov. 19
Dec. 6. School, Sacramento, Cal.............Nov. 19
Dec. 6. Heating, New Brighton, S. I.........Nov. 26
Dec. 6. Heating, Anamosa, Ia................Dec. 3
Dec. 9. Boston, Mass........................Dec. 3
Dec. 10. School, Wever, Ia..................Nov. 26
Dec. 12. Bridgeton, N. J....................Nov. 26
Dec. 13. Brooklyn, N. Y.....................Dec. 3
Dec. 15. Htg. Plant in School, Flandreau, S. Dak.....Dec. 3
Dec. 15. School, Ellendale, N. Dak..........Dec. 3
Dec. 17. School, Chattanooga, O.............Dec. 3
Dec. 21. Atlanta, Ga........................Oct. 29
Dec. 23. Charleston, S. C...................Dec. 3
Dec. 27 Ventilating, etc., Cleveland, O.....Dec. 3
Jan. 3. Plans, Albany, N. Y.................Dec. 3
Jan. —. Superstructure, Newport, R. I.......Nov. 19
Jan. 9. School, Wilmington, Del.............Dec. 3
Jan. 10. Phoenix, Ariz......................Dec. 3
Feb. 1. School, Peoria, Ill.................Dec. 3
——— Pittsburg, Pa.........................Dec. 3
Feb. 10. Keyser, W. Va......................Nov. 5
——— Machine shop, Birmingham, Ala.........Sept. 3

MISCELLANEOUS.

Dec. 5. Bulkhead, Boston, Mass..............Nov. 26
Dec. 5. Wall, Boston, Mass..................Nov. 26
Dec. 5. Garbage disposal, Philadelphia......Nov. 26
Dec. 5. Wall, Boston, Mass..................Dec. 3
Dec. 6. Channel, Rensselaer, N. Y...........Nov. 26
Dec. 7. Dredging, Brooklyn, N. Y............Nov. 26
Dec. 9. Garbage disposal, New York, N. Y....Nov. 26
Dec. 13. Tunnel, Boston, Mass...............Nov. 26
Adv., Eng. RECORD, Nov. 26, Dec. 3.
Dec. 13. Pier, etc., Philadelphia, Pa.......Dec. 3
Jan. 14. Park plans, Philadelphia, Pa.......Nov. 19
Dec. 15. R R, Valatie, N. Y.................Dec. 3
Adv., ENG. RECORD, Dec. 3.
Jan. 24. Tunnel, London, England............Nov. 5
Mar. 15. El. Ry., Shanghai, China...........Nov. 19
——— Garbage crematory, Newport, Ky.......July 30
Adv., Eng. RECORD, July 30.

NEW SCHOOLS.

Rushville, Ind.—The School Board is stated to have petitioned the City Council for permission to erect a $40,000 high school.

Santa Barbara, Cal.—The matter of erecting a $50,000 high school is stated to be under consideration.

Boston, Mass.—John McNamara & Sons, 61 Wareham St., Boston, are stated to have received the contract for the Munroe St. school, at $44,973.

North Tarrytown, N. Y.—The citizens are stated to have voted to issue $50,000 bonds for a school.

Cherokee, Ia.—School bonds amounting to $20,000 are stated to have been sold.

Flandreau, S. Dak.—Bids are wanted Dec. 15 for a steam heating plant for Flandreau Indian Industrial School. W. A. Jones, Commr. Indian Affairs, Washington, D. C.

Ellendale, N. D.—Bids are wanted Dec. 15 (change of date) for a building for the N. D. State Industrial and Manual Training School. T. H. Faus, Secy. Trustees, Ludden, N. D.

Chattanooga, O.—Bids are wanted Dec. 17 for a school in District No. 5, Liberty Township. Henry Brenan, Clk.

Wilmington, Del.—Bids are wanted Jan. 9 for a high school. William Turner, Chmn. Com. Bd. Education.

Peoria, Ill.—It is stated that bids are wanted Feb. 1 for a school; estimated cost, $40,000. Richardson & Hotchkiss, Archs., Dime Savings Bank Bldg.

Boston, Mass.—Bids are wanted Dec. 9 for a school. William T. Eaton, Chmn. Com. on New Bldgs. of the School Com.

Depere, Wis.—The Board of Education is stated to have decided to ask for plans for a high school; probable cost, $15,000.

Lexington, Ky.—It is stated that plans are being prepared by Richards & McCarty of Columbus, O., for buildings for the Reform School; probable cost, $90,000.

STREET CLEANING AND GARBAGE DISPOSAL.

Little Rock, Ark.—The City Council has under consideration the construction of a garbage crematory.

Winnipeg, Man.—The Council has under consideration the matter of submitting to the voters on Dec. 20 the proposition to erect a $13,000 crematory.

GOVERNMENT WORK.

New York, N. Y.—Bids are wanted Dec. 10 for erecting storehouse at the Navy Yard. Mordecai T. Edicott, Ch. Bureau Yards & Docks, Navy Dept., Washington, D. C.

Winthrop, Mass.—The contract for an electric light plant at the U. S. Mortar Battery at Winthrop Head has been awarded to Walworth Construction & Supply Co., 100 Pearl St., Boston. Price, $1,424.

Cleveland, O.—Local press reports state that Col. Jared A. Smith, U. S. Engr., has closed a contract with L. P. & J. A. Smith, Cleveland, to make repairs on the west breakwater sufficient to enable it to last through the winter. Cost about $20,000.

Algiers, La.—The following bids for a combined floating and graving steel dry dock were opened Nov. 30 by Mordecai T. Endicott, Ch. Bureau of Yards & Docks, Navy Dept., Washington, D. C.: Chas. R. Bradbury, New York, N. Y., $850,000; Maryland Steel Co., Sparrows Point, Md., $810,000; alternative bid, $837,000.

Boston, Mass.—The following bids were opened Nov. 26 at the office of Yards and Docks, Navy Dept., Washington, D. C., for boilers: Oil City Boiler Wks., Oil City, Pa., $8,292; Heine Safety Boiler Co., St. Louis, Mo., $7,300; Jno. O'Brien Boiler Wks., St. Louis, Mo., $6,380; The Stirling Co., Chicago, Ill., $6,717; Chas. H. Homer, Baltimore, Md., $10,200; Aultman & Taylor Co., Mansfield, O., $5,498; Evans, Almirall & Co., New York City, $6,693; Smith & Anthony Co., Boston, Mass., $8,600; R. A. Sanborn, Boston, Mass., $6,950; Jarvis Engineering Co., Boston, Mass., $9,797, $7,550, $8,406; Babcock & Wilcox Co., New York City, $6,590, $7,000, $8,415.

Atlanta, Ga.—Local press reports state that Attorney General Griggs and Secretary Bliss, who were constituted by Congress a committee to select a site for a new federal prison in the South, have decided on Atlanta as the location for same; probable cost, $3,000,000.

Port Royal, S. C.—The following bids were opened Nov. 26, at the office of Yards and Docks, Navy Dept., Washington, D. C., for a locomotive jib crane: E. M. Bailey & Co., Charleston, S. C., $12,500, Wm. Sellers & Co., Philadelphia, Pa., $42,368; Morgan Engineering Co., Alliance, O., $49,687; American Hoist & Derrick Co., St. Paul, Minn., $39,950; Brown Hoisting & Conveying Machine Co., Cleveland, O., $44,500.

New York, N. Y.—The following bids were opened Nov. 28 by James Knox Taylor, Superv. Archt., Treas. Dept., Washington, D. C., for mailing platform, extension and shed for U. S. Court House and Post Office, as advertised in "The Engineering Record": Cooper & Wygand, $13,986; Kenney & Kenney, Syracuse, N. Y., $12,304; Post & McCord, Brooklyn, N. Y., $14,270; Prince & Kinkel Iron Wks., $16,637; Stacy & Opdyke, Jr., Philadelphia, Pa., $12,235; Ryan & McFerron, $14,949; W. G. Triest, $12,237; Kelly & Kelly, $12,296; J. B. & J. M. Cornell, $14,735.

Address of bidders New York City, unless otherwise stated.

Brooklyn, N. Y.—The following bids for boilers were opened Nov. 26 at the office of Yards and Docks, Navy Dept., Washington, D. C.: Babcock & Wilcox Co., $18,480, $10,340 and $11,305; Burhorn & Granger, $12,991.95; J. J. Tomkins & Co., $10,250; Evans, Almirall & Co., $10,097; the Clonbrock Steam Boiler Co., $10,341; C. C. Peck, Rochester, N. Y., $9,490; Heine Safety Boiler Co., St. Louis, Mo., $11,035 and $9,905; John O'Brien Boiler Wks., St. Louis, Mo., $6,360; Aultman & Taylor Co., Mansfield, O., $8,167; C. C. Homer, Baltimore, Md., $12,100; Baldwin Engineering Co., $12,825; Oil City Boiler Wks., Oil City, Pa., $11,784; the Stirling Co., Chicago, Ill., $8,995.

Address of bidders New York City, unless otherwise stated.

New York, N. Y.—The following bids were opened Nov. 25 by James Knox Taylor, Superv. Archt., Treas. Dept., Washington, D. C., for taking down and rebuilding the west end wall of the rear building at the U. S. Assay Office: John E. Johnson, $11,700; Michael Moore, $5,750; Quincy & Crawford, $6,660; J. H. Cutler, $5,639; Hartman Horgan, $4,887. Bidders all of New York City.

Portland, Ore.—Bids are wanted Dec. 15 for dikes, etc., in Hayden Slough and Columbia River. Maj. W. L. Fisk, Corps of Engs.

Boston, Mass.—The following bids were opened Nov. 22, at the office of Supplies & Accounts, Navy Dept., Washington, D. C., for boilers: Jarvis Engineering Co., Boston, Mass., $13,828; Walworth Construction & Supply Co., Boston, Mass., $17,790; Burhorn & Granger, New York City, $11,887.57; Evans, Almirall & Co., New York City, $12,555.

MISCELLANEOUS.

Philadelphia, Pa.—Bids are wanted Dec. 13 for superstructure for Chestnut St. pier and Pennsylvania Ave. subway and tunnel. Thomas M. Thompson, Dir. Dept. Pub. Wks.

New Orleans, La.—Local press reports state that levee contracts have been awarded as follows: To W. M. Rushing, Benton, La., for Shady Grove levee, 45,000 cu. yds. at 9 cts. a cu. yd., and to Wm. Robson & Son, Robson, La., for Bayou Pierre levee, 50,000 cu. yds. at 10.45 cts.

Chicago, Ill.—See "Paving and Roadmaking."

Syracuse, N. Y.—Local press reports state that Henry B. Seaman of New York City has been employed to prepare plans for the elimination of grade crossings.

Los Angeles, Cal.—It is stated that plans have been adopted for the proposed 3d St. tunnel and the City Clerk has been directed to advertise for bids.

Valatie, N. Y.—See "Railroads."

Boston, Mass.—Bids are wanted Dec. 5 for building a wall of quarry faced granite or seam faced Roxbury stone at Franklin Park. Charles E. Stratton, Chmn. Park Commrs.

Orders for single copies, to complete files, must give the date of each issue required, and must be accompanied by remittance at rate of twelve cents for each copy desired. Single issues of Volume XXXVIII. will not be obtainable after January 1st, 1899.

THE ENGINEERING RECORD.

Volume XXXIX. Number 2.

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FATAL ELEVATOR ACCIDENT IN NEW YORK.

Another fatal elevator accident occurred in New York City on the afternoon of Tuesday, December 6, in which one man was instantly killed, one other so badly injured that he is not expected to recover, and a third seriously injured. The accident occurred to the elevator in the eleven-story building No. 46 Pine Street. A single Otis double-worm gear electric elevator was placed in the building some years ago, and it was to this machine that the accident occurred. The directors of the United States Fire Insurance Company, which occupies the eighth and the ground floors, were holding a meeting on the upper of these floors, and, after its adjournment, seven of the directors boarded the car, which was started for the ground floor. Accounts are conflicting as to exactly what then occurred, but the general opinion seems to be that the car descended about at its normal speed until somewhere near the bottom, when it is stated that the elevator boy, who was taking the place of the regular attendant, who was sick, lost control of the car. At any rate, for some reason, the hand wheel for shutting off the current was not moved at the proper time, and the car struck the bottom of the shaft with a violent jar. The motion of the hoisting apparatus continued until the counterbalance, a light framework in which a number of heavy weights were placed, was projected with considerable force against the I-beams which support the sheaves over the shaft. The frame of the counterbalance buckled, permitting four weights, each weighing in the neighborhood of 70 pounds, to fall through the full height of the shaft on top of the car, breaking through the light roof and instantly killing Mr. Walter H. Griffen, secretary of the United States Fire Insurance Company, and injuring Messrs. Thomas W. Cauldwell and George H. Smith, both of them directors.

To look into the direct cause of the accident it is necessary to describe in some detail the elevator mechanism. The capacity of the car was about 1,800 pounds and the speed was 250 feet per minute. The machine was of the usual worm gear type, an electric motor being directly connected to a shaft on which was mounted a pair of worm gears driving the drum on which the hoisting ropes are wound. On the motor shaft a double band brake was provided. One was operated by a weight, which was kept from acting by a magnet as long as current was supplied to the machine. If interruption in the current occurs, such as the blowing of a fuse, the magnet fails to act, and the weight thus released actuates the brake. In the other brake a cam, actuated by a fly-ball governor, the speed of which is proportional to the speed of the car, acts indirectly upon a toggle joint connected with the band of the brake. This latter brake acts as a speed limit, completely arresting the motion of the machine when it reaches a higher speed than that for which it is set. Means have to be provided for stopping the car at the upper and lower limits of its travel, so that if anything should happen to the operator no damage would be done. This is accomplished in this machine by cutting a thread on the extension of the hoisting drum shaft, in which a nut moves longitudinally back and forth to the shaft as it revolves one way or the other. At both ends of its travel, this device is arranged through a suitable lever to break the electric circuit. When this occurs, one of the band brakes is applied, as has been previously explained.

The counterbalance frame was in two parts, one connected by ropes to the car and the other connected by other ropes to the hoisting drum for reasons not necessary to explain. One counterbalance was directly above the other, as both moved in the same guides, and they might be considered as one. Both consisted of two cross pieces of iron, connected by vertical iron bars about ¾-inch thick. The sides of the cross pieces projected and the T-bar guides fitted into slots cut into these projections. The space between the cross pieces which were about 8 feet apart, was, in the case of the lower balance, entirely filled with rectangular weights of about the same length as the space between the vertical bars, the ends of the weights being slotted to fit between them. The upper counterbalance frame was about half filled with weights.

There was, it seemed, only about 8 inches clearance between the car and the bottom of the shaft when the car was at the ground floor, and about 18 inches clearance between the top of the counterbalance and the I-beams supporting the sheaves over the shaft. On account of the rapidity with which the down motion safety, that is, the device which, through the medium of the screw, broke the circuit and applied the brake to the motor shaft, acted in stopping the car, it was not possible to adjust this brake to act until the car is nearly at the level of the ground floor. Consequently it is probable that this stop might have been cut of adjustment and did not act quickly enough to prevent the car from bumping against the bottom and the counterbalance against the top of the shaft, provided the current was not shut off and the brake applied by the operator through the hand wheel. The weight of evidence shows that the elevator boy, either through fear or mistaking the ground floor for the one above, did not cut off the current by the hand wheel as he should have done, and the car, coming down quite heavily loaded, brought up at normal speed on the bumpers at the bottom of the shaft. The counterbalance, meanwhile, rising as the car fell, was carried up to the top of the shaft with sufficient force to buckle the sides of the frame, which spread apart and allowed the weights to fall.

This particular accident is the first of its kind, it is believed, on record, and it has pointed out a new source of danger in elevator construction that could easily be avoided if the counterbalance was carried in a shaft separate from that in which the car travels. In many instances it is impossible to provide room for this, but if it cannot be done, it does seem that the weights of the counterbalance should be firmly connected together and to the supporting rope.

Since the preceding was written, it has been stated that the city inspectors visited the elevator on the morning of the accident and found the automatic stop out of adjustment and notified the janitor of the building of that fact. The New York "Sun" of December 8 prints the following extract from the report of City Elevator Inspector F. Frankenberg:

"The cause of the accident was that while the car was on the down trip the operator failed to judge the ground floor properly. The car struck the bumpers at the bottom of the shaft, causing the back drum weights to raise the car weights, thus tipping the car weights into the shaft. Had the automatic stop on the motor car been set properly for the down stop, and the car properly stopped at the ground floor, the accident would not have happened."

NEW GAUGINGS OF THE ROCHESTER CONDUIT.

The gauging of pipe lines of considerable length is probably one of the most useful undertakings, professionally, the engineer of a system of water-works can carry out, provided he makes the results public. The present information of this nature is much too meager, and until the lack of data is remedied any marked advance of the theoretical views of the flow of water in pipes does not seem probable. The subject is in the same condition as the theory of the actual strains in bridges, referred to last week. It is therefore a pleasure to notice in the last annual report of Mr. Emil Kuichling, M. Am. Soc. C. E., an account of some recent gaugings of the conduits of the Rochester water-works under his charge, which were carried out in the face of unfavorable conditions, but yielded interesting results.

The old conduit, built in 1873-75, is divided by the Rush storage reservoir into two sections. Owing to insufficient appropriations for completing the permanent connections of the conduit, all measurements of its flow in both sections must be made in a tedious manner by observing the fluctuations of the height of the water in the reservoir and the evaporation for eight or more hours and ascertaining the rate of leakage from the reservoir as soon afterward as possible. The southern section of the conduit—from Hemlock Lake to the Rush reservoir—is formed of 50,807 feet of 36-inch riveted wrought-iron pipe, 15,447 feet of 24-inch pipe of the same class and 36,010 feet of 24-inch cast-iron pipe. The fixed gradient of the 36-inch pipe is 1 in 2,522, and that of the 24-inch pipe is one in 381.5, but the hydraulic gradient of the conduit while in operation is somewhat different. The northern section of the old conduit runs from the storage reservoir to Mt. Hope reservoir, and consisted until within a few years of 24-inch pipe throughout; at present it comprises 110 feet of 30-inch cast-iron pipe and specials, 46,268 feet of 24-inch cast-iron pipe and 503 feet of 24-inch wrought-iron pipe. This section of the conduit nowhere rises above a straight grade line, having a fall of 114.4 feet, connecting the bottoms of the two reservoirs.

The results of the complicated gauging operations were as follows: On June 22-23, 1897, during a period of 22½ hours, and during 5½ hours on November 9, the discharge from the southern section was at the rate of 6,598,400 and 6,675,900 gallons in 24 hours, respectively. On June 23-24, during a period of 22¼ hours, and during 8 hours on November 10, the discharge of the northern section was at the rate of 7,887,800 and 8,153,400 gallons in 24 hours, respectively. If these figures are compared with a discharge rate of 7,185,000 gallons measured in the southern section on October 10, 1890, and one of 8,392,700 gallons measured in the northern division on September 25, 1892, a marked reduction in the capacity of the pipe, amounting to about 1 per cent. annually on the average, will be noticed in both pipes, which Mr. Kuich-

ling attributes to accumulations of rust, sediment and organic growths on the interior of the pipe. "A further comparison can also be made," he states, "with the gaugings of the southern division, made early in 1876 by the late L. L. Nichols, which then exhibited a discharge of about 9,000,000 gallons per day, thus showing that such reduction has been progressive or continuous during the whole period of 22 years." It is believed that the rate of this diminution of flow will become smaller each year.

The new conduit was built in 1893-94 and is likewise in two divisions. The southern consists of 91,554 feet of 38-inch riveted steel pipe and 94 feet of 36-inch cast-iron pipe and specials; the northern division is made up of 45,394 feet of 38-inch riveted steel pipe and 1,218 feet of 36-inch cast-iron pipe, and has an abrupt turn of 90 degrees near the city line.

In the case of the southern division, the influence of the few short sections of 36-inch pipe was disregarded and the results of the tests are given as follows, the loss of head being observed and the coefficient c in the Chezy formula and the daily discharge being computed:

Date.	Oct. 4, '95.	Dec. 23, '95.	July 23, '97.	Nov. 18, '97
Lost head, ft.	91.053	92.899	91.563	91.398
Coefficient c.	116.71	114.05	115.50	112.04
Dis., gals.....	16,661,800	16,445,800	16,534,400	16,024,600

In the case of the northern division the amount of cast-iron pipe was too large to be passed over, and separate observations were accordingly made on 890 feet of 36-inch cast-iron conduit and 45,394 feet of riveted steel pipe. The results were as follows:

	Steel Pipe.		Cast-Iron Pipe.		
Date.	Lost Head.	Coef. c.	Lost Head.	Coef. c.	Discharge.
Oct. 17, '95..	72.021	109.35	1.234	129.45	19,729,700
Oct. 26, '95..	73.252	109.34	1.340	125.25	19,892,100
Nov. 7, '95..	73.445	109.07	1.337	125.25	19,870,200
July 28, '97..	73.766	106.11	2.026	99.22	19,373,400
Nov. 11, '97..	69.521	107.11	4.287	66.84	18,985,100
Nov. 19, '97..	69.609	106.45	4.318	66.24	18,851,700

The remarkable loss of head shown in the cast-iron pipe is believed to be due to a profuse growth of organisms.

The value of these results is considerably reduced by the report of some gaugings "made with the utmost care" in 1897 on 46,339 feet of 38-inch riveted steel pipe. The ten experiments lasted from 7¾ to nearly 16 hours each, and gave the followings values of c: 109, 113, 115, 117, 115, 112, 111, 116, 114, 113. Concerning these results Mr. Kuichling writes: "No good reasons can be given for the incongruities in the values of the coefficient for the series of experiments in 1897, and the results are submitted without further comment except that they emphasize the necessity of adopting the greatest refinement in making such measurements."

The exact difference in elevation between the reference points along the conduit, a distance of about 20 miles, had been determined by three lines of levels run with great care at different times during the last 10 years, but the results failed to agree as closely as was desirable, and an attempt was made to determine the correct elevations by using the pipe line itself as a leveling instrument. At a distance of 9.356 miles from the lake there is an air valve, from which a small pipe was carried up the neighboring hillside to the bottom of an open vessel, in which the water could come to rest. The position of the air valve was such that by closing two gates the water in each section would gradually come to rest. By plotting close simultaneous observations with hook gauges and barometers at each end of a section a diagram was obtained, which exhibited all the changes and irregularities, as well as the true mean elevation of the water surface at each point. Various corrections were made for instrumental errors, and the final result gave the elevation of the reference point at Rush reservoir as 248.788, the elevations found by the earlier levels being 248.370, 249.230 and 248.550, which shows the accuracy of instrumental work of this sort.

THE HOME INSURANCE BUILDING FIRE.

The Home Life Insurance Building, a modern tall office building on Broadway, New York City, fronting City Hall Park, was swept in its upper stories on Sunday night last by fire, and the occurrence promises to be of value as yielding information regarding the behavior of modern fire-resisting construction when attacked by an exterior conflagration.

FIGURE 1.—HOME LIFE INSURANCE BUILDING, NEW YORK.
N. LE BRUN & SONS, ARCHITECTS.

On the southwest corner of Broadway and Warren Street was a five-story brick building, with a wide front on Broadway and extending west to No. 7 Warren Street, where it adjoined a similar building. This corner building was of old-fashioned construction, with wooden floor beams. It was occupied as a clothing store by Rogers, Peet & Co., and by offices on the upper floors. Adjacent to it, at the south end of the Broadway front, was the modern steel-frame building of the Home Life Insurance Company. This building had a front of about 63 feet and a depth of 104 feet to the west. It showed fifteen stories and a mezzanine on the front, and the main roof is 206 feet above the curb. On the roof was built a sixteenth story, for janitor's apartments, etc., and the building was surmounted by a pyramidal tower reaching to a height of 260 feet above the curb. This building, as it appeared before and after the fire, is shown in the accompanying Figures 1 and 2. It is indented along its north wall by a light court about 20x24 feet in size, as shown in Figure 2, and also in Figure 3, which indicates the general arrangement of the floors from the ninth up, and serves to show the location of this court, which acted as a chimney when the flames from the adjacent building were driven into it. The east or Broadway front is at the bottom of the cut. The upper floors are similar in general dimensions, but vary in arrangement of partitions. Above the floor shown, the east and west walls of the light court are braced at every second story by a horizontal latticed strut in the north face of the building, which are shown in Figure 2. The original plans for this building contemplated a frontage of only 30 feet, and the erection had progressed for five or six stories on this basis, when the owners were able to secure land for an extended frontage on Broadway, and the final plan of the building was developed as shown in the figures. It thus became desirable to utilize such portions of the structure as had already been designed, manufactured, and in some cases erected, to conform to the original conditions. This resulted in especially rigid connections for the framework, and accounts for details of arrangement and construction which might have been different if the final conditions had prevailed in the beginning. The Broadway front is of white marble. The building was erected in 1892 and 1893, and is one of the most conspicuous in lower Broadway. Adjoining the Home Building on the south, and completing the block to Murray Street, is the fourteen-story steel-frame building of the Postal Telegraph Company, built about the same time as the Home Life Building.

On Sunday night, December 4, while the severest northeast gale of the year was raging, fire was discovered in the building occupied by the clothing store, at the Warren Street corner, and it soon gained such headway that it was impossible to check it. For some time the adjacent buildings were protected by the strenuous efforts of the firemen, although an iron-front building standing opposite, on the north side of Warren Street, suffered from broken windows and by the scorching and igniting of paint and woodwork in many places. The building in which the fire originated was filled with combustibles, and the flames, escaping through the windows and roof, were blown directly against the north walls of the Home Insurance Building. Although subjected to an intense heat, the building did not take fire for some time. The firemen entered the Home Building and endeavored to protect it with hose streams from their engines and from the fire pipes in the building. About an hour after the fire broke out, the roof of the corner building fell in. A great volume of flame was blown against the north side of the Home Building, and, converging in the open court there, was swept upward as if in a great chimney. An intense heat was thus concentrated upon the three walls of the court, and the glass in its upper windows gave way. It was said that the different stories thus caught fire independently through the court windows and probably almost simultaneously. One statement is to the effect that the flames first came out of the twelfth story windows progressively, and after that from the other stories. Above the eighth

floor the interior of the building is wrecked and its contents almost entirely destroyed.

Throughout these stories the woodwork and contents of all the rooms adjacent to the north court were burned. The fire did not extend south of the main corridor on the eighth floor, and on the ninth floor did not burn either south or west of the main corridors. In the upper stories some of the rooms in the south and southwest parts escaped wholly or partially. Above the eleventh floor the flames appear to have been the fiercest. In the main corridor on this floor the ironwork of the elevator shafts was badly distorted, and the flames swept through it and the rooms south of the adjacent corridor, and burned through the windows in the south wall of the court or light shaft between this building and the Postal Telegraph Building. This court, which is shown but not marked in the floor plan, Figure 3, is 20x10 feet. The corresponding windows in most of the floors above were also burned out, and the flames emerging from them scorched the woodwork of the adjacent walls and windows of the Telegraph Building, and set fire to some of the upper rooms, which were saved without serious damage. Rather less damage was done by the flames in the thirteenth floor than in the other upper stories. A view in this story is shown in Figure 4, which is from a point looking southwest from a window in the west wall of the light court, at a place probably subjected to the maximum of heat from the flames of the corner building. This shows an apparently good condition of the face brickwork and the appearance of the window casings. The windows on the right are of office rooms, the contents of which were destroyed. Those upon the left open into the elevator shaft, through which the flames were driven across the corridor into the Postal Telegraph Building's court.

Throughout the burned portion of the building the double wood floors were in general burned in those rooms adjacent to the north court, and in some of the other rooms, but they were not burned in all of the rooms on the east,

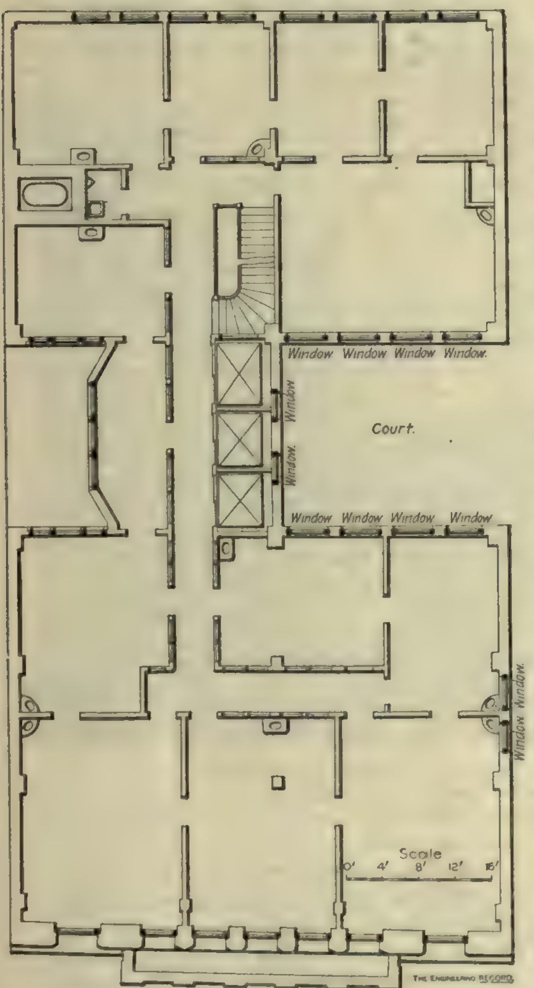


FIG. 3.—PLAN FROM NINTH FLOOR UP SHOWING LIGHT COURT.

FIG. 2.—THE HOME LIFE BUILDING AFTER THE FIRE.
[Into the light court shown the flames from the corner building were driven.]

south and west sides of the building. The solid parts of the partitions were built of 4-inch hollow porous terra cotta blocks, and the girder webs were protected by porous terra cotta blocks. The partitions in general stood well, except where weakened by the destruction of large areas of glazing and the wooden trim and doors. Most of the floors were deeply covered with débris, some of which was still in flames when inspected, so that it was difficult to ascertain accurately the condition of the floors or how much of the partition work had been destroyed by the firemen. Most of the plaster had disappeared from the walls and ceilings, and much of the inside brick work was loose. In the tenth story the partition wall on the west side of the west corridor was intact, and the public toilet rooms beyond were uninjured, although the adjacent rooms surrounding the court were burned out. The contents of the sixteenth story were destroyed, but the tower above had sustained no apparent injury. In the fifteenth story one of the floor arches had fallen for a length of about 20 feet. A curious freak of the flames was noticed in an oak door between two rooms on the west face of the building. The contents of the northern room were nearly all consumed, and the door was charred half-way through, while the south side of the door appeared uninjured, except for a portion of one of the top panels that was burned through, and the contents of the room on that side were uninjured. A view in the east part of the fifteenth story is shown in Figure 5, which is taken looking northeast. The buckled top flange of a plate girder is shown in the foreground, with shattered exterior marble work above it. The hollow block partitions at the left are practically intact. The door in this partition was burned out, and the contents and woodwork of the rooms on each side of it were destroyed. In the partition is shown a portion of one side of a riveted steel column, from the face of which several of the wide, thin, furring blocks have fallen, and are seen in the débris below. The remaining blocks at the bottom are ready to fall, and are wedged out by a piece of brick shown at the top.

On the eleventh floor two safes had been tipped over on their sides, but had not broken through the hollow tile floor. In the east side of the tenth story, a safe about 3x4x6 feet had gone through the floor between the beams without apparent injury to the latter, and had fallen on one corner upon the ninth floor, where it broke out a section of the hollow tile arch about 5 feet long. The safe carried down the archwork in the tenth floor, but itself stopped on the ninth floor, which it broke but did not pass.

A view in the east side of the twelfth story, looking west, is shown in Figure 6. The partition wall of expanded metal framework in the foreground is still standing, though its bottom support has been burned out. As is customary in buildings of this class, where floors are divided to suit the convenience of tenants, some of the partitions were apparently set indiscriminately on top of the floor boards, and were lightly secured to them and the ceiling above after the building had been practically completed. The burning of floor boards therefore added to the instability of these partitions. In the northeast corner of this story, some partitions, 2 inches thick, made with plaster or cement on a framework of expanded metal and small angles lightly secured to the floor and ceiling, although badly distorted, were effective and remained standing as shown. In these rooms a small interior closet, having three sides and a top, was made of the same construction, and, although torn out and knocked over during the fire, was found on the floor, its original shape retained, like a three-sided box. One corner of this closet is shown at the left in this figure. In the background is a hollow tile partition with some of the plaster adhering to it, and through the dark open doorway is faintly seen the window in the west wall of the court. These rooms were in a hot part of the fire and their contents were destroyed.

FIG. 4.—VIEW OF THE COURT AT THE THIRTEENTH STORY.

The white marble front wall was badly cracked and spalled by the heat of the flames sucking outward and upward through the windows after the different stories had been set on fire through the court windows. Much of the balcony and cornice and other ornamental marble work on the Broadway front fell to the street, and more was left unsafe and had to be dislodged. The 12-inch one-story marble columns in the front of the fourteenth story were cracked and shattered to destruction by the flames, so that it was necessary to support them and the cornice above by timber shores as soon as the building could be entered. Figure 7 is a view

FIG. 5.—VIEW IN THE EAST PART OF THE FIFTEENTH STORY.

in the southeast part of this story, looking northeast toward the ornamental exterior marble columns. Nearly all of one column is shown in the picture, and a portion of an adjacent one is seen at the right partly obscured by one of the timber shores supporting the cornice above. On the left is seen a portion of the exterior marble wall at the window casing, the surface of which is cracked and broken off. The brick rear, side and court walls endured well, although some cracks and distortions were observed. The iron and steel framework of the elevator shaft appeared in most places to have endured remarkably well, although considerably distorted at some points. As far as could be determined in the darkness and confusion, the iron stairways were uninjured.

The building was of steel cage construction, with riveted columns and flat arch floors. The front wall, however, was self-sustaining and independent of the framework, except as attached to it by lateral anchors. The walls were lined and the columns encased with 2-inch porous terra cotta ribbed furring blocks, which, with few exceptions, remained in position throughout the fire. The lower flanges of the main girders where they projected through the ceilings, and the solid-web knee-bracket wind braces between columns and girders, were protected by plaster or cement on wire cloth wrapped around them, and this in general was not destroyed, although in places it was noticed hanging so as to expose the steel surface. In a few places the blocks had fallen from the columns, exposing their vertical faces, which did not appear, however, to have been injured. In the fifteenth floor a line of deep plate girders near the Broadway front, and parallel to it, projected several inches above the floor line, and had apparently been boxed in with a wooden cover, forming a step, but without fireproofing to protect them. They were found exposed and considerably buckled and deflected, although still performing their service in apparent safety.

Below the eighth story there was no direct damage from the flames. Throughout the corridors and around the stairs and elevator shafts great quantities of water poured down to the basement, and the leakage through the floors damaged the lower stories in a proportion decreasing toward the ground, but no structural damage is apparent below the eighth floor. Up to the sixth floor, the north court was shielded by the south wall of the Rogers, Peet & Co. Building, which is still standing. Above that point, it was exposed to the full intensity of the flames, and two or three of the lower horizontal steel struts connecting the east and west wings across the north end of the court at every second story are considerably bent and distorted, although still in position. The upper ones are hardly injured. With these exceptions, and that of the iron window frames exposed to the flames, no material injury was evident to the main structure or the steel framework.

The floors consisted of transverse and diagonal matched boards nailed to wood strips on top of the steel beams, between which there was an open-air space several inches deep under the floor boards and over the arches. Throughout the building the floors were hard-burned hollow-tile flat arches, side construction with protecting skewbacks. These spaces were divided by concrete stops at intervals, built up solid from the arch to the floor board, which evidently in many cases prevented the burning of the floor through to the southern side of the building. The rooms shown adjacent to the large court and three corridors, and in some cases the rooms at the northeast corner on the

FIG. 7.—VIEW IN THE SOUTHEAST PART OF THE FOURTEENTH STORY.

Broadway front of the building, were most damaged.

At the west end of the main corridor there was a vertical stand-pipe extending through the entire height of the building and connected to the roof tank. In each story this pipe was provided with a valve, a quantity of hose pipe and a nozzle, and while the fire was in progress water from it was used by the firemen, under tank pressure, in every corridor to which they could obtain access. It is stated that eventually the leakage from the upper stories filled the basement with water to such a depth as to put out the boiler fires and make it impossible to pump water to supply the roof tank during the latter part of the fire. One of the elevators was run for some time after the fire had entered the Home Building and was used by the firemen until its machinery was disabled by the flames.

The observations and evidence obtainable at this writing show well for the construction of the building. Notwithstanding the area of unprotected window glass, it withstood for a considerable time the intense heat from a fierce adjacent fire, aggravated by a strong wind concentrating the flames in the deep court. Finally, when it became impossible to prevent this exterior flame from destroying the combustible contents of the adjacent rooms, the hot interior fires of dry cabinet work, furniture and papers were confined to the stories in which they originated, and to some extent to the separate rooms of those stories. The stairways and corridors were not destroyed, and the transmission of fire seems to have been external rather than internal; that is, through the windows from the outside, from story to story. The essential structural members of the building were safely preserved, and the result of the fire was simply to burn separately the contents of different rooms which were more or less independently ignited. The building undoubtedly served as a barrier and checked the advance of the flames, which might otherwise have proved difficult or impossible to control, and if the windows had been protected with steel shutters, it is possible that the contents of the building would have been practically uninjured and the fire confined to the building in which it started. The work of the firemen was seriously handicapped by the inefficiency of their hose streams at a height above about 125 feet, and by the fact that they were driven out of the upper corridors and un-

FIG. 6.—VIEW IN THE EAST PART OF THE TWELFTH STORY.

able to operate there the fire streams provided by the stand-pipe system in the building. Notwithstanding these disadvantages, they succeeded in confining the fire to the upper part of the building and preventing its spread below the eighth floor, three stories above the top of the corner building and the top of the protecting wall.

Since the fire, the Warren Street wall of the corner building has been pulled down and only a small part of the Broadway front is shown in Figure 2, adjoining the Home Life Building. The south wall is shown in position protecting the light court up to the seventh story. This view, with the smaller building demolished, shows the location of the light court, into which the flames were driven by the gale and in which they were confined as in a great flue. The broken windows in the eighth and upper stories and the broken and discolored marble work on the front indicate approximately the areas of fiercest fire. The marble cornice over the fourteenth story is shown supported by wooden shores adjacent to the shattered columns.

The architects of the Home Insurance Building were N. Le Brun & Sons, of New York City. The steel work was furnished by J. B. & J. M. Cornell & Co. and the fireproofing, which was made of Raritan hard-burned hollow tile, was furnished by the Central Fireproofing Company. Mr. John Darragh was the contractor for the masonry, and Mr. John Downey was the general contractor.

FRANKLIN BRIDGE, FOREST PARK, ST. LOUIS, MO.

In May, 1897, Mr. John Dean, the Engineer of the Park Department of St. Louis, Mo., prepared a plan for a concrete arch bridge of 60 feet span for Forest Park, in that city. Mr. Dean had had considerable experience with concrete construction in Europe, where concrete is quite generally used, and his design called for concrete finish for the arch ring and ornamental spandrel walls, coping and balustrade. The Council had appropriated only $5,500, which, it was feared, was not sufficient to provide for the structure as designed; but the Park Commissioner, Mr. Franklin L. Ridgely, insisted that the characteristic features be retained. Mr. Dean sent his design to the Melan Arch Construction Company of New York. This company applied its system to Mr. Dean's design, inserting steel I-beams in the ring and reducing the thickness of the concrete. The saving in concrete resulted in the award of a contract, on September 20, 1887, to the Geisel Construction Company, for the work complete, exclusive of roadway and sidewalk pavements, at a price several hundred dollars less than the appropriation.

On October 8 the abutments were completed up to the springing lines. They were founded on a solid clay stratum. Delay in delivery of the steel beams prevented them from being set in place until November, after which the arch was closed in three days. The centers were carried on mud sills, and an opening of 30 feet was left to avoid trouble from driftwood, in case of high water. When the arch ring concrete had been advanced about 5 feet from each springing line, the centers were loaded at the crown with 36 barrels of cement, amounting to seven tons in weight, to prevent deformation. These were gradually removed as the construction of the ring advanced. The concrete for the foundations was made of one part Alpha Portland cement, three of sand and six of broken stone. For the arch ring, one part of Alsen's Portland cement, two and one-half of sand and four of broken stone, was used. For the spandrel and wing walls, one part of Alsen's, three of sand and five of broken stone. Star Stettin cement was used for the balustrade, mixed one to three with gravel or crushed granite, except for the balusters, for which a one to two mortar was used.

The coping and base of the balustrade were cast in place in wooden boxes. The top was cast elsewhere in wooden boxes, and set in place like a cut stone. The balusters were cast in one part iron molds or flasks. Three molds were used, and it took nearly two months to cast the 120 pieces required. All the exposed surfaces were coated with about one inch of 1 to 2 or 1 to 2½ mortar, put in place at the same time as the concrete, and rammed together. After the forms were removed, the exposed surfaces were rubbed down with a wooden float until fairly smooth, after which they were worked over with cork floats, using little mortar.

As shown in Figure 1, the bridge has a span of 60 feet, a rise of 15 feet 6 3/16 inches, a total length of 92 feet, and a width of abutments of 10 feet. The ring is 11 inches thick at the crown, increasing to 30 inches at the springing, and has, imbedded in the concrete, eleven 8-inch 18-pound steel I-beams, spliced at the crown and spaced 3 feet center to center. The bridge is 32 feet wide, with a roadway 24 feet and a sidewalk 6 feet wide. The intrados is a curve of three centers. Four elaborate hand wrought-iron lampposts are set on the parapets at the ends of the bridge. The bridge has been completed and in satisfactory service nearly a year. It was constructed under patents owned by the Melan Arch Construction Company, of 35 Nassau Street, New York City.

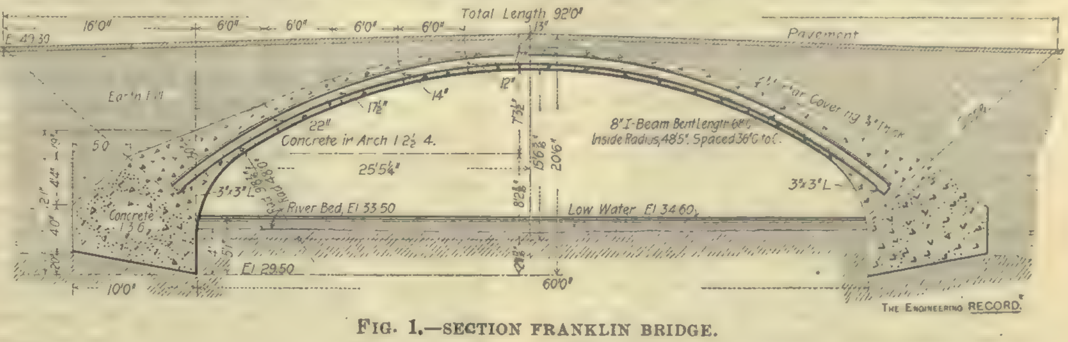


FIG. 1.—SECTION FRANKLIN BRIDGE.

A MELAN ARCH BRIDGE, FOREST PARK, ST. LOUIS, MO.

THE SAFETY OF THE BROOKLYN BRIDGE.

The recent publication of communications from Mr. Francis Collingwood and Col. Washington Roebling in the "Railroad Gazette" has produced such a state of unnecessary fear in the minds of New Yorkers concerning the safety of the Brooklyn Bridge that Mr. C. C. Martin, chief engineer and superintendent of the structure, has submitted the following report on the subject to Mr. John L. Shea, Commissioner of Bridges of New York City. It will be seen that it confirms Mr. Collingwood's statement, reprinted in "The Engineering Record" of November 26, that the bridge will carry safely any load that may come upon it. This statement, however, has never been disputed by engineers, for their criticism has been that long before the supporting strength of the cables was reached, the stiffening truss and perhaps some of the suspenders or diagonal stays would fail more or less, allowing the cables and roadways to move enough to produce a panic among the people on the bridge. The problem the management presents is not so much to keep the loads below the amount producing failure as to prevent distortions like those of July 29, which might cause a fatal stampede among the people on the structure. It is evident from the report which follows that the present condition of loading approaches the limit of safety of the stiffening trusses of the bridge, although not of the cables, and that Mayor Van Wyck and Commissioner Shea are fully justified in their earnest advocacy of another East River bridge near the existing one. The construction of such a bridge was urged in these columns several years ago.

The loads on the bridge at present are made up as follows:

The bridge railway trains are made up of four cars, a motor car, which, fully loaded, weighs 44 tons, and three passenger coaches, fully loaded weighing 28 tons each, making the total weight of a train 128 tons or 256,000 pounds. The trains run at 11.3 miles per hour, and if they run on 45 seconds headway they will be 748 feet apart from front to front. Hence the above load will be distributed over 748 feet, giving a load per lineal foot, for both tracks, of 690 pounds.

The trolley cars, loaded, each weigh 14 tons or 28,000 pounds, and are spaced 102 feet apart; hence this load, per lineal foot, is 550 pounds for both roadways. The load on the carriageways is taken to be two continuous lines of

trucks, one on each roadway, each truck occupying 20 feet and weighing 2.75 tons, 5½ tons on both roadways; hence the load from this source is 550 pounds per lineal foot.

The load on the promenade is taken at 50 pounds per square foot, although Mr. John A. Roebling says, in his original report of 1870, that 30 pounds per square foot is the maximum load of a moving mass of people. Since the promenade is 15 feet wide, the load due to this source is 750 pounds per lineal foot. The total moving load per lineal foot is therefore 2,540 pounds.

The length of the main span of the bridge, in the clear between towers, is 1,545 feet; hence the total moving load is 3,924,000 pounds, or 1,962 tons.

In 1892 the actual weight of the bridge superstructure, including cables and suspenders, was computed to be 5,828 tons. The additional dead load that has been added from time to time is as follows: Additional new track for bridge railway, additional hauling cables and supporting sheaves, electric feed wires and cables, trolley arms, telegraph and telephone wires and cables, trolley tracks and mail tubes, 430 tons. This makes the total dead weight and moving load 8,220 tons.

To obtain the strain in the cable produced by this load this weight must be multiplied by 1.7; the strain is thus found to be 13,974 tons. The ultimate strength of each cable is 12,300 tons, or the ultimate strength of the four cables is 49,200 tons. Divide this amount by the strain in the cable, and the factor of safety is found to be 3.52. That is to say that the whole strain, which is now 13,974 tons, must be increased by 35,226 tons to produce the strain of 49,200 tons, which is required to break the cables. Since the weight of the structure cannot be materially increased, the whole increase, if it comes at all, must come from the moving load; and, since that is 1,962 tons, it follows that the moving load must be increased the number of times found by dividing 35,226 by 1,962x1.7, which is 10½, before the limit of the strength of the cables is reached.

The elastic limit of the cables is two-thirds of the breaking strain, or 32,800 tons. The total moving load is 1,962 tons, and this would require to be increased 5.6 times in order to strain the cables even to their elastic limit, to which point the metal of the cables may be strained without injury.

With regard to the safety of the anchorages it is only necessary to say that during the first few years of the use of the bridge, both anchorages moved forward at the top about ⅝ inch, but there was no movement at the bottom. This movement was due without doubt to the compression or settling together of the timbers under the toe of the masonry of the anchorages. During the last eight years this movement has been about ⅛ inch at each anchorage; so that any strains that have been brought upon them up to this time have produced no injurious effect whatever, and it is not proposed to materially increase the loads on the bridge.

With regard to the eight saddles, careful measurements have been made from time to time, and the results show that within a year from the time the bridge was opened to public use, they had all moved toward the river about 4 inches. In the 14 years from 1884 to 1898 they had moved from 1 inch to 1¼ inches additional. There is nothing in this movement but what is normal and proper. In July last, when the outrageously unbalanced loading occurred, the saddles moved toward the river from ½ inch on some to 2½ inches on others. Those which moved forward at that time are all returning to their normal positions.

With regard to the movement of elevated railroad trains on the bridge, Mr. Martin states that the original schedule upon which they were run was approved by his department, and no change has since been made without proper sanction, and every direction from his office has been cheerfully carried out.

With regard to the trolley cars, soon after they entered upon the bridge a tendency was developed to run the cars nearer together than the 102 feet limit, which had been fixed as the distance apart they should run. Without delay the attention of the executive head of the associated trolley companies was called to the matter, and he at once increased the number of inspectors to five on each roadway; and that number were on duty when the buckling took place on July 29. How they came to allow the cars to run so close together as to form a continuous solid line from the point at which the obstruction occurred, near the Brooklyn tower, over the entire structure to the New York station, Mr. Martin cannot tell, unless their instructions were that they should not run closer to each other than 102 feet, and that they assumed that they might stand in solid line. Be that as it may, the bunching of the cars and the consequent buckling of the lower chord of some of the bridge trusses occurred. This did not in the slightest degree affect the strength or safety of the bridge.

In order to prevent absolutely the reoccurrence of such a condition of loading on the bridge, instructions were at once given to the inspectors that the cars were not to be allowed to approach each other nearer than 102 feet. In addition, the policemen on the bridge were instructed by the Police Department to aid in enforcing the rule for the trolley cars, and also to prevent bunching of teams on the bridge in case of blockades. Mr. Martin has not the slightest fear that any serious unbalancing of the loads on the bridge will hereafter occur. In his judgment the bridge is as safe to-day as it ever was, and that is equivalent to saying that it is absolutely safe; that no one need entertain for a moment any fears of its stability. The most careful inspection and supervision by his department of everything pertaining to the bridge has never been relaxed and will not be.

THE YIELD OF WELLS AND COLLECTING GALLERIES IN PERMEABLE SOILS.

[By James H. Fuertes, M. Am. Soc. C. E.]

There are many localities where a supply of water may be economically obtained from a permeable soil. Such supplies are frequently developed for cities or towns, and also for factories, stores or warehouses, which use large quantities of water for steam making, condensing or fire protection. This is particularly the case where water rates are high, as under some conditions a well may yield a large amount of water at a low cost, and, hence, may form an economical source of supply if the water is of suitable quality.

The probable yield of a proposed well may be estimated with a fair degree of closeness, although many complex conditions, dependent on the character of the soil, water and other factors, introduce numerous uncertainties. In the design of bridges and other similar structures, it is not allowable to depend upon the theoretical ultimate strength of the various members; it is customary to strain the members only a fractional part of what they might stand, in order to allow for unknown defects in the materials, unforeseen conditions of temperature and vibration, and for structural imperfections. In estimating the yield of a well, therefore, it should not be expected that a general formula will accurately give the absolute quantity of water which may be drawn from a particular soil. Such estimates must always be considered as merely aids to the judgment, and sufficient allowance should be made in all cases to provide for unforeseen, as well as foreseen, contingencies.

The yield of a permeable soil will depend on the local conditions of topography, on the rainfall over the tributary area, the character of the soil, the depth of the water-bearing stratum, and on the means used to collect the water. In permeable soils covering large areas, near the seashore or the shores of large lakes or tidal streams, the yield will be almost independent of the seasonal fluctuations of the rainfall, because the soil, in this case, may be regarded as a reservoir of enormous size, provided with a very large overflow channel, at the height of low tide in the case of a tidal water. The surface of the ground water under the southern part of Long Island slopes up from the sea on a grade varying from 2 feet per mile in dry to about 8 feet per mile in wet seasons, and wells sunk into the ground at some distance from the shore show consistently this change of level. In elevated locations, where the outlet is not into a large body of water with nearly constant level, but into a flashy stream, the ground water level, on the other hand, will be more or less influenced by both seasonal and local rainfall conditions. Generally speaking, ground water flows toward the water course rather than lengthwise of a valley. This is always true in a broad, sandy, lowland valley, but in a steep valley, with a coarse gravel subsoil, the ground water may flow parallel with the stream. The direction as well as velocity of flow may be determined by charging a few test holes with salt.

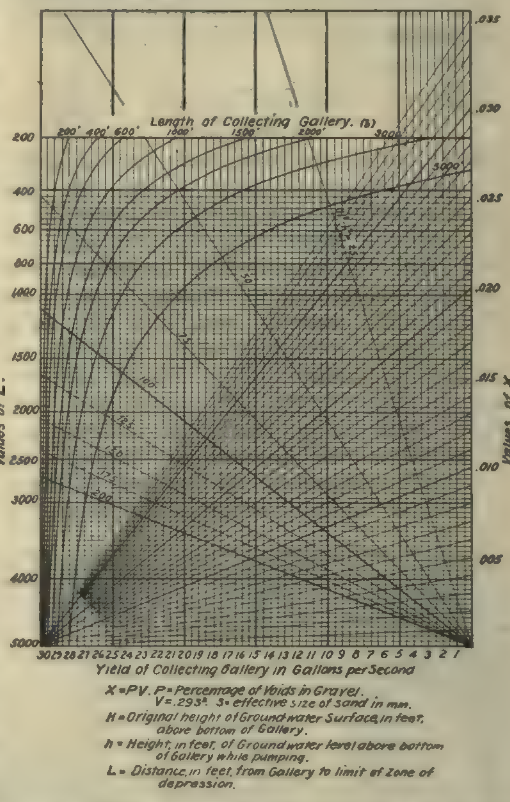


FIG 1.—DIAGRAM FOR DETERMINING THE YIELD OF A COLLECTING GALLERY.

The velocity with which ground water moves through sand and gravel depends upon the slope of the surface of the water, the size of the sand particles, the uniformity in size of grain, and the temperature. Darcy showed, as early as 1856, that, between quite wide limits, the velocity was proportional to the slope; and Hazen showed in 1892 that this was true for sands with an effective size, ranging from 0.01 to 3 millimeters, with uniformity coefficients under 5, while in coarse gravels the velocity was more nearly proportional to the square root of the head. He also showed that at freezing temperature the resistances were about double those at ordinary summer heat.

The theory of the movement of ground water was first thoroughly worked up by Thiem in 1870. Since then the subject has been more or less developed theoretically by Smreker, Oestern, Lueger, Thévenet, Kroeber, Soyka, Mancini and others. One of the most comprehensive discussions of the subject is given by Professor Frühling in the "Handbuch der Ingenieurwissenschaften." A brief study of two of the general formulas will give a clear insight

into some of the factors governing the yield of permeable soils.

The formula for the yield of a collecting gallery is $Q = X b (H^2 - h^2) \div L$.

The formula for the yield of a well is
$Q = 3.142 X (H^2 - h^2) \div \text{nat. log} (2R \div d)$.

Q = yield in gallons per second.

R or L = distance from well or gallery, in feet, to the approximate limit of the zone of depression.

H = height in feet from bottom of well or gallery to natural ground-water level.

h = height in feet from bottom of well or gallery to water level depressed by drawing the water out.

d = diameter of well in feet.

b = length of collecting gallery in feet.

X = PV. P = percentage of void in gravel; 30 to 40 in ordinary cases; in sands having a great variation in size of grain it may be as low as 20, while in very uniform, sharp sands it may reach 45 as a maximum. V = the coefficient of velocity of flow of the water in the sand. From a study of many data, its value has been deduced to be about $0.29 S^2$ where S is the effective size of sand or gravel in millimeters; it is assumed that the temperature does not vary much from 50 degrees Fahrenheit.

The formula for the yield of a collecting gallery is plotted in Figure 1, and that for the yield of a well in Figure 2.

It will be seen that in both of these formulas the yield will increase in proportion to the square of the effective size of the sand grain. The yield will also be greater in sands very uniform in size of grain than in mixed sands. If the limits of the zone of depression are not increased the yield will increase as the well is drawn down; or, if the water is pumped out of a well till the surface sinks to a certain point, and if this surface is then maintained at a constant elevation by pumping, the yield will gradually decrease to a fixed amount as the cone of depression spreads over greater territory. In the collecting gallery the yield increases in direct proportion to its length, while in the case

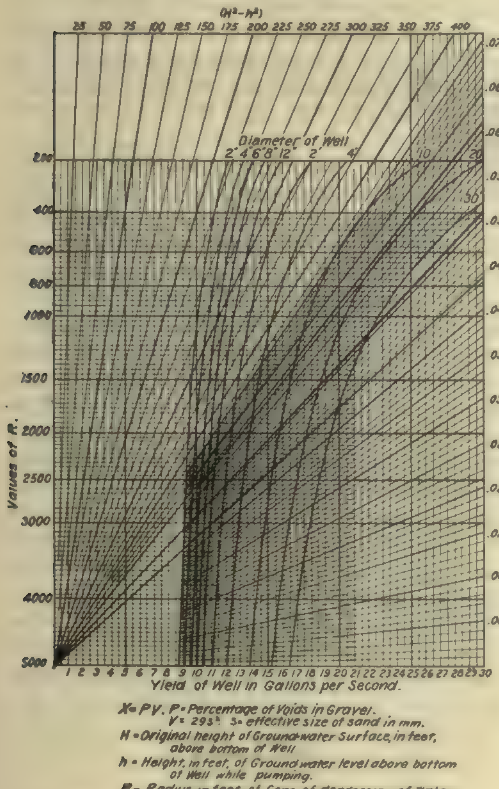


FIG. 2.—DIAGRAM FOR DETERMINING YIELD OF A WELL.

of a well the yield increases somewhat with the increase of the diameter, but not so rapidly.

As an example of the use of the diagrams, suppose we have a collecting gallery 1,000 feet long and we find that H = 12 feet, h = 2 feet, P = 0.3 and S = 0.4 millimeter, and assume R = 1,000 feet. X = PV = 0.014.

Begin at the left edge of Figure 1 at L = 1,000; go to the right to the curve marked b = 1,000; then go vertically down the inclined line X = 0.014; then go horizontally to the inclined line $H^2 - h^2 = 140$, and then vertically down to the bottom of the diagram and read the yield, 1.96 gallons per second. This is the quantity of water which will flow into the gallery from both sides, but as it also flows toward the ends of the gallery the true yield would be the above quantity, increased by the yield of a well of a diameter equal to width of the gallery. Suppose, in the present case, the gallery is 12 inches wide; the yield of a 12-inch well can be taken from Figure 2 as follows: Begin at the left edge of the diagram at R = 1,000; go to the right to the curve marked d = 12 inches; then go vertically down to the inclined line, X = 0.014; then horizontally to the left to the inclined line $H^2 - h^2 = 140$; then vertically down to the bottom of the diagram and read the yield, 0.84 gallons per second. The total yield of the gallery would therefore be 1.96 + 0.84 = 2.80 gallons per second. This illustration indicates the principles involved in the uses of the diagrams.

In the formulas X was determined as follows. According to Darcy and later writers: C = Vf where f is the fall in unit distance. According to Hazen, $C = 1{,}000 S^2 f$ where C is the velocity in meters per day; S is the effective size of sand grain in millimeters and f is the fall in unit distance. Therefore $1{,}000 S^2 f = Vf$ and $V = 1{,}000 S^2$; this, reduced to the basis of gallons per second, instead of cubic meters per day, gives $V = 0.29 S^2$.

Since the yield of the well varies directly with the value of X, i. e. with V, which varies with the square of the effective size of the sand grains, it is quite necessary, for careful estimates, that V be determined as accurately as possible. The experiments made at Malden, Mass., by J. C. Hoadley, indicated a value for X of 0.0115. The writer found it at Princeton to be 0.014 to 0.016. At Mannheim, Smreker found it to vary from 0.0411 to 0.062, and Thiem found it at Stralsund to be 0.123, while at Linz its value ranged from 0.079 to 0.175, according to the rate of pumping.

A comparatively small variation in the effective size of the sand will, as has already been mentioned, cause a considerable variation in the value of X. Thus, if P be taken at 0.30, and S be made successively 0.1, 0.3, 0.5, 0.7, 1.0, 1.2, and 1.4 millimeters, X will become, respectively 0.00087, 0.00783, 0.02175, 0.0426, 0.0870, 0.1251, and 0.1704. The value of X may be taken from Figure 3, by inspection, for various values of S and P.

From a series of test holes, analyses of the sand and gravel will give the factors for determining both V and P. A series of observations and a knowledge of the geological and topographical conditions will permit the determination of H; and a study of the various collateral considerations will determine h. This gives values to all the unknown factors except R, which may be determined approximately. Suppose, for instance, a 2-inch test well is driven in the ground, and it is found that H = 12 feet, S = 0.4 millimeter; P = 0.3, and when the water is drawn down so that h = 4 feet, the well yields on a continuous test 0.54 gallon per second. From Figure 3 X = 0.014, and from Figure 2 R = 3,000 feet. This value may be used for larger wells without serious error. Suppose, for instance, the comparative yield of a well 10 feet in diameter is desired, the other conditions being as above, except R, which will be assumed to vary as follows:

R = 1,500 ft.	3,000 ft.	5,000 ft.
Q = 0.97 gal.	0.88 gal.	0.82 gal.

It is thus seen that an error of 333 per cent. in the assumption of R, in the example given, causes an error of but 16 per cent.

Another important point noticeably shown by the diagrams is that the yield of a well, other things being equal, is only slightly influenced by its diameter. Thus, take all the conditions as given above, assume R = 3,000 feet, and vary the diameter successively as follows:

Diameter, ins....	2	6	12	24	120	240	360
Discharge, gals..	0.54	0.60	0.66	0.70	0.87	0 99	1.08

This shows the yield of a 2-inch well, under the conditions assumed, to be about one-half that of the 30-foot well. The greatest factors in the yield of a well are the depth of the water-bearing stratum and the depth to which the

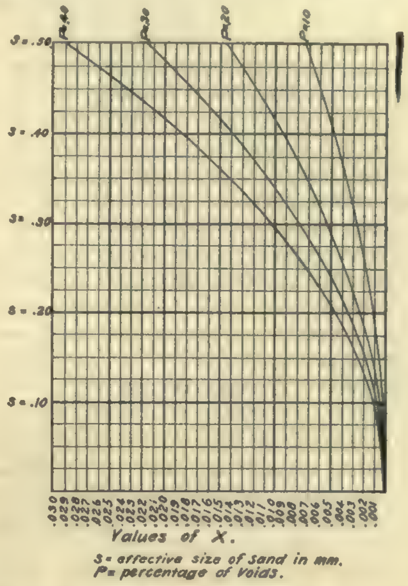


FIG. 3.—DIAGRAM FOR DETERMINING THE VALUE OF X TO BE USED IN FIGS. 1 AND 2.

water is drawn down by pumping. This is well illustrated by the following example: Assume a well 8 inches diameter; H = 30 feet; X = 0.014; R = 3,000; and then vary h, with the following results:

h = 28	26	24	22	20	18	16	14
Q = 0.70	1.00	1 30	1.70	2 0	2.3	2.7	3.0

Thus, in the case given, the yield, when the water level is drawn down 16 feet at the well, is three times as much as when it was drawn down 4 feet.

Aside from these theoretical considerations, there are other factors which influence the yield of a well. While the percentage of voids is about the same in nearly all permeable soils and sands, the amount of water that may be abstracted from such will be much less in very fine sands than in coarse ones. For instance, although a clay may contain as much as 60 per cent. or more of moisture, the particles are so fine that surface adhesion, or capillarity, will make it impossible for the water to flow through the mass, and hence a well sunk into such material would yield no water. In fairly permeable soils, having 30 to 40 per cent. of voids, surface adhesion will hold back from a third to a half of the water content; as a general average the amount of water which may be abstracted from a soil will approximate 20 per cent. of the wetted volume of the material. These considerations indicate that the factor X is not a constant for a given soil, but will probably be slightly larger for slow rates of pumping than for rapid rates.

The following table, showing the results of the test well pumping at Linz, Germany, bears out this deduction:

Water level reduced.	Gallons per second pumped.	X
2 feet	9.1	0.175
4 "	12.1	0.120
6.6 "	15.2	0.097
11 "	18 2	0.079

It is much to be regretted that there is such a scarcity of recorded tests by which the reliability of the foregoing formulas can be determined. The writer recently embraced the opportunity of making some observations for this purpose at the Princeton, N. J., water-works. The plant, at that time, consisted of two wells, each 25 feet in diameter, about 625 feet apart, sunk to bed rock and coupled together by a 6-inch siphon. From the daily pumping rec-

ords, corrected for slip, and from the records of the depth of water in the well, both covering the dry seasons of two years, the yield of the wells, when $H^2 - h^2$ was about 140, was quite reliably ascertained to be 6,000 gallons per hour per well.

A mechanical analysis of the gravel subsoil showed the sand, excluding stones over half an inch in diameter, to have an effective size of 0.43 millimeter, with a uniformity coefficient of about 3. The gravel contained about 40 per cent. of voids, and assuming $P = 0.3$, it is seen from Figure 3 that $X = 0.016$; from Figure 2, assuming $R = 1,000$, which was as near as it could be estimated from the data at hand, $Q =$ 1.6 gallons per second = 5,760 gallons per hour. Before these works were built, many test wells, yielding from 25 to 30 gallons per minute each, were sunk in different parts of the valley. The complete records of these tests are not available, but assuming $H^2 - h^2$ to vary from 72 to 156, the greatest probable difference in values, they would yield from 23 to 50 gallons per minute each. When $H^2 - h^2 = 100$ the yield would be about 30 gallons.

The foregoing formulas are only strictly applicable to cases where the wells are sunk to bed rock, and the water surface is free to rise and fall in the gravel. When the well does not go to bed rock, but also receives water through its bottom, the yield will be greater than the formulas indicate, in case H and h are measured from the bottom of the well. In artesian wells the yield will vary in direct proportion with the thickness of the water-bearing stratum and the amount the water level in the well is drawn down by pumping. The formulas also assume that the water level in the ground before pumping is commenced is a horizontal plane. Since the natural fall of the water surface is generally quite small, its effect on the yield of the well may be shown to be so small that it may be neglected. The effect of the natural slope of the ground water surface on the distances from the well or gallery, to which such surface will be affected by pumping is, however, very marked. The ground-water level is always lowered much more on the up-stream side, in proportion to the distance from the plant, than it is at the sides or on the down-stream side. The lowering also reaches to much greater distances up-stream than in other directions. By making the formulas fit general cases it is possible to estimate the amount of lowering at any point, and thus to determine, for instance, the distance which a well must be placed from the bank of a stream or other body of water to insure that no water from it may be drawn into the well under maximum conditions of pumping. It is also possible to investigate the probable lowering of the ground water at various points as to the effect of the pumping at the wells on the flow of adjacent streams, or the yield of adjacent wells.

One sees many blunders and examples of how not to do in efforts at increasing the yield of existing ground-water supplies. The writer recalls a case in a Western town of some size which may serve as an example. This city had a supply derived from an open well 25 feet in diameter, sunk by the bank of a small river. The whole country was underlaid with coarse sand, and ground water could be had anywhere by driving a well. The water company found that their well would not supply enough water to meet the demand of the rapidly growing city, and, to secure more, had a second well, 50 feet in diameter, dug close to the old one. The new well cost about $7,000, including the connections, and, of course, gave them very little more water than the old one. Not long afterward the company went into the hands of a receiver; and later, under a reorganization, the entire plant was abandoned and a new one was constructed on the gang well plan at a different site, from which an abundance of water was furnished.

In a small Eastern town the supply is from a well about 25 feet in diameter, and to increase this supply a series of 2-inch wells were driven down into the gravel and connected with a 6-inch suction main. The wells extended about 700 feet from the central station, on a line straight towards the highland from which the ground water was derived. The only effect of the driven wells was to lower the ground-water level on that side and consequently reduce the yield of the large well by about the amount of the yield of the small ones. The company found that the new plan did not materially increase the yield of their station, yet the little pump was kept working for some years.

RECENT TECHNICAL BOOKS.

It is hardly correct to class Mr. William J. Clark's "Commercial Cuba" as a technical book, yet this octavo volume of over 500 pages, published by Charles Scribner's Sons at $4, will prove of undoubted value to many technical men and manufacturing firms. The interest in the possibilities of the island under a stable, honest government, which has been aroused in this country recently, makes such a book of particular value. It gives the results of the author's travels and of his laborious collection and classification of material from many sources; just the information necessary before beginning the reconstruction of the resources of Cuba, for it must not be thought that this work of rehabilitation will be done under the conditions to which American business men are familiar. On the contrary, the island is the land of "mañana," the home of people whose characteristics are the reverse of those of this country, and a knowledge of those characteristics and a respect for the local customs are essential for any commercial success. The author's well-known position in the world of business gives him a quick apprehension of the facts which will be of interest to those who are looking for openings in the island, and his book will appeal to them with all the force of a well-presented financial report. Everything is developed like minute traveling orders for a skillful salesman. First comes a description of the peculiarities of the people, from their addiction to soft drinks to the use of silk hats among professional men. These things are not such trifles there as they are in this country, for the Cubans dearly love etiquette and formality, and failure to recognize this will be a stumbling block in the way of business success. The next section of the book is a general statement of the climate, geography, ways of communication, financial affairs, laws and productions of the island, and must have required much labor and time in its preparation. The chapters on currency, banking and legal systems will probably surprise many readers, for they reveal some of the heavy obstacles to be overcome before Cuban affairs rest on a sound basis. The volume closes with chapters on the particular resources of each of the eight provinces and of the city of Havana. It admirably fulfills its sub-title, "a book for business men," and should be read by everyone who wishes to understand what are the commercial possibilities of the island.

Every engineer and architect wishes at times to know how some of the materials he has to employ are manufactured. Cement, metals, glass and some other things he understands, but there are many others used less frequently which it is interesting to know about. Dr. F. H. Thorp, of the Massachusetts Institute of Technology, has supplied information about the manufacture of most chemical products in an octavo book of about 540 pages, entitled "Outlines of Industrial Chemistry," published at $3.50 by the Macmillan Company, New York. The subject of metallurgy is entirely omitted, and that of coal-tar colors condensed into a few pages, as these are distinct specialties, but outside these subjects there is hardly any branch of chemical technology which is not referred to more or less fully. Fuels, water, acids, alkalies, fertilizers, cements, glass and pottery, pigments, oils, soap, resins, starch, explosives, beer and wine, dyeing, paper-making and tanning are among the main heads of the book and serve to show its character. None of the special descriptions are more than outlines, for extended treatment is out of the question in such a volume, but the book gives in handy form the elementary information concerning various branches of the chemical industry which an engineer frequently wishes to have.

A comprehensive book on the design, construction and maintenance of sewerage systems has long been needed in the United States. There are a number of works on special features of the general subject of sewerage, but no American volume discussing it as a whole. Accordingly, Mr. A. Prescott Folwell, M. Am. Soc. C. E., has an open field for his "Sewerage," an octavo book of nearly 400 pages, published at $3 by John Wiley & Sons, but even were there competitors they would have to be pretty good to equal this work. There are occasional statements which do not agree with the opinions of "The Engineering Record," as is bound to be the case in a book on a subject where individual judgment must decide many questions, but the work as a whole is praiseworthy. It is divided into three parts, on designing, construction and maintenance, respectively. The first has chapters on the various systems of sewerage and sewage disposal, the amount of sewage and the flow in sewers, flushing, ventilation, preliminary engineering, designing, details, specifications and estimates. The second part describes the preliminaries before construction, laying out, supervision, measurement and methods of work. The third part is a brief statement of the elements of plumbing and maintenance. There are many valuable tables in the book, and it is liberally illustrated.

A number of years ago an issue of the "Technic" contained a paper by Professor C. D. Jameson, M. Am. Soc. C. E., then professor of engineering at the State University of Iowa, on the subject of Portland cement. It was favorably received at the time, and has recently been brought out as a 200-page octavo book, sold at $1.50 by the D. Van Nostrand Company, New York.

Readers of "The Engineering Record" will doubtless recall the series of articles by Mr. Charles H. Wright on the design of draw or rotating bridges which were printed in its columns about a year ago. These now appear, with much more material, in a 300-page octavo volume entitled "The Designing of Draw-Spans," which discusses both plate-girder and truss bridges in a thorough manner, a large number of cuts and folding plates making the text clear on topics requiring illustration. The opinion this journal has of the value of the book is best shown by the fact that portions of it have already appeared in its pages. The scope of the book includes the computation of stresses in draw spans, the special detailing such bridges require, and descriptions of the rotating and locking devices used on a large number of structures. It was pointed out in the issue of April 2 that drawbridge design was not entirely satisfactory, and that article should be borne in mind in reading Mr. Wright's book. It is published by John Wiley & Sons at $3.50.

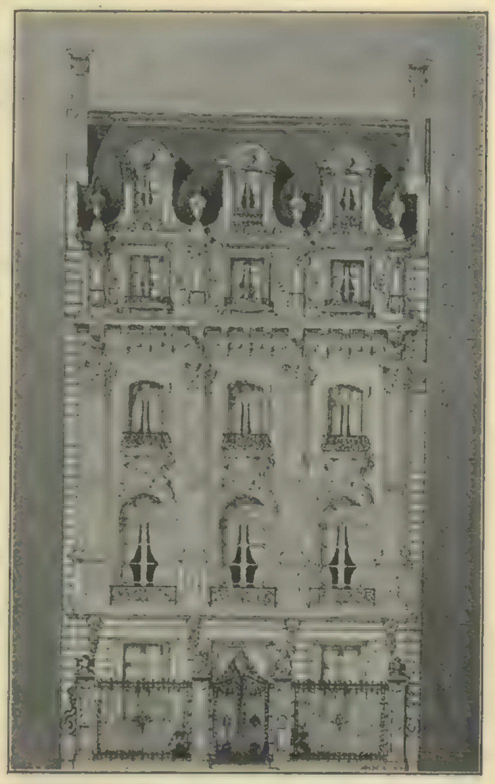
Special Assessments in Kentucky are governed by laws which differ widely from those of most States. A recent decision of the Supreme Court of that State, 47 S. W. Rep. 608, reads: "Where the cost of making sidewalks in some blocks is twice as much per yard as that of making such improvements in front of other blocks, it is improper to assess the cost against abutting property at an average price per yard for the entire length of the street."

PNEUMATIC CAISSON FOUNDATIONS FOR A RESIDENCE.

Although pneumatic caisson foundations have been used for years in bridge work, and have been adopted lately for several tall office buildings in New York City, the local conditions, weight of superstructure, and nature of the site, have not made it necessary to use them for private residences. There is now under construction in East Sixty-second Street, near Fifth Avenue, in the Borough of Manhattan, an expensive residence for Mrs. E. C. Fabbri, and the use of pneumatic caisson foundations there is believed to be the first application of this principle to residence work. The work is of interest on account of the conditions involved, and for the reason that some of the features of design and construction comprehend decided modifications of former practice, which will doubtless influence the conduct of future work of this class on lines somewhat different from those that have hitherto governed.

It was required to construct a costly residence, 45½ feet front, 84 feet in depth and seven stories or 80 feet in height above the curb, in a fashionable locality between two valuable houses which extend to the lot line on each side and are now occupied. Nearly all of the lot is covered by the structure. Most of the site was occupied by buildings with cellars 10 feet below the curb. Below the cellar floor there was a rock fill 10 to 20 feet deep, upon which the foundations of the former buildings had rested. The lot had evidently been filled in up to grade after the construction of those buildings. This rock fill was deposited on a stratum below water level of mud and clay from 4 to 10 feet thick, which filled the bed of an ancient water course, shown on old maps. This mud was of variable consistency, almost liquid in some places and quite hard and lumpy in others, but so soft and yielding in general that a considerable portion of the rock fill had sunk 2 or 3 feet into it. Below the mud irregular deposits of quicksand, hard pan and boulder clay extended to a stratum of decomposed mica schist 40 to 50 feet below the curb. This stratum was from 4 to 6 feet thick and overlaid a stratum of hard gneiss. The gneiss was found to be hard and sound, nearly level east and west, and smooth, and was considered to have a bearing strength equal to granite. The excavation for the cellar of the new structure was carried down in the rock fill to about ground water level, 18 feet below the curb. The rock fill contained some earth, old metal, wood, etc.; it had insufficient bearing capacity, and was otherwise unsuitable to receive foundations. The test boring indications, confirmed by subsequent developments, showed that there was great lack of uniformity in the clay stratum, and the occurence of quicksand, boulders, hard and soft clay, and large quantities of water, was so irregular as to make an unsuitable surface for grillage foundations above the mica schist. It was difficult to drive piles among the loose boulders, and the use of a pile-driver might have damaged the adjacent heavy buildings. The quicksand and the flowing water made open excavation impossible, and it would have been difficult to sink and maintain cofferdams for building foundation piers. The excavation of the main pit had proved very expensive, and it was finally determined to support the estimated weight of 4,000 tons of superstructure on pneumatic caissons, which were adopted reluctantly only after the architects and the consulting engineer were convinced that they were more reliable and economical than any other plan of substructure.

The necessity for carrying the foundations to bed rock was emphasized by the statement



THE FABBRI RESIDENCE.

that many of the large and handsome residences in the immediate vicinity have developed cracks through the large stones in their walls, and the apprehensions of trouble from subterranean waters were augmented by the fact that live gold fish had recently been taken from a similar excavation four blocks north. Special care was also requisite to avoid endangering the adjacent buildings, as the excavation of the cellar did not indicate the nature of the foundations for the party walls nor show to what depth they had been carried.

There are four longitudinal rows of riveted steel columns, supported on two rows of cylindrical caissons, as shown in the plan, Figure 1. The front wall, which is without columns, is supported on four deep rolled steel beams, 43½ feet long, carried on two caissons, 25 feet apart, and overhanging the centers of the caissons 9¼ feet at each end. The other six caissons are arranged in three transverse pairs, each 29¼ feet apart on centers. Each caisson supports a balanced double cantilever girder, about 16 feet long, which carries a column at each extremity. The inner ends of each pair of cantilevers are connected by a shallow plate girder, with its web in the vertical plane through the centers of the caissons and of the box girders. The middle top chord angles of the cantilever girders are spliced continuously to the connecting girder, and the lower chord of the connecting girder is heavily web and flange-spliced to the cantilever, as shown in the details, Figure 2, which also illustrate the drop shelf angle brackets used for connecting the rolled floor joists to the main girders. In the preliminary design the cantilevers were placed below the cellar floor level, but in order to reduce the danger of corrosion, prevent the collection of moisture, and make them readily accessible for inspection, painting, etc., they were raised above the floor level on brick piers, as shown in Figures 3 and 4. Above the cantilever girders the superstructure was of the ordinary steel cage construction, in which both the floors, roof, walls and partitions were supported by the columns, the metal work fire-proofed and the walls filled with brick and faced with marble in front.

The pneumatic caissons are circular, with comparatively small diameters, which enabled them to be exactly proportioned to the loads sustained, and make their pressure on a rock surface conformable to the bearing strength of the foundations and the masonry without involving a wasteful excess that would be produced by ordinary caissons. They were made of wood, instead of steel, as the use of wood promoted economy and rapidity of construction, and they were so designed that when completed the concrete filling formed a continuous monolith from the surface of the rock to the bottom of the brick pier, without the separation usually caused by permanently retaining the roof of the working chamber and the air shafts. Figure 5 shows the principal sections and elevations of a caisson, working chamber, cofferdam, air shaft and air lock, complete and being sunk. The caissons and cofferdam are substantially alike, except that the former was caulked airtight and has a steel cutting edge and a somewhat different arrangement of inner rings. Each substantially consists of a cylinder, 6 feet in internal diameter, made of first quality yellow pine staves, 3½ inches thick and 5½ inches wide, planed on all sides, having their inner and outer faces portions of the cylindrical surfaces, and cut to order from timber 4 inches thick and 6 inches wide. They were put together with white pine splines, one inch square, driven in every joint. These splines were at first painted with white lead, but after some experience were left unpainted to allow the moisture full opportunity for swelling the wood to make a tight joint. The staves

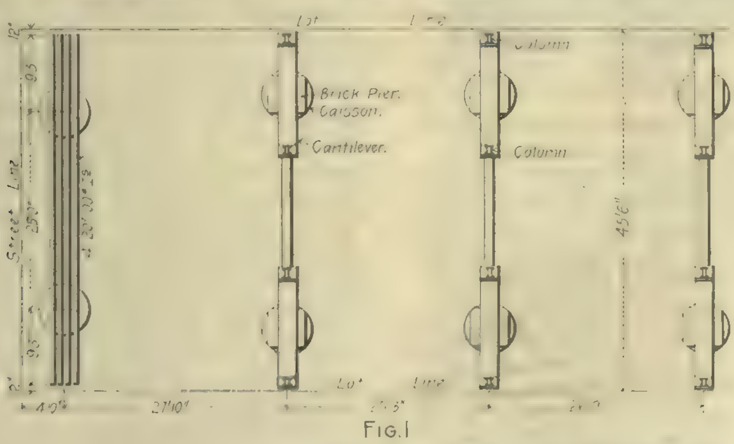


FIG. 1

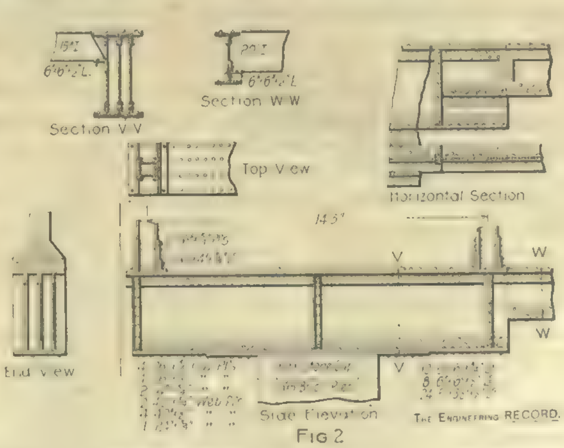


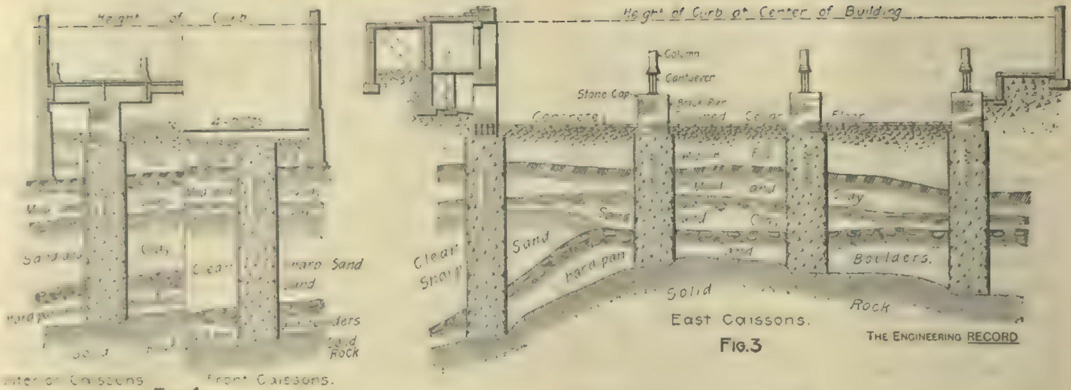
FIG 2

PNEUMATIC CAISSON FOUNDATIONS FOR A RESIDENCE.

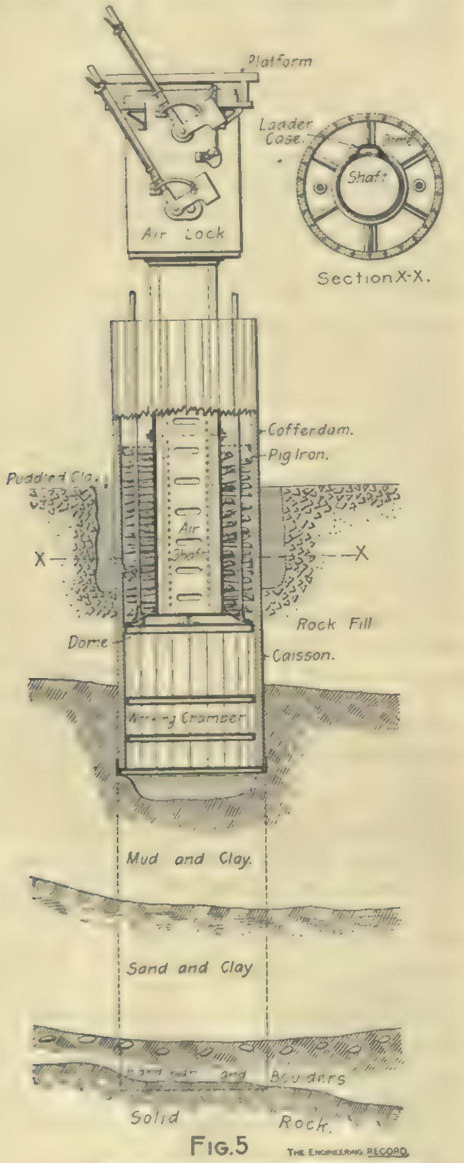
HAYDELL & SHEPARD, ARCHITECTS; GEORGE HILL, M. AM. SOC. C. E., CONSULTING ENGINEER; JOHN F. O'ROURKE, M. AM. SOC. C. E., ENGINEER AND CONTRACTOR FOR FOUNDATIONS.

were from 9 to 12 feet long, and were secured to inside V rings, welded, of 3x3x½-inch steel angles. Four of these rings were spaced as shown in Figure 5 in the caisson, and three were spaced at equal distances in each section of the cofferdam. The staves were connected to the rings by bolts in every fourth stave, and wood screws in the remaining staves. The bolts had countersunk heads on the outside of the cylinder. The screws had square heads bearing on the ring and did not quite penetrate the outer surface of the staves.

The cutting edge of the caisson was composed of a 9x¾-inch vertical steel plate, riveted to a 3x3-inch angle ring, 6 feet 8 inches in external diameter, the horizontal upper leg forming a shelf to receive the lower ends of the staves. The joint between the staves of the caisson and the lower section of the cofferdam, as well as the joints between adjacent sections of the cof-



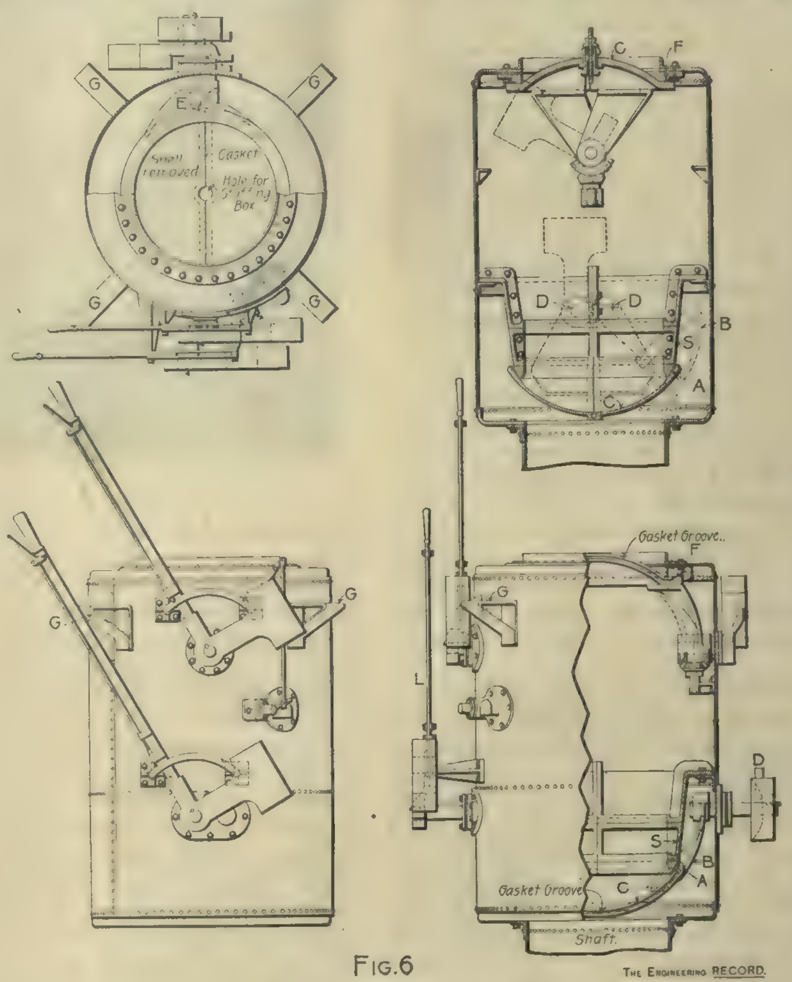
SECTIONS THROUGH FOUNDATIONS, FABBRI RESIDENCE.



SECTION AND ELEVATION OF A CAISSON.

ferdam, was made with inside rings of a 3x3-inch angle, to the flanges of which the ends of the staves are secured by bolts and wood screws. The adjacent ends of the sections abut on a hemp gasket, and the vertical seams between the staves are calked with oakum in the air chamber. The roof of the working chamber is formed by a steel dome ½-inch thick, with radial angle iron stiffeners, made in two sections and bolted with a hemp gasket to the special inside angle ring, about 6½ feet above the cutting edge. The top of the dome is flattened, and has a hole 3 feet in diameter through its horizontal surface, corresponding with the opening in the steel air shaft, which is flange-bolted with a hemp gasket to the dome. Two oblique connections are also riveted to the shell of the dome to receive the 2-inch vertical pipe for air pressure and for the whistle and electric light wire pipe. The air shaft is made in 8-foot sections, flange-bolted and gasketed together and surmounted by a special air lock. The air shafts have outside ladder cases, covering the step holes, which are cut through the sides. Both shaft and lock are patented by Mr. John F. O'Rourke, M. Am. Soc. C. E.

The details of the lock are shown in Figure 6. It consists of a riveted steel cylinder, 5 feet in diameter and 7 feet in height, with a slightly conical sectional cast-iron sleeve inside, the lower edge of which provides a circular inclined surface, A, for the bearing of the lower door or valve, C. This valve is a segment of a sphere, and is made in two sections, each of which is pivoted by a curved arm, B, to an axis, D. The axis, D, for each valve section has a pinion keyed to it. These pinions engage, so that if either axis is revolved the other one must follow, and both valve sections are simultaneously closed or opened. The axes project on each side of the cylinder, and are each counter-weighted and fitted with a shank, D, to which the operating lever, L, may be attached on either side, as convenient. The top of the caisson is furnished with similar sectional domed valves, C, which, however, take a horizontal bearing against a circular seat, F. These valves are also mounted on curved arms, E, so as to revolve into the annular space outside of the central passage through the shaft and allow full clearance for a bucket of the full diameter of the shaft. These valves are operated by means of a miter gear, made like the lower pinions to engage both shafts and operate with an idler the two halves of the valves simultaneously. In the center of the valve a 4-inch hole receives a stuffing box, through which the hoisting line is freely rendered. This stuffing box is made with a rubber sleeve packing of some length, for its vertical spindle, and is released from the valve when the latter is opened. When the valve is closed with the bucket outside the stuffing box hole is closed by a dummy wooden cylinder with a similar sleeve. The two sections of each valve close together against a rubber gasket. All connections are flange-bolted to the air chamber. Brackets, G G, etc., are riveted to the outside of the lock to support a timber working platform on top, clear of the dome. All the shafts are set in stuffing boxes, and a light iron frame, omitted in Figure 6 to avoid confusion, is attached to the top of the shaft sleeve, S, as a guard to prevent the bucket from interfering with the mechanism and to serve as a ladder. The valves on this lock are carefully balanced, and are easily and quickly operated by one man. They may be opened and closed so as to require but 10 seconds for the passage of the bucket through, and 40 buckets of spoil have been hoisted through the lock in an hour. Cylindrical steel concrete buckets, of one-half-yard capacity, were used. They were made with a diameter of 33 inches,



DETAILS OF THE AIR LOCK.

and the hinged bottom was in one piece, secured by a rigid horizontal bolt, 1 inch square, which projected diametrically across the lower edge of the bucket and engaged a square hole in a vertical strap riveted to the outside of the bucket. In order to dump the bucket, a pointed bar was inserted under the vertical strip and easily wedged it out, releasing the bolt, when the bottom opened by gravity. When the bottom was closed, the bolt was automatically snapped into the catch. Twenty-four-inch buckets, of one-third-yard capacity, with fixed bottoms, were used for excavating.

The caisson pits, 9 feet in diameter, were dug about 4 feet below the water level. A steam pump, with 4-inch suction, served to lower the water 6 inches an hour. The caissons were set in the pits by boom derricks, and the annular spaces 1 foot wide around their bottoms were filled with puddled clay. Air pressure was then admitted and excavation begun in the working chamber. The caissons were sunk a maximum distance of about 8 feet through the rock fill, where the progress was extremely slow, as slight as 1 foot in 24 hours on some occasions. Below the rock fill better progress was made, 11 feet having been sunk in five hours. The average weight of a wooden caisson and cofferdam was 6,000 pounds, of the air shaft 4,000 pounds, of the lock and machinery 12,000 pounds, and to this was added about 30 tons of pig-iron, piled on the dome of the working chamber in the annular space between the air shaft and the cofferdam. The excavation in the clay had a diameter 6 inches less than that of the inside of the caisson, so that the cutting edge was always engaged in the clay and plowed down through the undisturbed material without breaking the seal of the working chamber. There were no projections on the exterior of the caisson and cofferdam, excepting the heads of rivets in the cutting edge, and as the grain of the wood was all vertical and the sides were well greased, it was thought that a considerable reduction in friction was gained over that usually developed by steel caissons. Considerable blasting was necessary in excavating in the working chamber, and this was usually done with light charges of dynamite, one-half a stick or less being used for a blast. About 300 yards of material were excavated from the caissons. There were three men at work in each caisson at one time, and they remained there for eight hours, with a half-hour intermission for meals. With three forces on duty eight hours each, work was continuously prosecuted.

After the rock surface had been leveled and cleaned, the concrete, made 1, 2 and 3, was well rammed under the sides of the caisson and for a depth of two or three feet, or above the top of the steel cutting edge inside. The top was leveled, smoothed and waterproofed by three thicknesses of heavy paper, continued up vertically for some distance on the inside of the caisson walls and laid in hot tar. More concrete was immediately rammed above the paper, which thus formed an impermeable protective diaphragm which was considered effective in preventing the upward percolation of water through the porous concrete mass. The maximum pressure was 16 pounds per square inch, which was maintained until after the working chamber was rammed full of concrete up to within one foot of the dome. After it had set about three hours, wooden blocks were driven between the top of the concrete and the dome, and allowed to remain for seven hours. Then the tops of the cofferdams were secured against any buoyant effect or upward bottom pressure by means of inclined shores taking bearing on the adjacent walls. The air pressure was relaxed, and the pig iron ballast, the air lock and the air shaft, weighing in all about 40 tons, were removed. Then the sectional dome which formed the roof of the working chamber was unbolted from the caisson ring and removed, thus leaving the interior of the caisson and the cofferdam entirely free except for the horizontal rings of angle iron. These served as keys to engage the concrete, which was then filled in up to the top of the cofferdam so as to form a continuous mass without intervening or separating members.

The concrete in the working chamber was made in the proportions of 1, 2 and 3, and that in the shaft above 1, 3 and 5, of Giant and Portland cement, Cow Bay sand and three-quarter-inch Clinton Point broken stone, which was preferred to the 2-inch stone ordinarily used on account of its greater uniformity and strength and the convenience in shoveling. The concrete

FIG. 7.—VIEW OF CAISSON PARTLY SUNK.

in the chambers was lowered through the locks in buckets and rammed to flush. The top was finished around the edges from a center well that was left to work in and was filled up the last thing before the workmen withdrew. When work was resumed after removing the dome, usually about 24 hours after placing the last concrete in the working chamber, it was always found that very little water had penetrated the cofferdam under the maximum head of about 30 feet. Sometimes not more than 6 inches was found on top of the concrete. This was pumped out and the concrete for the upper part of the pier was loaded into the half-yard buckets and swung by the derrick boom over the tops of the cofferdams, where it was dumped and fell to the bottom, each bucketful being spread out and rammed to make a layer about 12 inches thick. Thus a solid continuous mass of masonry was formed, that does not inclose any iron, timber or other foreign material, and is substantially integral with the footing in the working chamber. All trouble and uncertainty in the difficult matter of packing the concrete solidly against the underside of the caisson roof is avoided by this method, and the pier is made practically monolithic. A typical view of one of the caissons partly sunk is shown in Figure 7, made from a photograph taken September 13 last. Here the top of the caisson is shown ready to receive the first section of the cofferdam, and held in the required position in the loose rock by means of horizontal timbers framed around it. The air shaft and air lock rise above the top of the wooden cylinder, and are surmounted by a movable working platform on which several men are standing.

The sinking of the first caisson was begun September 14 last, and the last caisson was completed and its concrete filling finished October 16. The first two caissons sunk required a week each, because at that time the rock filling was wholly excavated in the air chamber, but the later ones were sunk more rapidly, as most of the filling had been previously removed. Although, usually, air pressure was on only one caisson at a time, another one was being made ready, and a third from which the pressure had been removed was being concreted simultaneously on some occasions. The principal difficulties arose from lack of space in the narrow lot, the limited street front of 45 feet for receiving and shipping materials, and the necessity of conducting the work without obstructing the street or disturbing the adjacent residents. Notwithstanding these difficulties and the troublesome nature of the soil, the details of the design were completed, the material ordered, caissons built, and work completed, within six weeks. A force of about 100 men, including the night gang, was employed. Steam was purchased from the New York Steam Company, and was supplemented by an additional supply from the contractors' hoisting engine boilers when the steam company's supply was interrupted by changes being made in its plant.

The principal plant used for the caisson work comprised two Lidgerwood two-drum hoisting engines, two 20 horse-power boilers, two Rand 12x16-inch duplex air compressors, one 6-foot air receiver 10 feet long, one 4-inch Cameron steam pump, one 3-inch steam injector, two O'Rourke air locks, fourteen lengths of shaft, 100 tons of pig iron ballast, two 10-ton stiff legged derricks with 30-foot masts and 40 and 56-foot booms, rigged with three part boom, and hoisting falls reeved with ⅞-inch wire rope. To the foot of each mast was attached a horizontal wheel about 6 feet in diameter, around which a ¾-inch wire rope was twice wrapped. One end of the rope was attached to one of the capstan heads of the hoisting engine and the other end to the other capstan head. Each capstan head was fitted with a special friction clutch and lever, designed by Mr. Samuel Mattson, by means of which it could be thrown in or out of gear without interfering with the use of the drum for hoisting or topping. In this manner the boom could be readily swung as desired by one man, a convenience and considerable saving of time. Messrs. Haydell & Shepard are the architects of the building; Mr. George Hill, M. Am. Soc. C. E., consulting engineer, and Mr. John F. O'Rourke, M. Am. Soc. C. E., the engineer and contractor for the foundations, to whom acknowledgement is made for data from which this description has been prepared.

MECHANICAL PLANT OF A MODERN COMMERCIAL BUILDING.

The mechanical plant of the new building on Washington Avenue, between Ninth and Tenth Streets, in St. Louis, Mo., was described in a paper by Mr. William H. Bryan before the New

York meeting of the American Society of Mechanical Engineers as an example of the best practice in that section of the country, and it was believed that in adaptability to somewhat peculiar conditions of service, and in low first cost, as well as low cost of operation and maintenance, the installation is at least interesting. Mr. Bryan's paper contained over 50 pages, and from it the following abstract has been prepared. The parts eliminated mainly describe details of design that are familiar to those readers of "The Engineering Record" who have followed its articles describing the mechanical features of similar buildings:

The building is of brick and stone construction, of the character known as "standard slow combustion." It is owned by the Commerce Realty Company, and the tenants are the Hargadine-McKittrick Dry Goods Company. Its ground space is 109 feet front by 225½ feet deep, and it is eight stories high, besides basement. The architects of the building were Messrs. Eames & Young, of St. Louis, who, at an early stage of the work, called into association with them as advisory and consulting engineers the firm of Bryan & Humphrey.

The total cost of building, including mechanical equipment, ready for the tenants' use, was $301,000, or 9.9 cents per gross cubic foot, and 13 cents per cubic foot heated. The cost named included $20,000 for the use of the party walls of the adjoining building, $10,000 for Luxfer prism glass, and $9,000 for a sprinkling system. The value of the ground was $200,000, making the total investment a trifle over $500,000. The fact that the installation was intended to be a model one produced unusual competition. The author thought, therefore, that the prices given in the paper should be used with caution, and from 10 to 20 per cent. added when making use of the figures in estimating similar work.

The Boiler Plant.—Steam was required in the building for three purposes: heating, lighting and elevator service. As shown later, the maximum amount of steam required for heating was about 250 boiler horse-power. Careful computations showed that more than this amount would be necessary for the lighting and elevator service, even with the most economical steam engines. The maximum electrical requirements are shown later herein to be about 150 kilowatts—exclusive of the elevators—or about 200 electrical horse-power. Assuming a combined efficiency of engine and dynamo unit, from steam cylinders to switchboard, of 80 per cent., the maximum indicated horse-power is 250. Using simple steam engines at a water rate of 40 pounds per indicated horse-power per hour, the steam requirements would be 10,000 pounds per hour. Or, for compound engines at 28 pounds of water per indicated horse-power per hour, 7,000. These being divided by 30 to reduce them to boiler horse-power give 333 for the former, and 233 for the latter. The boiler horse-power required to operate the elevators is shown later to be as follows:

For steam elev's, 67 i. h. p., at 100 lbs. water rate, ÷ 30.	223
For hyd. elev's, with simple duplex pumps, 75 i. h. p., at 100 ÷ 30	250
For hyd. elev's, with compound pumps, 75 i. h. p., at 60 ÷ 30	150
For hyd. elev's, with high duty pumps, 75 i. h. p., at 28 ÷ 30	70
For elec. elev's, with dynamos driven by simple engines, 75 i. h. p., at 40 ÷ 30	100
For elec. elev's, if driven by compound engines, 75 i. h. p., at 28 ÷ 30	70

The following table shows some of the combinations which were possible, all of which were under serious consideration. It will be seen that the maximum steam requirements for electrical and elevator service might vary all the way between 303 and 583 boiler horse-power.

	H. P.
Compound dynamo engines and electric elevators	303
Compound dynamo engines and hydraulic elevators, with high duty pumps	303
Compound dynamo engines and hydraulic elevators, compound pumps	383
Simple dynamo engines and electric elevators	433
Compound dynamo engines and steam elevators	456
Simple dynamo engines and hydraulic elevators, with compound pumps	483
Simple dynamo engines and steam elevators	556

Compound engines and electric elevators having been selected, requiring 303 boiler horse-power as already shown, it was thought safe to install three units of 150 horse-power each, two to do the ordinary maximum service. This was equivalent to 4,955 pounds of water per hour per boiler, from feed of 212 degrees Fahrenheit into steam of 125 pounds gauge pressure. The "O'Brien" water tube boiler, made in St. Louis, and in the main similar to the Heine boiler, was selected. Each boiler contained 1,411 square feet of heating surface, or 9.4 square feet per horse-power. The cost of the three boilers set up, including Hawley furnaces, brickwork, foundations and a quarter-inch steel smoke flue, 48 inches in diameter and 135 feet high, was $6,288, being $13.97 per horse-power, or $1.48 per square foot of heating surface. The water tube boilers and the heating were let to Kupferle Brothers' Manufacturing Company, of St. Louis, at the gross price of $16,511.

The lowest bid on high grade return tubular boilers of the same capacity was $5,997, being $3,397 for the boilers and $2,100 for the Hawley down-draught furnaces, and $500 for the brickwork. The four boilers aggregated 524 horse-power. The price quoted was, therefore, $11.44 per horse-power, or $0.95 per square foot heating surface.

Elevators.—Tests upon the tenants' old elevator plant showed that the passenger elevator was in actual motion 47 per cent. of the time, and freight elevators, 35 per cent. of the time. The loading on the passenger elevators was assumed to be 75 pounds per square foot of car. There were to be two passenger elevators, located in the southeast corner of the building, each to have a safe carrying capacity of 1,500 pounds of live load at a maximum speed of 300 feet per minute. The other six elevators were to carry freight only. Two were to have a capacity of 3,500 pounds at a speed of 225 feet. Four elevators were to carry 1,800 pounds at 150 feet. A dumb waiter was to be provided carrying 200 pounds 100 feet per minute.

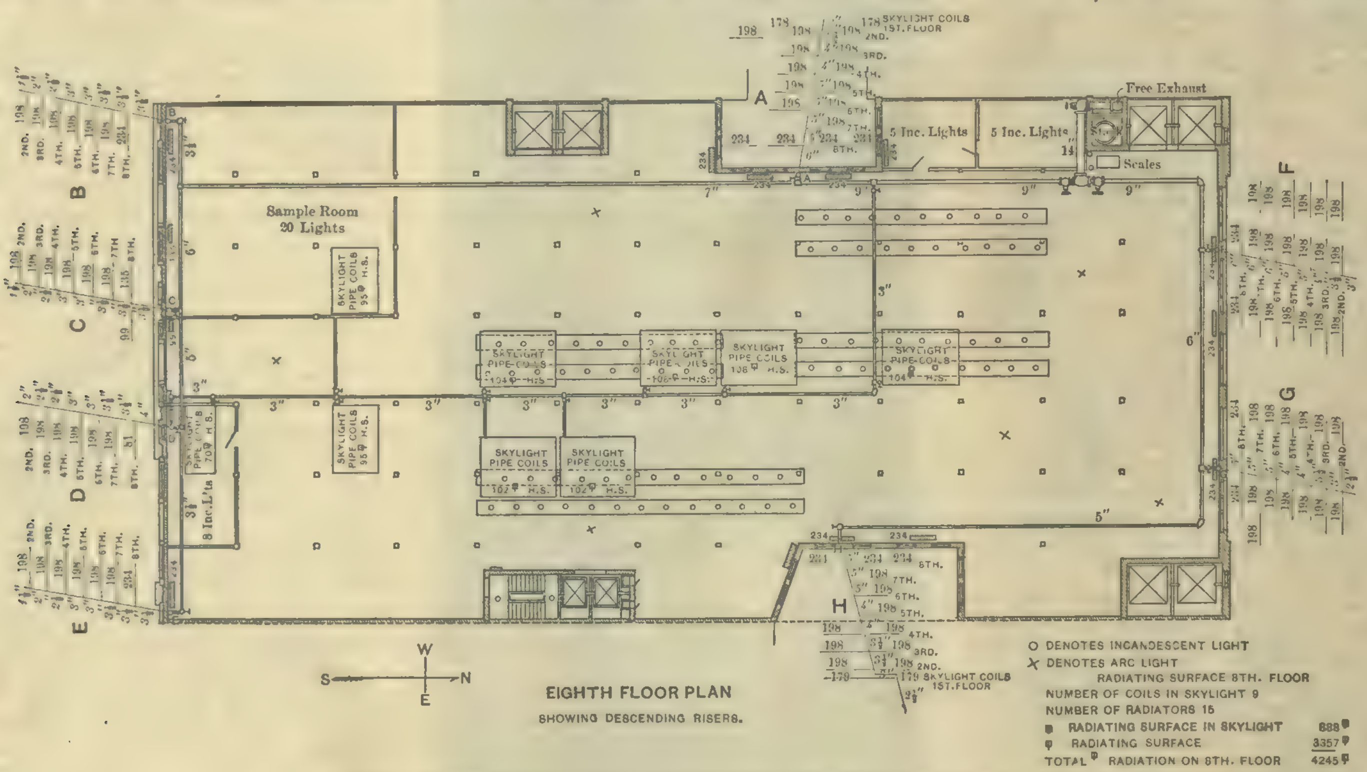


FIG. 1.—MECHANICAL PLANT OF A MODERN COMMERCIAL BUILDING.

The determining of the horse-power required to operate the elevator plant presented many difficulties. The problem was finally solved for hydraulic elevators in the following manner: The average net horse-power required by each freight elevator lifting its full live load was 20 horse-power, and for each passenger elevator, 22½ horse-power. There were six of the former in operation one-third of the time, but as they use no power coming down the average work done was 20 net horse-power. The two passenger elevators were assumed to be in operation one-half of the time, and their requirements were, therefore, 11¼; a total for the eight machines of 31¼ net average horse-power. Assuming an average efficiency of 55 per cent. from water end of the pump to work done, the horse-power of water end of the pump would be 56. On the basis of a mechanical efficiency of 75 per cent. for the pump the indicated horse-power of the steam end is 75, the figure already used in determining the boiler capacity.

The electric elevators, however, presented greater complications. Tests have shown that where drum machines are counterbalanced to half the average load, and where the same total load is carried both up and down, the net work done is simply that necessary to overcome friction, plus an allowance to cover the "surge" of energy required at each start. A study of this subject, in connection with records of tests made on similar plants, indicated that when operated under favorable conditions of loads, counterbalancing, frequency of stops, etc., these elevators should have an efficiency, running in

both directions, about as follows: The two passenger elevators, 3½ kilowatt hours per car mile; the two southwest freight elevators, 4¼ kilowatt hours per car mile; the four north freight elevators, 4½ kilowatt hours per car mile. On this basis, the electrical horse-power required to keep each elevator in motion was found to be 4⅜, 5⅝ and 6, respectively, per car mile. The speeds specified, however, were 3.4, 2.55 and 1.7 miles per hour, respectively, on on which basis 15.9, 14.45 and 10.2 elevator horse-power were required. Assuming that the passenger elevators might be in motion one-half the time, and the freights one-third, and multiplying by the number of elevators, the power consumed is found to be 15.9, 9.6 and 13.6 elevator horse-power, respectively; a total of 40, in round numbers. In view of the fact, however, that ideal conditions of loading and counterbalancing would never be reached, and also that uncertainty existed as to the actual number of stops per trip, and percentage of time which the elevators would be in operation, and in order to avoid any appearance of partiality to the electric installation, it was thought wise to increase this allowance by 50 per cent., and to call the total 60 electrical horse-power at the switchboard. Assuming a combined engine and dynamo efficiency of 80 per cent., the average indicated horse-power at cylinders of dynamo engines is 75, as already stated.

In computing the horse-power required to drive steam elevators, it was presumed that they would be run by direct connected steam engines in the ordinary manner. The machines are almost identical with the electric elevator of the drum type operated by worm gear, the direct connected steam engine taking the place of the distant steam engine generating current through a dynamo, and transmitting it for use in a direct connected electrical motor. The work done by the elevator proper is the same in both cases. Assuming the efficiency of the motor on the electric elevator to be 83 per cent., the net power consumed by the elevator mechanism itself is 50 horse-power. Taking the mechanical efficiency of the steam elevator engines at 75 per cent., the figure of 67 above referred to is arrived at.

The bids on electrical elevators stipulated that when starting from rest to full speed within five seconds the starting current was not to exceed the operating current at full speed by more than 50 per cent. The purchaser was to provide a third electrical generating unit of 75 kilowatts capacity in case electric elevators were adopted. The Sprague system was selected, at the price of $22,070, including ash hoist and safety gates. Four elevators were to be of the "X 38" type, with solenoid control; and the four south elevators of the "Z" type, with pilot motor control. The "X 38" machines are of the overbalanced single worm drum type. The type "Z" machines are similar to them, except that they have a double worm gear. To the above price should be added $3,134 for the cost of third engine and dynamo, etc., making a total of $25,204 for the elevator plant complete.

After the plant was installed an exhaustive test of capacity, speed and efficiency was made on one elevator of the type "X 38," and on one of the "Z" type. The following table gives the results:

Elevator.	Live Load, Lbs.	Speed Up, Ft. per Min.	Speed Down, Ft p.r Min.	Kw Hours per Car Mile.
Type Z ...	147	271	268	3 14
"	908	256	2 6	3 14
"	2,997	153	157	4 22
"	2,997	256	290	4 19
"	4,000	147	192	4.05
Type X 38	147	153	153	3.14
"	1,008	157	155	3 19
"	4,000	152	160	3.34
"	5,012	153	160	3.81

The observed data from the "X 38" machine are plotted in Figure 4. It is interesting to note the current of return to the line with light loads ascending, and heavy loads descending. It will be noted that type "Z" elevator has a a down speed, with operator only, of 268 feet per minute. With the same counterbalancing, it carries a load of 3,000 pounds up at 153 feet per minute, with motor operating on slow-speed notch of operating lever. When operated at high speed, this elevator lifted 3,000 pounds at a speed of 256 feet per minute, and with an economy per round trip slightly better than when operated at slow speed. This elevator carried 4,000 pounds up at 147 feet per minute, when operated on the slow-speed point of operating lever.

The type "X 38" elevator has a down speed of 153 feet per minute when running with operator only, and carries its full rated load of 4,000 pounds up at a speed of 152 feet per minute. This elevator carries 5,000 pounds up at a speed of 153 feet per minute. It is particularly interesting to note that the efficiency in kilowatt hours per car mile increased but slowly with increased loads. The kilowatt hours per car mile of travel are equal to good average practice, and will probably improve after longer operation of the plant.

The adjustment of the starting devices on the elevators was found to be for a 2½ to 3 seconds' start. This made the starting current exceed the running current by more than the 50 per cent. specified, which was based on a five seconds' start. When the starting devices were readjusted for a five-second start, this condition of the specifications was practically met.

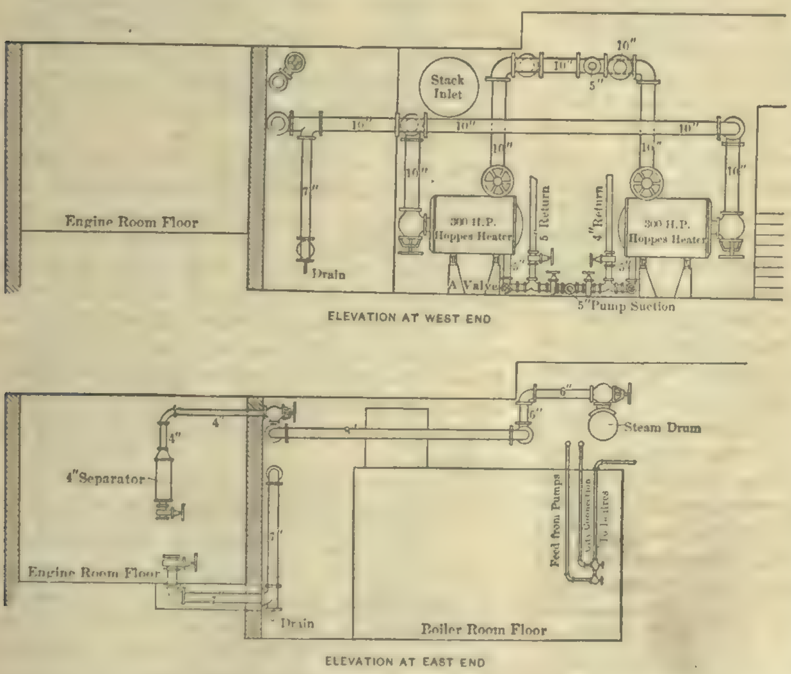
During the month July 12—August 12, 1898, the hours of operation were 283.5, and the average electrical horse-power, as shown by the watt meter, was 19.2, or 2.4 per elevator.

Dynamos and Switchboard.—A study of the purchaser's needs showed that they could be best met by a combination of 200 arc and 600 incandescent lamps. In addition, there were three motors driving fans in basement, and an allowance was also made for small fan motors throughout the house, and about 1 per cent. for drop in the wiring. These were summarized as follows:

200 arcs at 2½ amperes, and 220 volts, or 550 watts	= 110,000	watts.
600 220-volt 16 candle power incandescents at 60 watts	= 35,000	"
For motors, drop, etc	4,000	"
Total	150,000	"

It was decided that this load could be best handled by two 72-kilowatt generators. As such machines can run at considerable overloads, two-thirds of the total lights could be handled with one machine out of service. Three 50-kilowatt machines would have been better, but would have cost more. One hundred and fifty kilowatts at the switchboard is equivalent to 200 electrical horse-power. Assuming a combined efficiency of engine and dynamo unit of 80 per cent., the indicated horse-power in the steam cylinders is 250.

A departure from established practice was made in adopting a voltage of 220, instead of 110. This was done for three reasons: First, it was desirable to have an outside connection from a central station for use in the event of any serious accident to the plant. No central station, however, furnished direct current for power at 110 volts, but two convenient stations offered such service at 220 volts, both being from 220 to 440 direct-current three-wire systems. Second, it was believed that the electric motors would give better satisfaction at this voltage, and stopping and starting them would have less effect on the lights, as it was intended to run the entire light and power service from the same electrical apparatus. Third, the distances covered being quite large for an isolated plant, both the investment in copper and the



THE COMMERCE REALTY CO'S BUILDING.

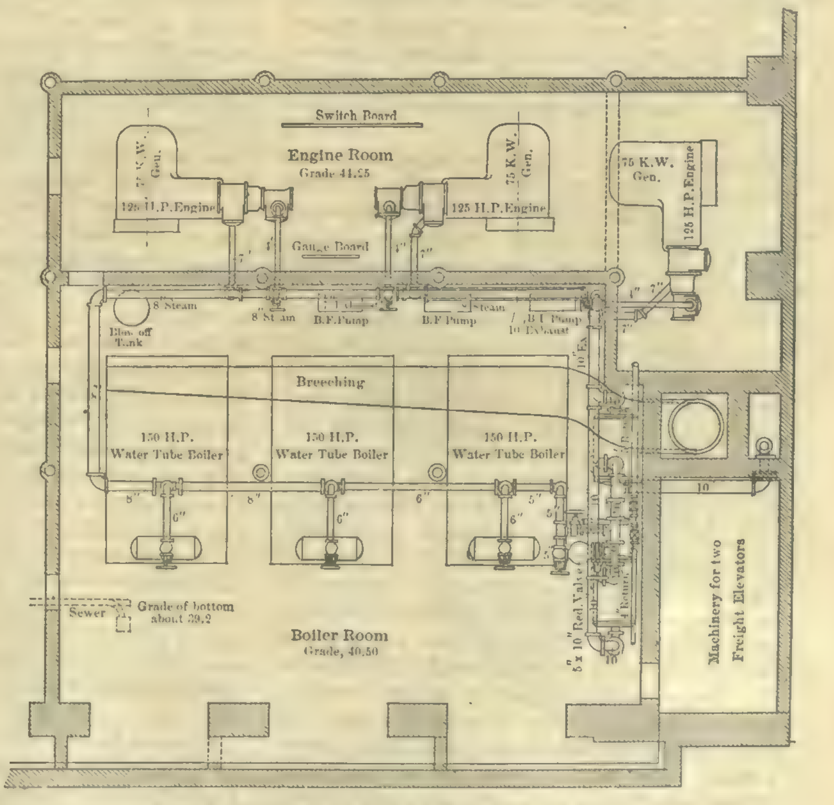


FIG. 3.—EXHAUST PIPING AND FEED-WATER HEATERS. FIG. 2.—SECTION OF BOILER AND ENGINE ROOM.

MECHANICAL PLANT OF A MODERN COMMERCIAL BUILDING.

"drop," or percentage of loss in wiring system, were materially reduced.

It is true that the 220-volt incandescent lamp is not as efficient as the 110, and that it costs more, thus increasing the cost both of fuel and of lamp renewals. The 110-volt 16-candle-power lamp ordinarily used, consumes about 55 watts, and the 220-volt, about 60. This means 9 per cent. more generating capacity and fuel burned. The 16-candle-power 220-volt lamps cost from 23 cents to 25 cents each, and the 110-volt, 18 cents to 20 cents. This inferiority is largely due to the fact that the number of 220-volt lamps in use is still small. The efficiency is improving, and the price falling as the demand increases, and it is believed they will, in the not distant future, approximate closely to the 110-volt lamp. In the present case, it was believed that the advantages of the 220-volt system overbalanced the objections named.

At the time this work was taken up the 220-volt arc lamp was in an experimental stage. It was a question whether to burn the arcs singly across 220 volts, or to use two 110-volt lamps in series. In either case, the inclosed arc lamp, burning in multiple, was to be used, for reasons explained later.

The electric elevators could, of course, have been operated alone with less than 75-kilowatt average; 75 horse-power, or 56 kilowatts, being the average amount of energy required, as already explained. As electric elevator service, however, is frequently subject to sudden and severe overloads for short periods, due to the starting and operating of a number of loaded elevators simultaneously, a surplus of power was necessary; and as it was desirable to have all the electrical units alike, and interchangeable, it was thought best not to reduce the size of the third unit.

The switchboard is of white Italian marble, with a panel with the usual instruments for each generator. There were to be two feeder panels, containing one 1,200-ampere double-pole double-throw switch, ten 150 and four 50-ampere double-pole double-throw knife switches with fuses, and one lamp ground detector. The board is designed with an extra power bus bar, so that the elevators can be operated separately from the lights, if desired. This has never been done, however, except when the plant was started, and before engines and generators were adjusted. The large double-pole double-throw switch enables either the motors or lights to be connected to outside reserve connection, the other being operated from the dynamo. When both sides of this switch are thrown to outside connections, the entire building is operated from a central station on a three wire 220 to 440 volt system.

General Electric dynamos were selected, the guaranteed efficiencies being 84, 89.5, 91.5 and 91.5 per cent. at quarter, half, three-quarters and full load, respectively. The three 75-kilowatt generators, with switchboard, etc., cost $5,135, or $22.80 per kilowatt; speed, 260.

Engines.—These were to be of the direct-connected type, for driving the two 75-kilowatt generators, each to be operated independently. The assumed efficiency of 80 per cent. fixed their capacity at 125 indicated horse-power each. The engines were to be of the horizontal center crank, tandem-compound, high-speed, non-condensing automatic type. The water rate to be not over 25 pounds per indicated horse-power hour, and the shaft governor was to control both high and low-pressure cylinders. Three 125 horse-power engines of the Imperial compound type, built by the Weston Engine Company, of Painted Post, N. Y., were selected. Dimensions of cylinder: high pressure, 12 inches diameter; low, 20 inches; stroke, 14 inches; speed, 260. Price, $4,268, or $11.38 per indicated horse-power. The same builders offered three simple engines, 15x14 inches, for the same service, for $3,616, or $9.64 per indicated horse-power. This should be reduced about 5 per cent. to be strictly comparable with the cost of the compounds. Computations showed that the horse-power hours of service per year would be sufficient to make the fuel saving of the compound over the simple enough to warrant the additional investment. The cost of engines and dynamos together was $9,403, which is $41.80 per kilowatt of dynamo capacity, and $25.07 per indicated horse-power of engine capacity.

Wiring.—The 220-volt multiple arc distribution was adopted, for reasons already explained. The arc and incandescent lamps were run from the switchboard on independent systems of wiring. The feeders for arc lights were of No. 2 B. & S. gauge, on porcelain knobs in the basement, and on metal cleats in the elevator shaft. All feeder wires were to have a one-sixteenth-inch lead cover in the elevator shaft. All wiring was to be rubber covered. The distributing circuits for arc lamps were of No. 12 B. & S. wire, each two lamps being controlled separately. The incandescents were to be grouped in circuits not exceeding 15 lamps each. Maximum drop between cut-out cabinet and lamps ¾ per cent.

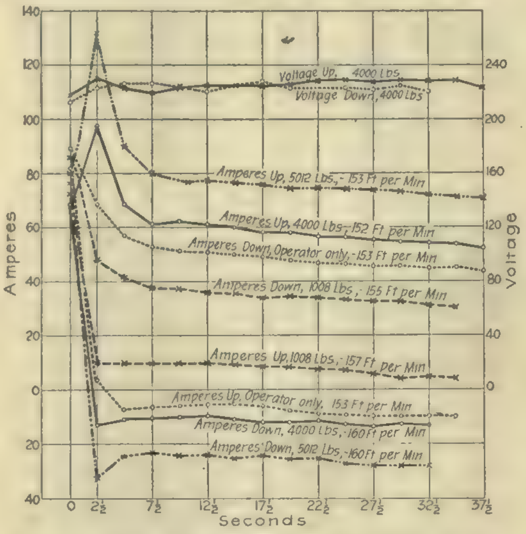


FIG 4.—OBSERVED DATA FROM ELEVATOR PLANT.

There are 189 arc and 579 incandescent lamps in the building. This work was let for $6,315 to the General Electric Company, their 220-volt arc lamp being selected. On the basis of 150-kilowatt capacity, the price per kilowatt was $42.10, including the entire work from the switchboard to the lights and fans, exclusive of special fixtures on first floor. Adding to this two-thirds of the contract price of the engines and dynamos gives the total cost of the electric lighting plant as $12,584, or $83.90 per kilowatt, exclusive of boilers and piping.

Steam Heating.—As the building, though large, was favorably situated as regards heat losses, being protected by the walls of adjoining buildings on both east and west sides, except at the two small light shafts shown in Figure 1, a plan of the top floor. The rear exposure is directly to the north, and is the only unfavorable one. It was decided that the most severe conditions would be met by assuming an external temperature of 10 degrees Fahrenheit, the building to be heated to 70 degrees Fahrenheit, with steam pressure not exceeding 2 pounds. The heat loss was computed on the basis of 80 B. T. U. per hour per square foot for exposed glass surface, and 16 for brick wall—the units given by Wolff. A problem was to determine the heat loss from the east and west walls, which were in contact with adjoining buildings. It was assumed that one of these buildings might be vacant in cold weather, and might reach as low a temperature as 32 degrees Fahrenheit. On this basis the heat loss would be about 10 B. T. U. per hour per square foot of wall. The changes of air to be provided for were assumed at 4 for the shipping room on first floor, 2 for the balance of first floor, and 1 for the rest of building.

From Carpenter we learn that 1 B. T. U. will heat 55 cubic feet of air 1 degree, and following his reasoning we get the following formula for the heat loss for each floor:

$$H = 80G + 16W + \frac{80nC}{55} + 10w.$$

in which: G = exposed glass surface in square feet. W = exposed wall surface in square feet. w = wall surface adjoining west store. C = cubic feet of space to be heated. n = changes of air per hour. This formula gives the amount of heat which the system must supply to replace the heat lost from wall and glass exposure when the building is maintained at 70 degrees Fahrenheit, and the external temperature is 10. It also provides heat to bring the fresh air entering the building through doors, windows, etc., to the same temperature.

It has been shown that one square foot of ordinary direct radiating surface will give off about 280 B. T. U. per hour, with steam of 2 pounds' gauge pressure. Dividing the heat loss by 280 and reducing we get the following formula for radiating surface:

$$R = \tfrac{2}{7}\left(G + \frac{W}{5} + \frac{w}{8} + \frac{nC}{55}\right).$$

In using this formula the factor 2/7 was changed to ⅓ to allow for the severe northern exposure, and to admit of the building being heated quickly when cold. The roof not being ceiled in, was assumed to have a heat loss equal to that of the exposed brick walls. The system of steam distribution was that of a main distributing riser going to the top floor, and there branching both ways along the four walls and supplying single-pipe descending risers, from which branch connections were taken to all radiators. The basement return for descending risers was divided into two sections. The radiators on first floor were supplied by an independent single-pipe main, going entirely around the basement and carrying both steam and returns.

The selection of the maximum heating pressure at between two and three pounds fixed for the velocity of steam in mains at about 37½ feet per second, causing a drop of pressure about 0.1 pound in 100 feet. These values were used in proportioning the mains and branches with proper allowance where the double-pipe system was used. The main riser is also intended to be used as a free-exhaust pipe, thus saving a long length of large pipe. This necessitates placing the back pressure and controlling valves of the heating system in the top floor, an inconvenience which was justified by the saving in first cost.

The exhaust was to be used for heating, supplemented by live steam when required. Each steam engine was to have a separator near its throttle. Two 300-horse-power Hoppes feed-water heaters were supplied. This large capacity was due to the fact that these heaters served also as receivers and expansion tanks. It was intended also that one could be cut out for cleaning or repairs without seriously disturbing working conditions. Figure 2 is a section of the boiler and engine room. Figure 3 shows the exhaust piping and feed-water heaters. The Paul system was used, and the contract price for the heating system alone was $6,984. The radiating surface was 18,073 square feet, this supplying one square foot of radiation for each 128 cubic feet of space to be warmed.

STEAM PIPE FAILURE ON THE "ALAMO."

A steam pipe accident on the steamship "Alamo," of the Mallory Line, at her pier in the East River, New York City, on the evening of December 3, adds another fatality to the already long list of accidents of that character, as seven men were killed by the escaping steam. The steamer had been used as an army transport during the summer and was only recently returned to her owners after an over-

hauling. The ship was about to sail, and the boilers and piping had been tested during the day to 160 pounds pressure by the Government inspectors, and everything was found satisfactory. The boilers, of which there were four, all discharged their steam into an immense superheater or steam chimney. At the side of this and near the top was a 12-inch angle valve pointing downward, and from this an 11-inch copper pipe led downward about ten feet, and then, with a long radius bend, it extended aft to the engine room. At the engine room bulkhead an expansion joint of the usual sleeve type was provided, and a flange at the bottom of the bend in the main steam pipe was connected with one of the flanges of the expansion joint by two rods, to keep the joint from blowing apart. Aft of the expansion joint the pipe rose slightly into the throttle valve, and the pocket so formed was provided with a drip. The throttle valve was connected directly to the bottom of the steam chest.

During the day the engines had been turned over occasionally, while the engineer was setting the valves, with but 80 pounds of steam, 100 pounds being the working pressure. This low pressure was maintained up to the time of starting and the fires were not spread, as it was only expected to take the ship down to Liberty Island to anchor for the night. Just before the signal to start was given the explosion occurred, filling the engine and boiler rooms with steam, from which several men escaped with difficulty. When the pressure went down, seven men were found to have perished. An examination showed that the steam pipe had pulled out of the collar or flange by which it was bolted to the flange of the angle valve on the steam chimney. The copper pipe had been flanged over this collar and also riveted to it by eighteen one-half inch rivets. These were found to have sheared off. The cause of the failure has not been determined. The water hammer theory seems to be disputed by the fact that the valve on the steam chimney had been open all day, and the fires under the boilers were too low to cause priming. It is said that an investigation is now being made of the material in the rivets that failed, and it may bring out the fact that they were defective. In the meantime the importance of good steam piping is emphasized.

VENTILATION AND HEATING OF A NEW BRUNSWICK SCHOOL.

The new high-school building in St. John, New Brunswick, Canada, is heated by an unusually complete indirect blower system for a building of its size. Air is supplied by the double-duct method, the mixing of the cold and hot air taking place at the base of the various fresh-air flues.

The building was erected from the plans of Mr. G. Ernest Fairweather of St. John, and the heating system was installed by Mr. Thomas Campbell from the designs of the B. F. Sturtevant Company, which furnished the heating apparatus. The building is a three-story and basement structure, measuring about 78x128 feet in plan. Figure 1 shows the basement, in which the machinery and apparatus of the plant are located; Figures 2, 3 and 4 are plans of the ground, second and top floors respectively. The entrances and stairways for the pupils are at either end of the building and are connected on both the ground and the second floors by a central corridor provided with coat and cloak rooms for teachers and for pupils. There is an entrance for teachers and visitors at the front of the building, and over this is situated the principal's office. Two parts of the building projecting from the rear, and accessible through hallways adjoining the cloak rooms, are used for toilet rooms. These are located in the basement and on the two floors above, as shown on the plans. The top floor is chiefly given up to a large assembly room occupying the center of the floor, with two small rooms on either side separated by continuations of the main stairways which rise in dormer windows, as shown in Figure 4.

A single boiler located in the basement furnishes steam for the heating coils and for the steam engine, which drives by belt a 7-foot blower capable of discharging about 40,000 cubic feet of air per minute at a speed of 180 revolutions per minute. Air is drawn into the basement of the building through adjacent windows, and is forced by the blower through heating coils of the sectional-base type, containing 5,000 linear feet of 1-inch steel pipe, equivalent to a heating surface of about 1,700 square feet. The coils are provided with a by-pass leading to a system of cold-air ducts, located above, and separated from those conveying the hot air. An elevation of blower and heating coils is shown in Figure 5. A damper in the by-pass is only opened during school hours, as cold air is, of course, not needed when warming the building previous to its occupation by the pupils. The outlet chamber of the blower is also provided with a hinge damper, which is ordinarily allowed to project against the current of hot air so as to divert a sufficient quantity to temper the cold air passing through the heater by-pass. The two systems of ducts, the cold above the hot, are suspended around the center of the basement, decreasing in size as branches

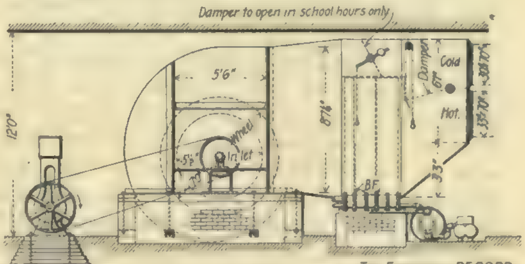
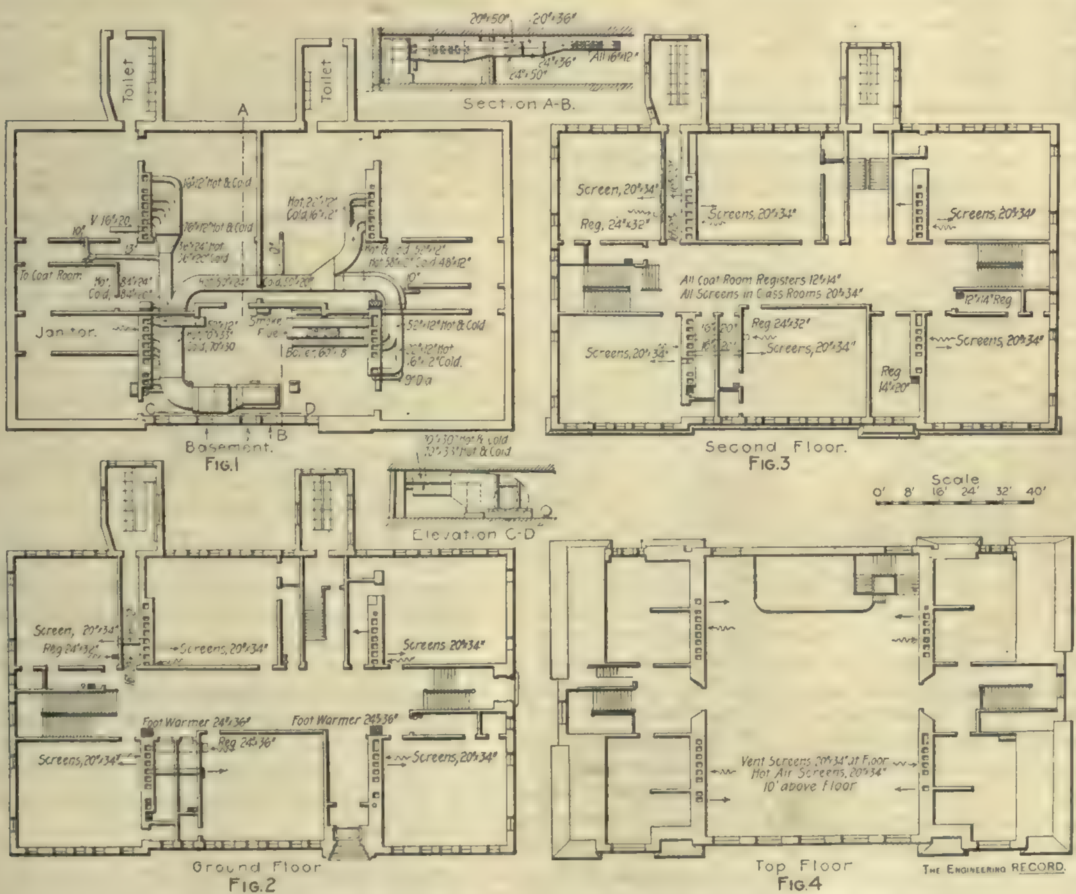


FIG. 5

are taken from them. There are four interior walls extending through the building, and in these are located the flues, both for heating and for ventilation. The branches from the ducts lead to the bases of these flues, as shown in Figure 1, and a mixing of the air in the two takes place at this point. The mixing dampers are of the Sturtevant hinged-cylinder type, and are controlled by hand from the room to which the flue leads. The air supply of each room may have, therefore, any temperature desired, irrespective of that of the other rooms, within the limits of the temperature of the outside air and that available from the heating apparatus. Fresh-air inlets to the class rooms are located 8 feet from the floor, and those in the assembly room 10 feet. They are 20x34 inches in size and are provided with wire screens. Air is carried through similar screened openings located at the floor and almost directly below the inlets, leading to flues rising alongside of the heating flues. The flues are brought together into four groups at the roof, where four ventilating covers serve to discharge the vitiated air into the atmosphere.

As shown in the drawings, floor registers are provided in a number of places and are supplied by circular flues. These are located in the cloak rooms, and two of large size in the ground-floor hall are for use as footwarmers. Where the class rooms are separated from the flue wall by a cloak room or corridor the fresh air is carried in a short duct as shown. Under these conditions it is necessary to lead the corresponding ventilating duct from a floor register underneath the floor to the ventilating flue.

The toilet rooms are given no direct supply of air, but are provided with ventilating flues to carry away the foul air and to assist in maintaining a passage of air from the corridors into these rooms. This is brought about by the slightly greater pressure of the air as it is delivered by the blower into the main part of the building. At the third floor, pipes lead from the top of the flues to brick ducts above the third-story ceiling, where they discharge in two of the ventilating centers.



VENTILATION AND HEATING OF A NEW BRUNSWICK SCHOOL.
THE B. F. STURTEVANT COMPANY, BOSTON, MASS., ENGINEERS.

AMERICAN SOCIETY OF MECHANICAL ENGINEERS.

In the preceding issue of "The Engineering Record" a report was made of the various meetings of the American Society of Mechanical Engineers up to and including the session on

Thursday morning. On Thursday afternoon the Batchelder system of pneumatic tubes for transporting the mails in New York City was described by Mr. Batchelder. Afterwards about one hundred members visited the New York Post Office and saw the system in operation. Before leaving the society house there was presented to the society a handsome portrait of Mr. John Fritz. It had been intended to make the presentation when Mr. Fritz was present, but as soon as he found that this was intended he disappeared. Captain Robert W. Hunt made a most excellent presentation speech.

On Friday the convention opened for the consideration of the remaining papers, together with the several queries that had been submitted for discussion.

The first paper was entitled "The Calorific Power of Weathered Coals," and was presented by Messrs. R. S. Hale and Henry J. Williams. In 1896, samples of Maryland, Virginia, Pennsylvania and Ohio coals were collected and arranged for testing as follows: For tests of fine coal, the samples were ground in a coffee grinder, and thoroughly mixed and divided into two parts. For tests of lump coal, the coals were broken into lumps of about nut size, and alternate lumps taken from the pile to form two samples. Having thus obtained two reliable samples of each coal, or four samples, where tests of both fine and lump coal were to be made, one sample was tightly sealed in an ordinary pint fruit jar, while the corresponding sample was exposed out of doors for eleven months in an uncovered tin can, provided with a diaphragm or bottom of fine wire gauze. Rain and snow fell upon the coal, but the wire diaphragm permitted the water to drain off, while a paper disk placed upon the wire gauze prevented the coal from sifting through the meshes. The lump samples were exposed in pans of much larger size, which were provided with holes to let the water drain off. This method of exposure closely reproduces the conditions to which the surface of a pile of coal, left out of doors, would be exposed. At the end of eleven months all the samples were analyzed by Mr. Williams. Proximate analyses were also made and the calorific power obtained by the bomb calorimeter. The average of the results obtained shows that weathering, under the conditions described, decreases the percentage of carbon, hydrogen, nitrogen; increases the percentage of oxygen, and does not materially alter the percentage of sulphur.

The conclusions drawn from an examination of the results are: First: That weathering decreases by about two per cent. the theoretical calorific power, as calculated by Dulong's formula. Second: That weathering decreases by about one-half of one per cent. the actual or true calorific power, as shown by the three results obtained with the bomb. Third: That if the results calculated from the above analyses are interpolated from Kent's curve, which is based on the per cent. of fixed carbon, as determined by approximate analysis, the latter being a more or less variable quantity according to the age and degree of exposure of the coal, the remarkable result is obtained that the weathering of a sample of coal increases the percentage of fixed carbon in the combustible, and also increases by about one per cent. the calorific power of the coal. The results also show that where coals have not been exposed to oxidation, by weathering or otherwise, there is a reasonably close agreement between the results calculated by Dulong's formula and those obtained with the bomb calorimeter. Last of all, they show that when it is desired to compare the respective calorific powers of coals that have been altered to a greater or less extent by oxidation with those of coals that have not been exposed to the weather, the use of Dulong's formula, or any of its modified forms at present in use, as well as the use of Kent's curve, would lead to erroneous conclusions.

The next paper was presented by Mr. W. H. Bryan, treating of the "Mechanical Plant of a Modern Commercial Building," and may be found in abstract on another page.

Mr. R. P. Bolton, in discussing the paper, thought that all considerations in the design of the mechanical plant should be subordinated to the heating, for if the building was not heated properly it would be a failure. He did not believe in basing the heating surface entirely upon the difference in temperature, as the wind had a very great effect; in fact, in one building he had moved considerable surface from the upper to the lower floors. By the use of the Paul system, the heating surface in Mr. Bryan's building had been cut down by 25 per cent., the owners of the system guaranteeing to heat the building with less surface if this system was applied. Mr. Bolton thought that the owners of the system were taking big chances, as the surface originally specified by Mr. Bryan seemed to be about right. Regarding specifications for boilers, he said that it did not do to specify for a particular amount of heating surface, and offered his practice as the best way to place bidders on an even footing. He submits to boiler makers the height of the chimney to be built, the kind and the amount of coal to be burned per square foot of grate surface per hour for a given evaporation. He thought that Mr. Bryan's comparison of types of elevators should be taken with caution. In the building equipped by Mr. Bryan, the elevator service was very different from the service in a modern office building. Mr. Bolton believed that the double pressure system of hydraulic elevators, such as was installed in the Bowling Green Building in New York City, was the most economical type. This same system was installed in the Standard Oil Building in New York City, and a complete description of it appeared in "The Engineering Record" of October 22 last. Mr. Bolton had no figures as to the economy of this system when operating with the Worthington triple expansion pumps that usually operate it, but when a small duplex pump was used to supply power the steam consumption varied from 534 to 264 pounds of steam per car mile, as the load was increased from light to full load.

Mr. George Hill criticised the steam and exhaust piping, in that the steam piping was not sufficiently direct, and that the exhaust piping contained too many bends. He believed the prices obtained by the author were not especially low, as they were about the same that he had frequently received. He did not believe the author's electric specifications rigid. Mr. Hill preferred carbon to copper brushes on the dynamos, and it was his custom to specify a current density of 40 amperes per square inch in switchboard connections. Mr. Hill then gave the coal consumption of several different buildings, the details of which he described.

"Experiments on the Flow of Steam Through Pipes" was the subject of the next paper. It was presented by Professor R. C. Carpenter. Professor Jacobus said that very elaborate work had been done on this subject by Ledoux, who took into account condensation, grading of the pipes, etc., and compared the phenomena of the flow of air with those for steam. A report of these tests was published in the "Annales des Mines," in November, 1892, and Professor Jacobus thought the values obtained by Professor Carpenter should be compared with those of Ledoux.

Mr. Kent thought that the paper was based upon insufficient data.

The next paper was by Mr. Charles L. Newcomb, and it described a very extensive series of experiments made by the author upon the friction of different makes of fire hydrants. The paper was read from manuscript, as it was not completed in time to be printed.

The list of papers having been exhausted, the convention now turned its attention to the query: "Does It Pay to Pickle Ordinary Castings?" Mr. Newcomb thought a large shop could not afford to do so, and favored the sandblast. A jobbing foundryman, he believed, feared the sandblast, as it shows up flaws and blow-holes. Mr. H. H. Suplee spoke of hydrofluoric acid, which is used in Germany and leaves a smooth surface.

"Have You any New Notions on Machine-Shop Floors?' proved to be quite an interesting topic. Mr. Newcomb considered that 3-inch matched spruce flooring laid on kyanized timbers, made a good machine-shop floor. It has to be replaced about once every four or five years. For a second floor he advocated 3-inch spruce, covered first with paper to prevent any dust getting through, and then 1⅛-inch matched maple.

Mr. A. A. Cary told of a test he had made of laying a floor composed of sections, one of spruce, one of yellow pine, one of comb-grained pine and a fourth of maple. Maple proved to be the best, and he found maple used in the flooring of a piano factory.

A floor was described by Mr. W. F. Durfee, made by excavating, filling with broken stone and using 4-inch plank, 5 inches wide, laid on chestnut sills with small cracks between planks, and at 45 degrees with the building line.

Shortly after the meeting adjourned.

"The Engineering Record" regrets that in the article in the issue of December 3, discussing the block of model flat houses recently constructed for the Hoboken Land & Improvement Company, Mr. William Paul Gerhard was not given credit for having designed the plumbing, gas, water and drainage work. Although the article dealt mainly with the architectural features, yet some of the details of Mr. Gerhard's work were described, and therefore credit should have been given him. Messrs. D. C. Weeks & Son were the general contractors and should also have been credited in the account.

ENGINEERING SOCIETIES.

The New England Water Works Association will hold a quarterly meeting in headquarters, Tremont Temple, Boston, December 14. The papers announced deal with pumping machinery, in accordance with the general programme for the season's meetings previously noticed in these columns. They are as follows: "Possibilities of Economy in Pumping Engines, as Based on the Latest Accomplishments," by George H. Barrus, M. E., Boston, Mass.; "The Advantages of Triple Expansion Pumping Engines," by J. M. Betton, M. E., Brooklyn, N. Y.; "The Latest Designs in Pumping Machinery, Comparing Same with Practice of Twenty Years Ago," by a representative of the Edward P. Allis Company, Milwaukee, Wis., and also by a representative of Henry R. Worthington, Brooklyn, N. Y.; "The Application of Oil and Gasolene Engines to Pumping Machinery," by Freeman C. Coffin, C. E., Boston, Mass., and "Comparison Between Low and High Duty Pumping Engines on a Small Water Works Plant," by John E. Smith, superintendent, Andover, Mass. On the morning of the meeting, members will have an opportunity to visit the pumping station of the Metropolitan Water Works, at Chestnut Hill, for the purpose of seeing the pumping machinery. In addition to the regular engine, the new 30,000,000-gallon triple-expansion pumping engine, built by the Edward P. Allis Company, one of the largest in the country, may be running. The members will also be able to examine the foundations of the new pumping station, now being built near the old one.

The Fiftieth Anniversary of the Society of Civil Engineers of France was celebrated with unusual formality in June of this year, the meetings being attended by the President of France, the Ministers of Commerce, Industry,

Post Office and Telegraphs, and Public Works, and a large number of foreign engineers, including Sir John Wolfe Barry, Mr. Horace Bell and Dr. J. H. Tudsbery, from the Institution of Civil Engineers; Mr. E. Pontzen, from the American Society of Civil Engineers; Messrs. C. L. Bouton and A. H. Zeller, from the Engineers' Club of St. Louis; Mr. H. D. Woods, from the Boston Society of Civil Engineers, and Mr. E. L. Corthell, from the Western Society of Engineers. The anniversary actually fell on March 4, but for several reasons the celebration was postponed three months and made coincident with the dedication of a monument to the society's founder, Eugene Flachat. The excursions of the association and its guests to various works in the vicinity of Paris and its social functions are described in an interesting report just received from Secretary A. de Dax.

The American Society of Civil Engineers met December 7, Mr. J. J. R. Croes presiding. A paper entitled "Some Experiments on Bridges Under Moving Train Loads," by F. E. Turneaure, Assoc. Am. Soc. C. E., was presented and discussed orally by Mr. G. H. Thomson, Mr. H. B. Seaman, Mr. Bernt Berger and Mr. T. K. Thomson. Announcement was made of the deaths of F. C. Doran, Chicago; Philip Golay, Morgantown, W. Va., and of James Francis, Lowell, Mass.

Notice was given that at 20 o'clock, December 14, Mr. H. S. Maxim, M. Am. Soc. C. E., will give a lecture in the society rooms descriptive of the progress in aerial navigation experiments, and of machine guns, one of which will be exhibited and operated with blank cartridges. The lecture will be illustrated by stereopticon views and ladies will be welcomed. Adjournment was followed by the usual collation.

The following were elected. By the Board of Direction, December 6:

As Associate—William Wodman Graham, Durango City, Mexico.

As Juniors—Alexander Simpson Farmer, Brooklyn, N. Y.; Andrew Daniel Fuller, Boston, Mass.; Olaf Morrough Kelly, Brooklyn, N. Y.

As Associate—Ralph Peverley, New York City.

By letter ballot, December 7: As Members—F. W. Bond, Principal Assistant Engineer St. Louis & Oklahoma City Railroad, Sopulpa, I. T.; W. Bradford, Pittsburg, Pa.; A. F. Harley, Consulting Engineer General Asphalt Co., Baltimore, Md.; F. C. Kunz, Assistant Engineer Bridge and Construction Department Pencoyd Iron Works, Pencoyd, Pa.; M. J. Reiseger, Architect and Assistant Engineer to Messrs. Keepers & Thacher, Paterson, N. J.

As Associate Members—C. I. Bausher, Bridge and Construction Department Pennsylvania Steel Co., Harrisburg, Pa.; C. J. Hogue, Locating Engineer, Choctaw, Oklahoma & Gulf Railroad, South McAlester, I. T.; J. L. Howard, Assistant Engineer Distribution Department, Metropolitan Water Board, Boston, Mass.; J. C. Irwin, Division Engineer Maintenance of Way and Structures, New York Central & Hudson River Railroad, Albany, N. Y.; F. W. Kinsey, Assistant Superintendent Morris & Cummings Dredging Co., New York City; A. E. Phillips, Assistant Engineer Sewer Department, Washington, D. C.; H. Rittenhouse, Masonry Inspector Norfolk & Western Railway, Eggleston, Va.

NOTES.

A Memorial of the late Col. George E. Waring, Jr., has been inaugurated through the initiative of the Chamber of Commerce of the State of New York. It is proposed that $100,000 be raised by public subscription, the income to be paid to the widow and daughter of Col. Waring, and upon their decease the principal to be paid to Columbia University to constitute the "Waring Municipal Fund," the interest on which shall be devoted to the purpose of instruction in municipal affairs. The fund has now reached a total of $63,540, the largest part of which has been contributed by members of the Chamber of Commerce.

The Water Supply of Buildings which is available for use in extinguishing fire is receiving attention as a result of last Sunday night's fire in New York City. The Board of Public Improvements of the Borough of Manhattan on December 7 passed a resolution recommending to the Department of Public Buildings "that an ordinance be drawn and forwarded to the Municipal Assembly compelling the owners of all buildings beyond ten stories in height to provide receptacles capable of holding as many gallons of water as the Fire Commissioner of this city shall direct, and that this supply shall be kept constantly intact under a heavy penalty for failure to comply with it."

Oil on Highways has been investigated by Mr. Montgomery Meigs, M. Am. Soc. C. E., who was led to undertake the experiments by a report that leaking oil from a pipe near a Pennsylvania road greatly improved the latter. He accordingly applied to the Standard Oil Company for some crude oil, and received a tank containing 130 barrels for the tests. Eight barrels have been used on a very muddy road near Keokuk with most satisfactory results, the oil forming a sort of water-proof crust, which prevents the dirt from becoming mud during rains. The tests indicate, so far as they go, that a barrel of crude oil is sufficient for a strip of road 100 feet long and 12 feet wide, but the period during which the oil remains effective does not seem to have been ascertained. Mr. Meigs states that while oil will never take the place of good paved roads, it may possibly enable fair dirt roads to be constructed where lack of good materials and expense render macadam or gravel roads out of the question.

PERSONAL.

Mr. Benjamin C. Brown has been re-elected superintendent of the Woodbury, N. J., water department.

Lieutenant Eugene Shinkle has returned to Bellevue, Ky., and will resume his duties as city engineer.

Mr. J. H. Payne has been appointed assistant engineer of the Denver & Gulf Railway system, with headquarters in Denver, Colo.

Mr. Daniel Castleman has resigned as superintendent of water works of Connersville, Ind., and has been succeeded by Mr. Gillett Gordon.

Mr. Albert S. Cheever, M. Am. Soc. C. E., has been appointed chief engineer of the Fitchburg Railroad, with headquarters at Fitchburg, Mass.

Mr. Frank Otis Melcher, M. Am. Soc. C. E., lately chief engineer of the Fitchburg Railroad, has been appointed division superintendent of the same road.

Mr. William Jackson, M. Am. Soc. C. E., city engineer of Boston, has returned from Europe with a large amount of data regarding bridges in continental cities, collected in the interest of the design of the new Cambridge bridge.

Mr. E. C. Shankland, M. Am. Soc. C. E., has withdrawn from the firm of D. H. Burnham & Co., architects, of Chicago, and has in connection with his brother, Mr. R. M. Shankland, M. E., opened an engineering office under the firm name of E. C. & R. M. Shankland, at 816 "The Rookery," Chicago. The firm will devote special attention to the design of building construction and foundations, office buildings, warehouses, factories and power plants.

Lieutenant Colonel William M. Black, Corps of Engineers, U. S. A., has been temporarily assigned to duty in the office of the chief of engineers in the War Department, in charge of the division of personnel and fortifications, a position he held when he was appointed engineer commissioner of the District of Columbia. He takes the place of Major Joseph E. Kuhn, who has been summoned to Leavenworth, Kan., by the illness of his wife.

Messrs. Charles G. Darrach, M. Am. Soc. C. E., and Henry A. Macomb will withdraw from the firm of Wilson Brothers & Company, engineers and architects of Philadelphia, Pa., on February 1 next. After Mr. Darrach retired from the Philadelphia water department, some years ago, where as assistant to Chief Engineer McFadden he had full charge of that important city department, he connected himself with the above-named firm as mechanical and civil engineer, and has had personal charge of the designing and superintendence of many large engineering projects with which this firm has been identified. Mr. Darrach has been an occasional contributor to the columns of "The Engineering Record." Mr. Macomb is an architect of known ability and experience extending over a period of about 20 years with the present firm. The experience and standing in the profession of Messrs. Darrach and Macomb should secure them a sucessful and lucrative practice.

OBITUARY.

Mr. James Egan, a contractor on railroads, died in Milwaukee, Wis., December 2.

Mr. Benjamin C. Clifton, assistant street commissioner of Bayonne, N. J., died December 1.

Mr. Leonard M. Fletcher, a maker of builders' iron work, died in Philadelphia, Pa., December 2.

Mr. John Baizley, proprietor of one of the oldest iron works in Philadelphia, Pa., died in that city December 3.

Mr. James G. Lindsley, superintendent of the Newark Lime & Cement Company, died in Kingston, N. Y., December 4.

Mr. William Nichalls Bolling, long connected with the engineering department of the Baltimore & Ohio Railway, died in Baltimore, Md., December 6.

Mr. Bernard Feeney, a contractor for highway work, who had built the Weehawken loop of the Hudson County Boulevard, died at Union Hill, N. J., December 4.

Mr. Edward Kilpatrick, one of the leading builders of private residences in New York City, died December 5. He also built the Edison Building and a number of churches.

Mr. Thomas W. Grant, a contractor of Shenandoah, Pa., who had been interested in street paving in the City of Mexico and in Philadelphia reservoir contracts, died in Shenandoah December 1.

Colonel James Francis, M. Am. Soc. C. E., agent of the Proprietors of the Locks and Canals on the Merrimac River, died at Lowell, Mass., December 1. He was the second child of James Bicheno Francis, the noted hydraulic engineer and former president of the American Society of Civil Engineers, and was educated in private schools in the vicinity of Lowell and Boston. At the age of 20 he entered the Lowell machine shop and served a year learning to use machine tools. From April, 1861, to August, 1865, he spent as a commissioned officer in the War of the Rebellion. He was with Sherman in the march to the sea and was wounded at Antietam. He rose to the rank of lieutenant colonel. From September, 1865, to the following April he served in the engineer department on the Hoosac Tunnel, chiefly in surveying and leveling. For nineteen years following he was assistant engineer on hydraulic work for the Proprietors of the Locks and Canals on the Merrimac River, and in January, 1885, he was appointed agent and engineer of the same company, involving the management of the water power of the Merrimac River at Lowell. He was also a member of the American Society of Mechanical Engineers and the Boston Society of Civil Engineers.

CONTRACTING NEWS

OF SPECIAL INTEREST TO

CONTRACTORS, BUILDERS, ENGINEERS, AND MANUFACTURERS

OF ENGINEERING AND BUILDING SUPPLIES.

For Proposals see page 'x,

WATER.

Racine, Wis.—It is stated that the matter of putting in a pump to increase the water pressure at fires is under consideration.

Mobile, Ala.—Gov. Johnston has signed the bills providing for water-works and a sewerage system for Mobile.

Parkersburg, W. Va.—W. T. Rittenhouse, City Clk., writes that 7 or 8 tons of lead will be required for the Water Dept.

Jamestown, N. D.—The contract for sinking an artesian well has been awarded to the Rust Well Machinery Co. of Ithaca, N. Y., at $2.45 per ft.

Norfolk, Va.—J. Thomas Peelle, Registrar, writes that the contract for a filtration plant, daily capacity 6,000,000 gals. (Jewell gravity system), has been awarded to the New York Filter Mfg. Co., 26 Cortlandt St., New York City, at $55,000, exclusive of building.

Far Rockaway, N. Y.—The purchase of new pumping engines of large capacity is contemplated. Chas. R. Better, Ch. Engr. and Supt. Queens Co. Water Co.

Tacoma, Wash.—It is proposed to improve and increase the water supply by the construction of 5 miles of flume or stave pipe at an estimated cost of $75,000.

Denver, Colo.—According to local press reports, the Denver Land & Water Co. proposes to expend $20,000 for improvements to the irrigation system in the valley of Cherry Creek.

Bonham, Tex.—It is stated that bonds to the amount of $5,000 have been authorized for the extension of water mains.

Oto, Ia.—The proposition to issue water-works bonds will be voted upon in January, according to reports.

Orange, N. J.—Bids are wanted Dec. 12 for a pumping station or plant, dam and excavation at Campbell's Pond. John J. Cuddy, Chm. Water Com.

Kettle Falls, Wash.—It is stated that a special election has been called for Dec. 28 to vote on the issue of bonds for a water system.

Fargo, N. D.—It is stated that the City Engr. has submitted a preliminary estimate of the cost of new boilers for the pumping station, amounting to $2,300.

Orangeburg, S. C.—Frederic Minshall, C. E., 150 Nassau St., New York City, writes from Pocomoke City, Md., that he has about completed plans for water-works, sewerage and electric lighting for Orangeburg, S. C., contracts for which will be let about Dec. 20. Estimated cost, $55,000.

Boston, Mass.—See "Gov. Work."

Gaffney, S. C.—It is stated that bids are wanted Jan. 3 for $18,000 bonds. Frederick Minshall, Engr., 150 Nassau St., New York City.

Dunkirk, N. Y.—Bids are wanted Dec. 20 for installing an additional pump of 6,000,000 gals. daily capacity in the pump house. C. E. Hequembourg, Chmn. Com. Bd. Water Commrs.

Phoenix, Ariz.—Press reports state that the Hudson Reservoir & Canal Co. proposes to construct a dam 200 ft. high and 600 ft. long at the head of "Tonto Basin," thus creating a lake which will cover 18 sq. miles, for the purpose of irrigating 1,000,000 acres in the Salt River Valley. Estimated cost, $2,500,000.

Columbus, Miss.—Press reports state that the proposition to issue $70,000 bonds for water-works and a sewerage system carried at the election held Nov. 29.

Camden, N. J.—Articles of incorporation have been filed by the Metropolitan Water Filtering Co., with a capital of $2,000,000. The objects of the corporation are to sink wells and shafts and to erect water-works. The corporators are Leander P. Randall, Edward P. Evans, Howard H. Sypher and Charles Pflaum, Jr.

Groton, S. D.—It is stated that P. J. Stacey has the contract for sinking an artesian well at $4 a ft.

Womelsdorf, Pa.—Press reports state that the Womelsdorf Water Co. is preparing to extend its system to Robesonia, 2 miles away.

Howard, S. D.—Local press reports state that the construction of water-works is under consideration.

Jamestown, N. D.—The proposition to issue $7,500 bonds to provide for the sinking of an artesian well carried at the recent election.

Hintonburg, Ont.—The Village Council has under consideration the construction of water-works.

Denver, Colo.—The Board of Supervisors has voted to call a special election to vote on the municipal ownership of the water-works.

North Tarrytown, N. Y.—The Pocantico River Water Co. has filed articles of incorporation; capital stock, $250,000. This company takes possession of the property and franchise of the old Pocantico Water-Works Co., which furnished water to North Tarrytown, Tarrytown, Ardsley, Dobbs Ferry, Irvington and Hastings.

Philadelphia, Pa.—Chief Trautwine, of the Water Bureau, has prepared a new set of outline plans, as requested by the Park Commission, for the reservoir on George's Hill.

Fort Berthold, N. D.—See "Government Work."

Kansas City, Mo.—The Board of Public Works has under consideration the proposition to repair Holly St. reservoir.

Prescott, Ariz.—Press reports state that $15,000 bonds have been sold for purpose of building a storage dam.

Glen Campbell, Pa.—Press reports state that water-works are to be constructed at once.

Laporte, Ind.—It is stated that the Western Engineering & Construction Co. has secured the contract for putting in water-works. The water will be brought about 5 miles. Cost, $87,000.

Williamsport, Ind.—The Williamsport Water & Light Co. has been incorporated. Capital stock, $10,000. Directors: J. H. Brown, B. O. Mayer and George Mayer.

Lawrenceburg, Ind.—It is stated that the city has under consideration various propositions for the construction of water and electric light plants.

Tuskegee, Ala.—The town has petitioned the Legislature for authority to issue $30,000 water and light bonds.

Granville, Mass.—According to reports, the question of building water-works is under consideration.

Nevada City, Cal.—It is stated that steps are being taken toward building a water system. T. H. Carr, City Clk.

Saginaw, Mich.—Water-works bonds, amounting to $15,000, have been sold.

Washington, Ga.—A bill has passed the House authorizing the Council of Washington to issue bonds for water-works, electric lights, etc.

Chicago, Ill.—Bids are wanted Dec. 31 for brass castings for hydrants and stop valves at the water-works shop. L. E. McGann, Commr. Pub. Wks.

Boston, Mass.—Bids are wanted Dec. 12 for feed water heaters, meters, etc., for the pumping station, Calf Pasture, Dorchester District. Benj. W. Wells, Supt. of Sts.

Somersworth, N. H.—Bids are wanted Dec. 15 for $177.000 water-works bonds. Arthur J. Seavey, Mayor.

Cullman, Ala.—An election will be held Dec. 12 to vote on the proposition to ask the Legislature for authority to construct water-works and an electric light plant.

New York, N. Y.—The following bids were opened Dec. 8 by the Department of Water Supply; *a*, 62 tons straight pipe; *b*, 75 tons branch pipe: Fox & Engel, 253 Broadway, *a*, $18; *b*, $35. McNeal Pipe & Foundry Co., 52 Wall St., *a*, $17.50; *b*, $36. Warren Foundry & Machine Co., *a*, $17.90; *b*, $40.

Bids were also received as follows: For 2 boilers at the 97th St. boiler-house and for taking out 4 old boilers; Evans, Almirall & Co., $11,333; E. Rutzler, $11,394; Henry R. Worthington, $13,100; Heipershausen Bros., $11,800. Bidders all of New York City.

Montgomery, Ala.—The following bids were received for furnishing cast-iron pipe and special castings: Dennis Long & Co., Louisville, Ky., $15,926.48; McNeal Pipe & Foundry Co., Burlington, N. J., $19,900.80; American Pipe & Foundry Co., Chattanooga, $13,361.20. Bids for gates were as follows: Coffin Valve Co., Neponset, Mass., $1,494.75; Rensselaer Mfg. Co., Troy, N. Y., $1,638.90; Michigan Brass & Iron Co., Detroit, Mich., $1,309.45; Chapman Valve Mfg. Co., Boston, Mass., *$1,392.40.

*Contract awarded.

The City Council has adopted the report of Geo. A. Ellis, Consulting Engr., recommending that 12 additional artesian wells be sunk; estimated cost, including air lift contract, special castings, gates, foundations, etc., $55,000.

McKinney, Tex.—The following bids for the construction of water-works were opened Nov. 30 by J. M. Pearson, Mayor: Kelley & Steele, Georgetown, Tex., *$26,234.75; O. J. Gorman, Dallas, Tex., $26,544; C. W. Olcott, Dallas, Tex., $26,899.96.

*Contract awarded.

Florence, Colo.—The following bids for constructing works were opened Nov. 28: *a* signifying complete system with cast-iron pipe, *b* complete system with spiral riveted pipe, *c* complete system with wood pipe.

Ruemmeli & Siebert Refrigerating Machine Co., 3900 Chouteau Ave., St. Louis, Mo.; *a*, $177,205; *b*, $165,740.

Orman & Crook, Pueblo, Colo.; *a*, $160,578; *b*, $148,020.

Holmes & Allen, Denver, Colo.; *a*, $172,375; *b*, $164,375.

R. P. McDonald, Denver, Colo.; *a*, $144,200; *b*, $132,000; *c*, $140,200.

Greenville Construction Co., Greenville, O.; *a*, $139,300; *b*, $129,800.

Mitchell Bros., Denver, Colo.; *a*, $138,000; *b*, $130,675; *c*, $119,687.

Shutt Improvement Co., Pueblo, Colo.; *a*, $138,000; *b*, $128,000.

Geddes & Searle Stone Co., Denver, Colo.; *a*, $137,000.

John M. O'Rourke, Denver, Colo.; *a*, $136,200.

H. C. McCreary, Denver, Colo.; cast-iron pipe line only, $75,802; stand-pipe without foundation, $6,000.

SEWERAGE AND SEWAGE DISPOSAL.

Baltimore, Md.—The Council Committee on Highways has decided to report favorably ordinances to construct brick and pipe sewers in certain streets.

Santa Monica, Cal.—It is stated that Fred Eaton, Consulting Engr., of Los Angeles, has prepared specifications for an engine and pump with a capacity of 100,000 gals. per hour for flushing the sewers.

Mason City, Ia.—The following bids for the construction of a sewer were opened Dec. 2 by W. P. Fitch, City Clk.: J. H. Killmar, Des Moines, Ia., *$23,900; J. W. Gardiner, Mason City, Ia., $25,797; E. T. Webster, Dubuque, Ia., $29,200; O'Neil & Son, Faribault, Minn., $26,350.

*Contract awarded.

Newark, N. J.—Engineer Adam has submitted to the Board of Works' Sewer Committee a plan for the enlargement of Duryee St. sewer; estimated cost $19,000.

Mobile, Ala.—See "Water."

Davenport, Ia.—The special committee appointed to investigate the feasibility of constructing an intercepting sewer has reported the estimated cost to be $55,000, not including the 9-ft. sewer from Marquette St. to the city limits, estimated to cost $57,850. The estimated cost of extending the present system is $51,370.

Hamilton, O.—Bids are wanted Jan. 2 for $8,200 sewer bonds. M. O. Burns, City Clk.

South Bend, Ind.—Bids are wanted Dec. 26 for 15-in., 18-in. and 24-in. pipe sewers. L. A. Hull, City Clk.

Evansville, Ind.—Bids are wanted Dec. 17 for a sewer. George W. Swearingen, Clk. Bd. Pub. Wks.

Orangeburg, S. C.—See "Water."

Hamilton, O.—Bids are wanted Jan. 2 for storm sewers on Dayton, 2d and 3d Sts. Bids are also wanted for a sanitary sewer on 3d and 2d Sts. M. O. Burns, City Clk.

Philadelphia, Pa.—Bids are wanted Dec. 15 for repairing sewers, manholes, etc., and cleaning sewers, etc., during the year 1899. Thomas M. Thompson, Dir. Dept. Pub. Wks.

Cincinnati, O.—Bids are wanted Jan. 3 for sewers on Bassett Road. A. B. Rattermann, Pres. Bd. City Affairs.

Oakland, Cal.—Bids are wanted Dec. 12 for a sewer in Castro St. J. W. Thompkins, City Clk.

Toledo, O.—Plans and specifications have been prepared for sewers in main sewer district No. 31. Lem. P. Harris, City Clk.

Middleboro, Mass.—The State Board of Health sustains the complaint against the town for polluting the Nemashet River by sewage, and recommends the construction of works for collecting and purifying the sewage, and that the existing outlets into the Nemashet River be closed and the discharge of sewage through them be discontinued.

Louisville, Ky.—The Board of Public Works has received plans for a new sewer to drain the western portion of the city, which it is proposed to build at a cost of about $200,000.

Newark, N. J.—The Board of Works and the Essex County Park Commission have under consideration the proposition to construct a city sewer through Branch Brook Park. Engineer Adam estimates the cost of sewers through the park at $46,500, and if constructed outside the park the cost is estimated at about $95,000.

McKee's Rocks, Pa.—The Borough Council, on Nov. 30, passed an ordinance for the construction of sewers in several streets.

Carlisle, Pa.—A. Z. Wetzel, Boro. Secy., writes that plans are being prepared for a sewerage system.

Columbus, Miss.—See "Water."

Livingston, Mont.—The City Council has passed an ordinance for a sewer in District No. 2, to cost about $4,000.

Sioux City, Ia.—Local press reports state that it is proposed to build an 8-in. pipe sewer from the various manufacturing plants to the Missouri River; estimated cost, $5,000.

Birmingham, Ala.—An ordinance has been adopted providing for storm sewers, estimated to cost $4,500. A. J. Camp, City Clk.

Waycross, Ga.—It is stated that a sewerage system will be built at a cost of $37,000.

Nashville, Tenn.—Local reports state that the Board of Public Works will solicit bids for a 30-in. brick sewer.

Macon, Mo.—Chas. L. Farrar, City Clk., writes that it was voted Dec. 6 to issue $20,000 sewer bonds.

Red Bank, N. J.—The following bids for sewers were opened Nov. 29 by the Board of Town Commissioners, as advertised in "The Engineering Record," Hedenberg & Kinsey, Engrs.: P. H. Harrison & Son, 220 Broadway, New York, *$9,652.30; Doolittle & Brooks, 26 West Broadway, New York, $12,333.05; J. Erwin Hillpot, Bound Brook, N. J., $13,502.40; F. Kohlmeyer & Co., 102 Park St., New York, $10,703.80; Antonio Costa, Orange, N. J., $13,518.60.

*Contract awarded.

Buffalo, N. Y.—The following bids were opened Dec. 1 by the Board of Public Works for Van Rensselaer and Emslie St. trunk sewer: Andrew Beaser, 74 Sanford St., $74,974; John Harrer, $79,700; Henry Harter, $85,978; John Mumm, $93,657; Thomas F. Moore, $96,872; W. G. Smith, $96,898; William Franklin, $101,614; Brown, Stabell & Griffiths, $109,920; Ritzmann & Miller, $115,522; George Dark & Thomas Dark, $120,500; Christopher Smith, $134,334. Bidders all of Buffalo.

Scranton, Pa.—Joseph P. Phillips, City Engr., writes that the following proposals were received Dec. 1 for constructing a system of lateral sewers in Section "C" of the Fifth District: Length, 4,000 lin. ft.; 8-in. to 24-in. pipe. The price per ft. includes the building of 23 manholes, 16 basins and 140 house connections (about 2,800 ft.): Donohoe & O'Boyle, Scranton, Pa., $2.27 per lin. ft., extra basins $97, extra manholes $37; V. H. O'Hara, Scranton, Pa., $2.24 per ft., extra basins $90, extra manholes $35.

BRIDGES.

Milwaukee, Wis.—Local press reports state that the construction of a viaduct over the Menomonee valley, at Grand Ave., is under consideration; cost, about $100,000.

Mekinock, N. D.—It is stated that the bridge across Turtle River has been ordered rebuilt.

Benton Harbor, Mich.—It is stated that the City Clerk has been authorized to advertise for bids for repairing the bridge across the St. Joseph River at an estimated cost of $2,000.

Blair, Neb.—Bids are wanted Dec. 20 for steel county bridges in the year 1899. Watt Gauldrie, Co. Clk.

Plattsmouth, Neb.—Bids are wanted Dec. 31 for building county bridges for the year 1899. James Robinson, Co. Clk.

Houston, Tex.—Mayor S. H. Brashear writes that the contract for Franklin Ave. bridge has been awarded to Morgan Rhodes Construction Co. of Waco, Tex. See our issue of Nov. 26 for list of bids received.

South Bend, Ind.—The construction of a brick arch bridge, with stone abutments, over the creek on Johnson St., has been recommended in the Council.

Batavia, N. Y.—The Town Board has petitioned the State Railroad Commissioners to build a bridge over the tracks of the Buffalo, Rochester & Pittsburg Ry. Estimated cost, $8,000.

Maquoketa, Ia.—It is stated that the construction of a 200-ft. iron bridge in Monmouth Township, to cost about $3,500, is under consideration. Fred Fischer, Aud.

Brewton, Ala.—A bill is before the Legislature authorizing the county to issue $25,000 bonds to build a bridge across the Conecuh River.

Spokane, Wash.—See "New Depots."

Burrows, Ind.—It is stated that the Wabash Railway will build an iron bridge over Rock Creek. Jos. Ramsey, Jr., Gen. Mgr., St. Louis, Mo.

Norristown, Pa.—It is stated that Edwin M. Richie, County Surveyor, has prepared plans for a 60-ft. 3-span iron bridge.

Peshtigo, Wis.—It is stated that the Wisconsin & Michigan Ry. Co. will build a bridge across the Sturgeon River at a cost of $35,000. S. L. Fisher, Pres., Chicago, Ill.

Carthage, Mo.—It is stated that an order has been issued for the Missouri Pacific Railway to build a bridge across its tracks at Sycamore St.

Herkimer, N. Y.—A petition is stated to have been presented to the Board of Supervisors for permission to bond the town for $13,500 for a bridge over the West Canada Creek.

Detroit, Mich.—C. W. Hubbell, C. E., of the Water Board, writes that it is proposed to replace several 30-ft. to 40-ft. wooden bridges in the Water Works Park with permanent structures. No definite action has yet been taken by the Board of Water Commissioners.

Jackson, Mich.—A. Torrey, Ch. Engr., Michigan Central R.R. Co., Detroit, Mich., writes that the contract for a steel foot bridge has been let to the Detroit Bridge & Iron Wks., Detroit, for $4,000.

Moline, Ill.—See "Government Work."

Leavenworth, Kan.—J. W. Niehaus, Co. Clk., writes the contract for 3 iron bridges has been awarded to the Missouri Valley Bridge & Iron Wks., Leavenworth, for $1,150.

Sigourney, Ia.—Bids are wanted Dec. 13 for building county bridges for the year 1899. A. Stranahan, Co. Aud.

Hastings, Neb.—Bids are wanted in January for building county bridges for the year 1899. D. R. Bigelow, Co. Clk.

Cincinnati, O.—The contracts for the work on the new Baltimore bridge, over the Big Miami, are stated to have been awarded as follows: Superstructure, to King Bridge Co., Cleveland, O., at $49,900; substructure, to A. J. Wellman, at $34,797.50; piling for protection of south abutment, to C. H. Glandorf, at $10,125.

Fresno, Cal.—The following bids for the construction of a county bridge were opened Nov. 23 by the County Board of Supervisors: P. F. Dunden, San Francisco, $10,300; Cotten Bros., Oakland, $9,700; J. H. McKay, Oakland, $9.900; Clark & Henery, Stockton, $10,400; Cal. Bridge & Construction Co., San Francisco, *8,770.

*Contract awarded.

Lowell, Mass.—The following bids were opened Nov. 30 for the superstructure of a bridge over the Boston & Lowell R.R. on the extension of Lundberg St.: Canton Bridge Co., Canton, O., *$5,662; Wrought Iron Bridge Co., Canton, O., $5,667; Groton Bridge Mfg. Co., Groton, N. Y., $5,879; Youngstown Bridge Co., Youngstown, O., $5,960; Pittsburg Bridge Co., Pittsburg, Pa., $5,975; Boston Bridge Works, Boston, Mass., $6,000; King Bridge Co., Cleveland, O., $6,048; Frank R. Long & Co., New York City, $6,117; New England Structural Co., $6,129; Massillon Bridge Co., Massillon, O., $6,176; Variety Iron Works Co., Cleveland, O., $6,200; Edge Moor Bridge Works, Wilmington, Del., $6,276; Berlin Iron Bridge Co., East Berlin, Conn., $6,296; Harrington & Robinson, $6,372; Toledo Bridge Co., Toledo, O., $6,440; New Jersey Steel & Iron Co., Trenton, N. J., $6,500; Penna. Steel Co., Stutton, Pa., $6,590; Horseheads Bridge Co., Horseheads, N. Y., $6,600.

*Contract awarded.

PAVING AND ROADMAKING.

Lancaster, Ky.—Bids are wanted Dec. 19 for $33,000 Garrard Co. turnpike bonds. Hon. R. A. Burnside, Co. Judge.

Baltimore, Md.—The Council Committee on Highways has decided to report favorably ordinances to repave with brick Park Terrace and with asphalt on Fulton Ave.

East St. Louis, Ill.—County Judge Rhodes, on Nov. 26, upheld the legality of the ordinances for about 7 miles of brick paving ordered by the City Council. Probable cost, about $200,000.

Chicago, Ill.—The Board of Local Improvement has passed ordinances for paving with brick and asphalt in several streets.

Rochester, N. Y.—Ordinances are before the Council for paving North Clinton St. with Medina block; estimated cost, $66,000; also with asphalt, estimated cost, $54,000.

Rochester, N. Y.—The County Board of Supervisors has adopted resolutions providing for the improvement of East Ave. and Little Ridge roads at respective costs of about $12,000 and $30,000.

San Francisco, Cal.—The City Street Improvement Co. has secured a contract for bitumen pavement on Market St. for about $31,000.

Macon, Ga.—W. M. Lasley has secured the contract for about 15,000 sq. yds. of vitrified brick pavement at $2.08 per sq. yd. The Georgia Quincy Granite Co. has the contract for about 10,000 sq. yds. granite pavement at $2.53 per sq. yd.

Norfolk, Va.—The Common Council has passed a resolution providing for the paving of Chapel St.

Baltimore, Md.—See "Electric Railways."

Dallas, Tex.—The Franklin Fire-Proofing Co. has received a contract for 11,400 sq. yds. of 2-in. rock asphalt pavement on 6 in. concrete at $1.97, giving a 10-year guaranty. The company offered the same pavement on a 5-year guaranty at $1.92, and 2 ins. of asphalt on bois d'arc blocks at $1.35, time of guaranty not stated in the report received from Mr. I. A. Moore, City Secy.

Baltimore, Md.—Act. City Com. O. W. Connett has awarded a $4,702 contract to J. L. Robertson, in which the main items are 1,550 yds. Belgian block paving at $1.79, and 1,100 yd. Belgian block repaving at 79 cts.

Meadville, Pa.—Bids are wanted Dec. 16 for 3,120 sq. yds. brick paving on Terrace St. D. T. McKay, Jr., City Clk.

Jacksonville, Fla.—Bids are wanted Dec. 22 for 20,350 sq. yds. of grading, 15,454 lin. ft. of stone curbing and 21,000 sq. yds. of brick or block pavement on Main St. Philip Prioleau, City Engr.

Buffalo, N. Y.—It is stated that bids are wanted Dec. 13 for paving Park View Ave. R. G. Parsons, Secy. Bd. Pub. Wks.

Lima, O.—It is stated that bids are wanted Dec. 19 for $40,000 paving bonds. C. E. Lynch, City Clk.

Atlantic City, N. J.—The City Council, on Dec. 5, ordered that bids be advertised for paving several streets. Bids to be received Dec. 26.

Philadelphia, Pa.—Bids are wanted Dec. 15 for repairs to paved streets and for resurfacing streets with sheet asphaltum during the year 1899. Thomas M. Thompson, Dir. Dept. Pub. Wks.

Syracuse, N. Y.—Bids are wanted Dec. 12 for $198,000 local improvement bonds. Elbert F. Allen, City Treas.

Pittsburg, Pa.—Bids are wanted Dec. 15 for paving Shakespeare St. Edward M. Bigelow, Dir. Dept. Pub. Wks.

Amsterdam, N. Y.—It is stated that a bill will soon be presented in the Legislature for the construction of about 20 miles of macadamized road from Amsterdam to Northville.

Lowell, Mass.—Local press reports of Dec. 7 state that the $30,000 loan resolution for the extension of Aiken St. has passed the Board of Aldermen.

Peoria, Ill.—It is stated that the Board of Public Improvement has adopted estimates for about 17,000 sq. yds. of asphalt paving and about 10,000 sq. yds. of brick. Total cost, $60,000.

Erie, Pa.—City Engineer Briggs has recommended that $3,000 in next year's appropriation be set aside for the purchase of a 10 or 12 ton street roller.

Buffalo, N. Y.—The Board of Park Commissioners, on Dec. 6, ordered its Grounds and Road Committee to begin at once the construction of Humboldt Parkway. The speedway will be 50 ft. wide.

Oskaloosa, Ia.—It is stated that a resolution has been adopted to pave with brick on "D" St.

Jersey City, N. J.—The New Jersey Mexican Asphalt Co. has secured the contract for paving Prospect St., at $1.73¼ per sq. yd.

Buffalo, N. Y.—The Park Commisioners opened the following bids Dec. 3 for the repair of asphalted streets under their jurisdiction for the next five years: The Barber Asphalt Paving Co., New York City, for 11 cts. per sq. yd. and the German Rock Asphalt & Cement Co., Buffalo, for 4⅞ cts.

Bristol, Tenn.—The proposition to pave Main St., in Bristol, Tenn., and Bristol, Va., is under consideration. J. C. Beyers, Secy. Bd. of Trade.

Macon, Ga.—The City Council has decided to pave Fifth St. with Belgian block.

Chicago, Ill.—The Council has under consideration an ordinance providing for a boulevard along Lake Ave. to Jackson Park.

Atlantic City, N. J.—The City Council has passed a resolution to pave Atlantic Ave. with vitrified block on a concrete base, the city to pay 60 per cent. of the cost, provided the West Jersey & Seashore R.R. Co. will lower its tracks. Estimated cost, $100,000.

Tippecanoe City, O.—Bids are wanted Jan. 2 for $1,172.80 street improvement bonds. John M. Haaga, Village Clk.

Danville, Ky.—Boyle County Court has decided to issue $45,000 worth of turnpike bonds.

Cairo, Ill.—The City Council has been petitioned to pave Ohio Levee St. with brick, according to plans prepared by Chas. Trupp, City Engr.

Omaha, Neb.—The following bids for paving were opened Dec. 2 by the Board of Public Works. *a*, Street asphalt, Class B, 1½-in. surface, 1½ in. asphalt binder, 4 in. concrete, 5 yrs. guarantee; *b*, vitrified brick, 6 in. concrete, 1 yr. guarantee; *c*, vitrified brick, 6 in concrete, 5 yrs. guarantee; *d*, stone block, Colorado sandstone, 6 in. sand, 1 yr. guarantee; *e*, curbing asphaltic sawed sandstone. The Grant Paving Co., Omaha, *a*, $1.64.2. The Barber Asphalt Co. (of New York City), Omaha, *a*, $2.05. Hugh Murphy, Omaha, *a*, *$1.59; *b*, $2; *c*, $2.10; *d*, $1.60. A. C. Powers, *c*, *67c.

*Awarded subject to selection of material for paving by property owners.

Louisville, Ky.—Local reports state that the following bids were opened Dec. 2 for asphalt pavement on several streets with five and ten year guarantees. These bids were for two kinds of pavement, both with a foundation of 6 inches of concrete, and differing merely in the wearing surface and binder, pavement No. 1 having 1½-in. binder and 2-in. wearing surface, and No. 2 a 1-in. binder and 1½-in. wearing surface: Assyrian Asphalt Co., Chicago, Ill., No. 1, $18.90, $28.90; No. 2, $18, $28. Barber Asphalt Paving Co., New York City, No. 1, $19.50, $24.30; No. 2, $17.50, $22.30. Alcatraz Asphalt Co., San Francisco, Cal., No. 1, $19.40, $23.40; No, 2, $17,40, $21.40. Bids received from L. R. Figg and the Boston Paving Co. were rejected as informal.

POWER PLANTS, GAS AND ELECTRICITY

Smithfield, Va.—We are informed that R. J. Palmer, of Norfolk, Va., has the contract for putting in an electric light plant.

New London, Ia.—The Council is said to be considering the proposition of Frank Williams to put in an electric light plant.

St. Louis, Mo.—Supt. Benedict of the Fire Alarm and Police Telegraph system is stated to have received the following bids Nov. 28 for putting the city wires under ground in that part of the city affected by the conduit system: The Southern Electric Supply Co., *$13,618, and the Western Electric Supply Co., 10 N. 9th St., St. Louis, Mo., $14,190. *Contract awarded.

East Chicago, Ind.—The East Chicago Light & Power Co. has been incorporated; capital, $1,500. Incorporators: Geo. W. Wilson and H. N. Haley.

Huron, S. D.—It is reported that Harry Sterling contemplates putting in a steam plant for operating the electric light plant.

Clarendon, Ark.—The Clarendon Light & Heat Co. has been incorporated; capital, $6,000. Incorporators: J. W. Robinson, H. Bateman and J. Jones.

East Hartford, Conn.—The Electric Light Committee is stated to have decided to award the contract for electric lighting to the Hartford Electric Light Co.

Carthage, Mo.—Owen Ford, 710 Security Bldg., St. Louis, is preparing plans for the municipal electric lighting plant for which the $25,000 bonds were voted. R. Lundy, City Clk.

Independence, Mo.—H. B. Speechter, of Louisiana, Mo., is stated to have applied for a franchise to erect a $30,000 electric light plant.

Franklin, N. Y.—The Delaware Electric Light & Power Co. has been incorporated, to furnish light in Sidney and Franklin; capital, $250,000. Peter G. Stappers, of 345 W. 28th St. New York City, is one of the incorporators.

Lawrence, Mass.—It is reported that the Lawrence Gas Co. will construct an electric light plant.

New York, N. Y.—See "Gov. Work."

Marshalltown, Ia.—A committee is stated to have been appointed, with Councilman Ward as chairman, to investigate the question of lighting the town by electricity.

Athens, Ala.—The question of issuing bonds for an electric light plant is reported to be under consideration.

Boston, Mass.—See "Gov. Work."

Richmond, Va.—A charter has been granted to the James River Construction Co. to erect a plant to be used for the development of the water power of James River for electrical and manufacturing purposes. R. Lancaster Williams, Pres., Richmond; F. C. Todd, Vice Pres., Baltimore; A. W. Wedell, Secy., Richmond.

Youngstown, O.—See "Public Buildings."

Donaldsville, La.—The Superintendent of the electric plant is reported to have recommended the purchase of an additional boiler and engine.

San Francisco, Cal.—See "Gov. Work."

San Bernardino, Cal.—Bids are wanted Dec. 19 for lighting fixtures in the court house. J. B. Pasazette, Co. Clk.

Orangeburg, S. C.—See "Water."

Royal Oak, Mich.—Bids are wanted Dec. 20 for an electric light plant. Wm. Hilzinger, Engr. in charge.

Washington, D. C.—See "Gov. Work."

Mayville, N. D.—The Goose River Mill Co. is reported to have applied to the Council for a franchise for an electric light plant.

Lawrenceburg, Ind.—See "Water."

Wilmington, Del.—It is stated that the Bay State Gas Co. will shortly begin the erection of a plant in this city for furnishing electricity for lighting and heating purposes.

Tuskegee, Ala.—See "Water."

St. Cloud, Minn.—C. M. Hertig, Pres. Benton Power & Traction Co., writes that nothing has been done in the matter of improving the water power at Sauk Rapids, Minn., beyond the making of preliminary plans and surveys.

Findlay, O.—Wm. B. Cutter, of Buffalo, is stated to have purchased the city's natural gas plant.

Bath, Me.—The Bath Light & Power Co. has been organized; capital, $100,000. E. W. Hyde, Pres., Bath; H. H. McCarty, Treas., Bath.

Washington, Ga.—See "Water."

Charlotte, Mich.—It is stated that the question of establishing a municipal lighting plant will probably soon be submitted to the voters.

Hagerstown, Md.—The Council, on Dec. 1, passed an ordinance to establish a municipal electric light plant, and providing for the sale of $60,000 bonds for same.

Millbrook, N. Y.—The Millbrook Gas & Electric Co. has been incorporated; capital, $15,000. Directors: W. E. Smith and Richard J. Scales, of Millbrook; Samuel Thorne of New York City, and others.

Fonda, Ia.—We are informed that the proposition to build an electric light plant in connection with the water-works plant will be voted upon at the April election. Address R. F. Beswick, Chmn. Water Com.

Williamsport, Ind.—See "Water."

Sherbrooke, Que.—It is stated that bids are wanted Dec. 15 for lighting the streets with electricity. C. W. Cate, Chmn. Com.

Middleport, N. Y.—Bids are wanted Dec. 13 for furnishing 25 arc lights of 2,000 c. p. each, for 5 years. Thos. P. Hammond, Village Clk.

Waterloo, N. Y.—Bids are wanted Dec. 26 for between 50 and 60 arc lights of 2,000 c. p. each to light the village for a period of 5 years. Isaac G. Gregory, Pres. Bd. Village Trustees.

Duluth, Minn.—Bids are wanted Jan. 16 for the purchase of a telephone franchise. H. W. Cheadle, City Clk.

Richmond, Ill.—It is reported that the citizens are agitating the question of erecting an electric light plant.

Greenup, Ky.—The Greenup Light Co. has been incorporated to erect an electric light plant in this town; capital, $5,000. Incorporators: Chas. Schmutz, J. E. Pollock and R. E. L. Wilson.

Cullman, Ala.—See "Water."

Columbus, Wis.—Mayor W. C. Leitsch writes that a committee has been appointed to investigate the feasibility of constructing an electric light plant in connection with the water-works.

Rockford, O.—We are informed that the Rockford Electric Lighting Co. is about to build a $6,000 plant. A. H. Robinson, Pres.

Key West, Fla.—Messrs. Laflin are reported to have applied for a franchise and right of way for the construction of an electric railway and light plant.

St. Paul, Minn.—The St. Paul Gas Light Co. has submitted the following bids for arc lights for 1898: 120 at $69.50, 146 at $94, 138 at $115.50. For gas lighting, the company's bid was $23 for ordinary street lamps, $26.50 and $28.50 for two forms of Welsbach lamps, and $1.30 per 1,000 ft. for gas in public buildings. Tenders for about 3,200 gasoline lights were received from the Carbon Light & Power Co., Jersey City, N. J., which bid $8.24 per lamp, and from the American Development Co., St. Paul, which bid $9.54. These prices are for lighting the lamps and gasoline, and do not include renewals, lamps, etc.

ELECTRIC RAILWAYS.

St. Albans, Vt.—A company is being formed to build an electric railway from St. Albans to Swanton and to the Bay; length of road, 13 miles. Dr. Reynolds, F. C. Kennedy, J. J. Flynn and others, of Burlington, are interested.

Hampton, Va.—The Peninsula Ry. Co., represented by a committee consisting of John G. Livezy, of Newport News, and Francis F. Causey, of Hampton, has received a franchise.

Irwin, Pa.—The McKeesport & Irwin St. Ry. Co. is stated to have petitioned for a franchise.

Baltimore, Md.—The Consolidated Ry. Co. has applied for a franchise on Chase St. It is stated that if the franchise is granted the company will pave Biddle St., at a probable cost of $50,000.

Port Angeles, Wash.—John Cain and Geo. H. Clementson are stated to have applied for a franchise.

Waukegon, Ill.—The Chicago & Milwaukee Electric Ry. Co. is said to have in contemplation the building of a line between this city and Evanston.

Lake Bluff, Ill.—The Chicago & Fox Lake Electric Ry. Co. is stated to have received a franchise.

Troy, N. Y.—The Troy City Ry. Co. is stated to have petitioned for permission to extend its line. Chas. Cleminshaw, Pres.

East Liverpool, O.—It is stated that bids will soon be asked for building the proposed line between this place and Lisbon, a distance of about 20 miles. J. L. Francis is said to be interested.

Birmingham, Mich.—Almeron Whitehead and Frank Hagerman, of this place, are stated to have received a franchise for an electric railway through Bloomfield Township.

Cincinnati, O.—It is stated that contracts will be let about Jan. 1 for building the Cincinnati, Lawrenceburg & Aurora Electric Railway. J. C. Hoover, Pres. Hamilton Corliss Engine Works, Hamilton, O., is reported to be interested.

El Paso, Tex.—The County Commissioners have granted right of way for an electric railway to V. E. Magi and J. W. Lee, representing the D. C. Breckinridge Co., of New York City, who, it is said, will build the proposed road. They will also build an extension to Ysleta, Tex.

Ottawa, Ia.—Walter Reeves is stated to have applied for a franchise.

Fitchburg, Mass.—The Fitchburg & Leominster St. Ry. Co. is reported to have received a franchise to double track its Main St. line and build in Blossom St. A. H. Moore, Ch. Engr.

Hammonton, N. J.—W. I. Garrison, Frank Souders and others, of Atlantic City, are stated to have applied for a franchise, to connect with the proposed trolley system from Camden to Atlantic City.

Newport News, Va.—The Peninsula Ry. Co. is stated to have received a franchise.

Allentown, Pa.—A charter has been granted to the Allentown & Slatington Electric St. Ry. Co. Length of road, 17 miles. Capital, $200,000. Directors: Francis J. Crilly and Walter J. Saeger, Allentown; Francis A. Kreitz, Slatington, and others.

Wardner, Idaho.—The Wardner Kellogg Electric Ry. Co. has been incorporated, with a capital of $500,000, to build an electric line between this city and Kellogg. Directors: Bartlett Pressley, of Kellogg; Lawrence O'Neill, of Murray; B. Flaig, of Wardner, and others.

Kansas City, Mo.—Joseph Heim, Pres. East Fifth St. electric road, is stated to have filed plans with the Board of Public Works, and was given permission to construct the new road at once.

Ferguson, Mo.—The Suburban R.R. Co. is stated to have received a franchise.

Warren, O.—It is stated that the Cleveland & Chagrin Electric Ry. Co. will extend its line to Warren.

Canton, O.—The Canton & Massillon Electric Ry. Co. will extend its line on Navarre St. and Garfield Ave., a distance of two miles.

Key West, Fla.—See "Power Plants, Gas and Electricity."

Lookout Mountain, Tenn.—The Lookout Mountain & Lula Lake Ry. Co. (Incline No. 2) is stated to have applied to the Commissioners for franchises on a number of thoroughfares on the mountain.

New Rochelle, N. Y.—The Westchester Electric Ry. Co. is stated to have received a franchise.

RAILROADS.

Guthrie, Okla.—The Arkansas, Guthrie & California R.R. Co. has been organized to build a line between here and Shawnee; capital, $50,000. Directors: Henry Hudson, Chicago; H. L. Miller, Guthrie; W. S. Search, Shawnee, and others.

Bryan, Tex.—The citizens are reported to be agitating the question of building a railroad from here to Stone City to connect with the Hearne & Brazos Valley, a distance of about 11 miles.

Farmington, Mo.—A charter is stated to have been granted to the Farmington & Irondale Ry. Co., with a capital of $20,000, to build and operate a line of standard gauge railway from Irondale to Farmington, a distance of about 20 miles. Incorporators: H. J. Cantwell, W. Carter and others.

Boise, Idaho.—A charter has been granted to the Idaho Northern R.R. Co.; capital, $2,500,000. Directors: W. Thos. Hart, of Weiser; Bamford Robb, of Portland, and Joseph Perrault, of Boise.

Delavan, Wis.—It is stated that the Milwaukee & St. Paul Ry. Co. will build a 2½ mile extension to Delavan Lake.

NEW DEPOTS.

Spokane, Wash.—It is stated that work will soon commence on the depot which the Great Northern R.R. Co. proposes to erect here. Three bridges will be erected in connection with same. Jas. R. Hill, Pres., St. Paul, Minn.

Denison, Ia.—It is reported that the Northwestern Ry. Co. proposes to build a $40,000 depot here in the spring.

PUBLIC BUILDINGS.

Youngstown, O.—Bids are wanted Dec. 16 for $54,000 bonds to be used for the equipment of the Mahoning County Infirmary, plumbing, lighting, etc. C. F. Brenner, Co. Aud.

Boston, Mass.—Plans submitted by Chas. F. McKim, 160 5th Ave., New York City, have been provisionally accepted for the proposed music hall; probable cost, $300,000.

Kankakee, Ill.—It is stated that plans are being prepared by J. T. Fortin, New Era Building, Chicago, for a $40,000 hotel.

Fargo, N. D.—Walker Bros. are stated to be interested in the building of a $45,000 opera house.

New Haven, Conn.—It is stated that a $50,000 addition will be erected to the Garde Hotel. W. H. Garde, Proprietor.

Detroit, Mich.—The Board of Works has decided to recommend that the contract for the G. A. R. memorial building be given to Spitzley Bros., 83 Beacon St., Detroit, at $39,000.

Calumet, Mich.—It is reported that this village has voted to issue $20,000 bonds to build an opera house.

Los Angeles, Cal.—The Alta Planing Mill Co., 7th and San Pedro Sts., Los Angeles, is stated to have received the contract for the Chester Building at $40,850.

Pittsburg, Pa.—It is stated that plans are being prepared by Chas. Bickel, 524 Penn Ave., Pittsburg, for a 14-story office building for Smithfield St.; probable cost, $750,000. I. P. Thurman, Arch St., Allegheny, is said to be interested.

Cincinnati, O.—Crapsey, Carroll & Crapsey, Sam'l Hannaford & Son, J. W. McLaughlin and Harry Hake, all of Cincinnati, are stated to have received 1st, 2d, 3d and 4th prizes respectively for the proposed Saengerfest Building.

Charleston, S. C.—Bids are wanted Dec. 23 for erecting the Auditorium, as advertised in "The Engineering Record."

Albany, Ore.—It is stated that bids are wanted, Jan. 6, for remodelling and improving brick court-house. Frank Crabtree, Co. Clk.

Shelton, Conn.—The Episcopal Society of the Good Shepherd is said to be preparing to build a $30,000 church. Rev. F. H. Mathison.

Dallas, Tex.—Bids are wanted, Dec. 15, for the erection of a synagogue. J. Riely Gordon and H. A. Overbeck, Associated Archts., for Com.

Lexington, Ky.—Bids are wanted Dec. 19 for the erection of a temporary structure at the Kentucky State Houses of Reform. Mrs. L. E. Yandell, Pres., 315 Broadway, Louisville.

Madison, Minn.—It is reported that the County Commissioners are considering plans for a new court-house.

Lebanon, Ind.—The Commissioners of Boone County are said to be considering the matter of erecting a $150,000 court-house.

Lowville, N. Y.—The matter of erecting a $15,000 town hall is said to be under consideration.

Boston, Mass.—The plans of F. A. Norcross, 110 Tremont St., Boston, have been approved for a store and apartment building, to be erected at 121 Chambers St., to cost $50,000. Louis Seigal is owner.

Baltimore, Md.—The City Council has passed an ordinance appropriating $60,000 for ground and buildings for an infectious disease hospital.

Chicago, Ill.—N. S. Crowen, 707-85 Dearborn St., Chicago, is said to be preparing plans for a $65,000 wholesale building.

New York, N. Y.—The Trustees of the Columbia University, at a meeting Dec. 5, are said to have adopted the plans of McKim, Mead & White, 165 5th Ave., for four buildings; probable cost, $750,000.

Youngstown, O.—R. F. & E. R. Thompson, 13 Central Square, Youngstown, are said to be preparing plans for a $100,000 office building.

Jefferson City, Mo.—F. B. Miller, Archt., of this city, is stated to be interested in the erection of a $25,000 opera house.

Liverpool, N. S.—Bids are wanted Dec. 23 for a public building. E. F. E. Roy, Secy. Dept. Pub. Wks., Ottawa, Ont.

Ashland, Ky.—It is stated that bids are wanted Jan. 3 for a church. J. R. Geiske, Archt., Ceredo, W. Va.

FIRES.

Lincoln, Neb.—The Lincoln Normal University is reported to have been destroyed by fire; loss, $100,000.

Rochester, N. Y.—The Academy of Music is stated to have been burned Dec. 2; loss about $40,000.

New Bedford, Mass.—The garbage plant on Athaway Road, owned by Edgar H. Gammons, was burned Dec. 2; loss, about $40,000.

Alton, R. I.—The woollen mill of Wm. A. Walton, of Providence, has been destroyed by fire; loss said to be $125,000.

NEW FACTORIES.

Messrs. Hartwell Brothers, Vincennes, Ind., write that the recent fire in their factory did no harm to the steam plant. They will, however, start a small branch works in Illinois and will require a boiler and engine of 30 to 50 horse-power.

The Consumers' Ice Company, Clarksburg, W. Va., will build an ice plant, 38x85 feet.

The Wichita Union Mill Co., Wichita, Kan., will erect a building 30x34 feet, with 75 to 100 horse-power in steam plant.

The Belle City Malleable Iron Co., Racine, Wis., writes that its burned molding department, comprising buildings which if put in a straight line would be 900 feet long and 76 wide, will be rebuilt at once with brick.

The P. Wall Manufacturing Supply Co., Allegheny, Pa., is building an addition to its factory 90x130 feet, and contemplates a change of power from steam to gas.

MANUFACTURING NOTES.

The Cutler Manufacturing Company, Rochester, N. Y., gives an interesting evidence of the prompt effect of territorial expansion in the fact that it is about shipping its first mail chute to Honolulu, to be erected in the Judd Building.

The Pittsburg Terra Cotta Lumber Company announces the development of an export trade for its product. Material for fire-proofing a building for the Tramway Power Company, in Dublin, Ireland, was sent some time ago from East Palestine, O., and workmen from this country have put in place about 1,500 tons of the work. Another contract, amounting to about a thousand tons, has been received for a municipal building to be erected in the City of Mexico.

President J. W. Duntley, of the Chicago Pneumatic Tool Co., has sailed for Europe to look after business connections in Great Britain and on the continent. The company reports an increasing call for its tools, taxing to the utmost its increased manufacturing facilities.

The Buffalo Forge Company has recently received the following letter from a firm in Paris, Pontibriand & Frére, Limiteé: "We are very glad to inform you that we have our new foundry in operation since last week. We have already casted twice and your blower gives us very good satisfaction."

The Berlin Iron Bridge Company, of East Berlin, Conn., is erecting for the town of Whitehall, Washington County, N. Y., a riveted girder bridge having a span of about 70 feet. The bridge is of latticed girder type, with steel floor beams, and of a design to carry, besides ordinary traffic, the weight of a steel road roller.

BUILDING INTELLIGENCE.

NEW YORK, N. Y.

278-284 Cherry st, 3 br stores and tenements; cost, $30,000 all; o, Jos W Kierst; a, Fred T Camp.

318 E 9th st, br stores and flat; cost, $20,000; o, August Ruff; a, Kurtzger & Rohl.

287-297 Elizabeth st, 4 br stores and flat; cost, $99,000 all; o, Friedman & Feinberg; a, M. Bernstein.

83-87 Jackson st, br stores and tenement; cost, $20,000; o, Solomon Levin; a, Sam Sass.

89-91 Jackson st, n w cor South st, br tenement and stores; cost, $25,000; o, Solomon Levin; a, Sam Sass.

394-351 E 3d st, 2 br tenements; cost, $36,000 all; o, Lena and Sarah Michelson; a, Horenburger & Straub.

175 Monroe st, br flat; cost, $22,000; o, Fay & Stacom; a, Chas Rentz.

N s W. Houston st, 35 w Hancock st, 3 br stores and flats; cost, $84,000 all; o, Laurowitz & Fine; a, G Fred Pelham.

134 W 45th st, br stable; cost, $15,000; o, Wm E Fein; a, Louis Korn.

S s 123d st, 80 e 2d ave, br tenement; cost, $70,000; o, C B Drew; a, Geo S Drew.

Madison av, s e cor 94th st, 2 br flats; cost, $175,000 all; o, Jas H Havens; a, Neville & Bagge.

S s 75th st, 252 e 1st ave, br store and flat; cost, $40,000; o, Adolph Wiedhoff; a, Edw Wenz.

N s 92d st, 175 w Central Park W, br flat; cost, $120,000; o, Paul B Pugh & Co; a, G A Schellenger.

N s 108th st, 400 w Columbus ave, 2 br flats; cost, $40,000 all; o, Edward Miller; a, John Hauser.

S s 100th st, 175 e Amsterdam ave, 5 br and stone stores and flats; cost, $125,000 all; o, Chas Kervan; a, Henry Anderson.

N s 108th st, 100 w Central Park W, 2 br flats; cost, $130,000 all; o, Thos J McLaughlin; a, Henry Anderson.

Central Park W, s w cor 68th st, granite marble and br church; cost, $200,000; o, N Y Second Church of Christian Scientists; a Frederic R Comstock.

N s 107th st, 187 w Columbus ave, br storage; cost, $60,000; o, Bernheimer & Schmid; a, Louis Oberlin.

E s 3d ave, 125 n 171st st, 4 br flats; cost, $88,000 all; o, Emil Goldner; a, Rudolph Werner.

Washington ave, s e cor Wendover ave, 6 br flats; cost, $113,000 all; o, Emil Goldner; a, Rudolph Werner.

E s Brook ave, 286 s 168th st, br flat; cost, $15,000; o, Dennis Farrell; a, W C Dickerson.

Bathgate ave, n e cor 174th st, 2 br flats; cost, $33,000 all; o, Newfield & Cohen; a, M Bernstein.

N s 139th st, 250 e St Anns ave, 8 br flats; cost, $120,000 all; o, Lottie Rattner; a, M Bernstein.

Jackson ave, n e cor Cedar pl, br flat; cost, $18,000; o, Jennie E Miller; a, Edw Wenz.

E s Washington ave, 400 n 164th st, 3 br flats; cost, $68,000 all; o and a, Lorenz F. Weiher, Jr.

N s 135th st, 100 e Brook ave, 6 br flats; cost, $150,000 all; o, Chas Wahlig; a, Edw Wenz.

MISCELLANEOUS.

Canton, O.—N w cor Public Square, 5-story steel business block; cost, $50,000; o, Kenney Bros, Canton, O.

Elmhurst, Pa.—Stone and frame residence; cost, $20,000; o, Col L A Watres; a, J R Comstock, 98 5th Ave, New York City.

Newport News, Va.—Washington av, 4-story br bank block; cost, $16,000; F F Finch, o; W D Hill, a. Twenty-eighth and Lafayette, br business block; cost, $11,000; D S Jones, o; G E Connel, a.

PROPOSALS OPEN.

Bids Close. — See Eng. Record.

WATER-WORKS.

Dec. 12. Plant, etc., Orange, N. J .... Dec. 10
Dec. 12. Boston, Mass .... Dec. 10
Dec. 13. Pipe, etc., Boston, Mass .... Dec. 10
Dec. 15. Somerville, Tenn........ Dec. 3
Adv., Eng. Record, Dec. 3.
Dec. 15. Bonds, Somersworth, N. H........ Dec. 10
Dec. 16. Bonds, Little Falls, Minn........ Dec. 3
Dec. 20. Pump, Dunkirk, N. Y........ Dec. 10
Dec. 20. Orangeburg, S. C .... Dec. 10
Dec. 31. Brass castings, Chicago, Ill........ Dec. 10
Jan. 1. Crisfield, Md .... Nov. 12
Jan. 3. Bonds, Gaffney, S. C........ Dec. 10
Mar. 15. Belem, Para, Brazil........ Nov. 26
—— Pump, Austin, Tex........ Sept. 10
—— Tempe, A. T........ Nov. 5
Adv., Eng. Record, Nov. 5, 12.

SEWERAGE AND SEWAGE DISPOSAL.

Dec. 10. Washington, D. C........ Nov. 5
Adv., Eng. Record, Nov. 5.
Dec. 12. Little Rock, Ark........ Dec. 3
Dec. 12. Oakland, Cal .... Dec. 10
Dec. 13. Philadelphia, Pa. .... Dec. 3
Dec. 13. Independence, Mo........ Dec. 3
Dec. 15. Philadelphia, Pa........ Dec. 10
Dec. 17. Evansville, Ind........ Dec. 10
Dec. 19. Newburgh, N. Y .... Nov. 19
Dec. 20. Orangeburg, S. C........ Dec. 10
Dec. 26. South Bend, Ind........ Dec. 10
Dec. 30. East Cleveland, O........ Dec. 3
Jan. 2. Bonds, Hamilton, O........ Dec. 10
Jan. 2. Hamilton, O........ Dec. 10
Jan. 3. Cincinnati, O........ Dec. 10
Jan. 10. Bonds, Grass Valley, Cal........ Dec. 3
Jan. 15. New York City........ Dec. 3
—— Pittsburg, Pa........ Nov. 5

BRIDGES.

Dec. 13. Philadelphia, Pa........ Dec. 3
Dec. 13. Sigourney, Ia........ Dec. 10
Dec. 15. Valatie, N. Y .... Dec. 3
Adv., Eng. Record, Dec. 3, 10.
Dec. 20. Blair, Neb........ Dec. 10
Dec. 22. Lorain, O........ Nov. 5
Dec. 28. Chicago, Ill........ Nov. 5
Adv., Eng. Record, Dec. 3.
Dec. 28. Norfolk, Va........ Dec. 3
Adv., Eng. Record, Dec. 3, 10.
Dec. 31. Plattsmouth, Neb........ Dec. 10
Jan. 1. Cathlamet, Wash .... Nov. 26
Jan. 2. Quebec, P. Q........ Oct. 1
Adv., Eng. Record, Oct. 1, 8.
Jan. 3. Brookhaven, Miss........ Nov. 19
Jan. — Hastings, Neb .... Dec. 10
—— New Kensington, Pa........ Oct. 22
—— Plans, Lafayette, La........ Dec. 3

PAVING AND ROADMAKING.

Dec. 12. Dayton, O........ Nov. 19
Dec. 13. Philadelphia, Pa........ Dec. 3
Dec. 13. Buffalo, N. Y........ Dec. 10
Dec. 14. Indianapolis, Ind........ Dec. 3
Dec. 15. Beaumont, Tex........ Dec. 3
Dec. 15. Jacksonville, Fla........ Nov. 26
Dec. 15. Philadelphia, Pa........ Dec. 10
Dec. 15. Pittsburg, Pa .... Dec. 10
Dec. 16. Meadville, Pa .... Dec. 10
Dec. 17. Crownpoint, Ind........ Nov. 26
Dec. 19. Hamilton, O .... Nov. 26
Dec. 19. Bonds, Lancaster, Ky........ Dec. 10
Dec. 19. Bonds, Lima, O........ Dec. 10
Dec. 20. Cincinnati, O .... Nov. 26
Dec. 21. Hoboken, N. J........ Dec. 3
Dec. 22. Jacksonville, Fla........ Dec. 10
Dec. 26. Atlantic City, N. J........ Dec. 10
Dec. 29. Bonds, Georgetown, Ky........ Dec. 3
Jan. 2. Bonds, Tippecanoe City, O........ Dec. 10
Jan. 5. Decatur, Ind........ Dec. 3
Feb. 27. Yonkers, N. Y........ Dec. 3

POWER, GAS AND ELECTRICITY.

Dec. 13. Stockton, Cal........ Nov. 26
Dec. 13. Middleport, N. Y........ Dec. 10
Dec. 13. Power plant, etc., Boston, Mass........ Dec. 10
Dec. 15. Somerville, Tenn........ Dec. 3
Adv., Eng. Record, Dec. 3.
Dec. 15. Sherbrooke, Que........ Dec. 10
Dec. 16. Bonds, Little Falls, Minn........ Dec. 3
Dec. 16. Bonds, Youngstown, O........ Dec. 10
Dec. 17. Gas fixtures, San Bernardino, Cal........ Dec. 10
Dec. 19. Wiring, etc., New York, N. Y .... Dec. 10
Dec. 19. Colton, Cal........ Dec. 3
Dec. 20. Electric Light Plant, Mt. Pleasant, Mich .... Dec. 3
Dec. 20. Orangeburg, S. C........ Dec. 10
Dec. 20. Royal Oak, Mich........ Dec. 10
Dec. 26. Waterloo, N. Y........ Dec. 10
Dec. 27. Woodsfield, O........ Dec. 3
Dec. 27. Gas fixtures, Washington, D. C........ Dec. 10
Dec. 29. Power plant, etc., San Francisco, Cal........ Dec. 10
Jan. 1. Pasadena, Cal........ Dec. 3
Jan. 1. Bonds, Lawton, Mich .... Nov. 26
Jan. 2. Vincennes, Ind .... Oct. 22
Adv., Eng. Record, Oct. 22, Nov. 12, 26.
Jan. 6. Johannesburg, So. African Repub........ Oct. 22
Jan. 16. Duluth, Minn .... Dec. 10
Mar. 31. Telephone, Shanghai, China........ Nov. 1

GOVERNMENT WORK.

Dec. 10. Crane, New York, N. Y........ Nov. 5
Dec. 10. Storehouse, New York, N. Y........ Dec. 3
Dec. 13. Power plant, etc., Boston, Mass........ Dec. 10
Dec. 15. Dikes, etc., Portland, Ore........ Dec. 3
Dec. 17. Wiring, etc., New York, N. Y .... Dec. 10
Dec. 20. Revetments, Duluth, Minn........ Nov. 26
Adv., Eng. Record, Nov. 26 to Dec. 10.
Dec. 21. Toms River, N. J........ Dec. 10
Dec. 23. Metal work, etc., Tompkinsville, N. Y........ Nov. 19
Dec. 23. Cement and gravel, Mobile, Ala........ Nov. 26
Adv., Eng. Record, Nov. 26 to Dec. 10.
Dec. 27. Gas fixtures, etc., Washington, D.C. Dec. 10
Dec. 29. Boiler plant, etc., San Francisco, Cal. Dec. 10

BUILDINGS.

Dec. 10. School, Wever, Ia........ Nov. 26
Dec. 12. Bridgeton, N. J........ Nov. 26
Dec. 12. School plumbing, Washington, D.C. Dec. 10
Dec. 13. Brooklyn, N. Y........ Dec. 3
Dec. 15. Htg. Plant in School, Flandreau, S. Dak........ Dec. 3
Dec. 15. School, Ellendale, N. Dak........ Dec. 3
Dec. 15. Dallas, Tex .... Dec. 10
Dec. 16. Bonds, Youngstown, O........ Dec. 10
Dec. 17. School, Chattanooga, O........ Dec. 3
Dec. 21. Atlanta, Ga........ Oct. 29
Dec. 19. Lexington, Ky........ Dec. 10
Dec. 23. Liverpool, N. S .... Dec. 10
Dec. 23. Charleston, S. C........ Dec. 3
Adv., Eng. Record, Dec. 10.
Dec. 27. Ventilating, etc., Cleveland, O........ Dec. 3
Jan. 2. School, Luverne, Minn........ Dec. 10
Jan. 3. Plans, Albany, N. Y .... Dec. 3
Jan 3. Ashland, Ky........ Dec. 10
Jan. 6. Albany, Ore........ Dec. 10
Jan. 9. School, Wilmington, Del........ Dec. 3
Jan. 10. Phoenix, Ariz........ Dec. 3
Jan. —. Superstructure, Newport, R. I........ Nov. 19
Feb. 1. School, Peoria, Ill........ Dec. 3
—— Pittsburg, Pa........ Dec. 3
Feb. 10. Keyser, W. Va .... Nov. 5
—— Machine shop, Birmingham, Ala........ Sept. 3

MISCELLANEOUS.

Dec. 12. Levee, New Orleans, La........ Dec. 10
Dec. 13. Pier, etc., Philadelphia, Pa........ Dec. 3
Jan. 24. Park plans, Philadelphia, Pa........ Nov. 19
Dec. 15. R. R., Valatie, N. Y........ Dec. 3
Adv., Eng. Record, Dec. 3, 10.
Dec. 15. Grade crossing, Philadelphia, Pa........ Dec. 10
Dec. 19. Engrs. supplies, New York, N. Y........ Dec. 10
Jan. 24. Tunnel, London, England........ Nov. 5
Mar. 15. El. Ry., Shanghai, China........ Nov. 19
—— Garbage crematory, Newport, Ky. July 30
Adv., Eng. Record, July 30.

NEW SCHOOLS.

Worcester, Mass.—The School Committee has voted to recommend the erection of a high school at the South End.

Ft. Berthold, N. D.—See "Government Work."

Chester, Pa.—It is stated that Seymour Davis, Walnut St., Philadelphia, is completing plans for the proposed high school; probable cost, $125,000. Wm. S. Johnson, Chmn. Com.

Cleveland, O.—The members of the Euclid Ave. Congregational Church are stated to have decided to erect a Sunday-school building to cost about $30,000.

Chicago, Ill.—It is stated that plans are completed for the North Division High School; estimated cost, $150,000.

Port Chester, N. Y.—The matter of erecting a high school is said to be under consideration.

Santa Barbara, Cal.—It is stated that an election will be held Dec. 17 to vote on issuing $50,000 school bonds.

Moline, Ill.—At the April election the citizens will probably be asked to vote on issuing $25,000 bonds for a school.

Lynchburg, Va.—It is reported that J. L. Pettyjohn & Co., of Lynchburg, have received the contract for a high school at $18,000.

Luverne, Minn.—Bids are wanted Jan. 2 for a school in District No. 24. T. Johnson, Clk. School Bd.

Washington, D. C.—Bids are wanted Dec. 12 for reconstructing and replacing a portion of the plumbing system in the Grant school. J. B. Wight, Chmn. Commrs. D. C.

STREET CLEANING AND GARBAGE DISPOSAL.

Cairo, Ill.—The City Council has been petitioned to pave Ohio Levee Street with brick, according to plans prepared by Chas. Trupp, City Engr.

Camden, N. J.—The Street Committee of the City Council has decided to advertise for proposals for necessary repairs to garbage crematory.

Philadelphia, Pa.—The following bids were opened Dec. 5 at the Bureau of Street Cleaning, Dept. of Pub. Wks., for cleaning the streets, the city having been divided into six districts: *a*, R. & J. Peoples, 25th and Callowhill Sts.; *b*, Oliver Wilson, 734 S. 17th St.; *c*, Daniel Dooley, 4831 Lancaster Ave.; *d*, M. F. Gallagher; *e*, R. P. Bennis, Germantown, Pa.; *f*, R. W. Elliott, 1404 Moyamensing Ave.; *g*, Thomas Parker, 9 N. 13th St.; *h*, Robert Higgins, 4655 Lancaster Ave.; *i*, James Curran, 2617 Williams St.; *j*, George W. Ruch, 2851 Hutchinson St.; *k*, D. McMahon & Co., P. O. Bldg., Germantown, Pa.; *l*, E. H. Vare, 704 Betz Bldg.; *m*, John Laughlin & Co., 1312 Filbert St.

District No. 1, *k*, $83,950; *l*, $83,700; *f*, $84,777; *j*, $85,339; *b*, $87,297; *c*, $87,700; *g*, $90,000; *a*, $91,000.

District No. 2, *l*, $144,989; *j*, $147,225; *k*, $147,750; *a*, $148,800; *m*, $148,944; *g*, $149,900; *f*, $159,899; *c*, $160,000; *b*, $163,-999.

District No. 3, *c*, $43,900; *k*, $43,950; *j*, $46,700; *l*, $47,000; *h*, $47,400; *a*, $52,-000; *g*, $53,000.

District No. 4, *j*, $124,980; *k*, $134,750; *i*, $134,970; *a*, $138,400; *m*, $138,690; *g*, $139,444; *l*, $159,000.

District No. 5, *j*, $83,336; *g*, $84,900; *k*, $84,993; *a*, $88,000; *l*, $94,987.

District No. 6, *d*, $19,900; *j*, $21,700; *e*, $21,800; *k*, $23,000; *g*, $26,000; *a*, $28,-000; *l*, $30,000.

Philadelphia, Pa.—The following bids for the removal and disposal of garbage for 1899 were opened Dec. 5 by Thomas M. Thompson, Dir. of Pub. Wks.: American Product Co., 14 S. Broad St., for entire city, $358,000. Geo. W. McClintock, Girard Bldg., for entire city, $389,-000; 4th dist., $139,000; 5th dist., $129,-000. Thos. Parker, 9 N. 13th St., for 1st, 2d and 3d dists., $225,000.

New Bedford, Mass.—See "Fires."

St. Joseph, Mo.—The Board of Health has under consideration the following estimates for a Thackeray incinerator plant: $16,000 for a plant having a capacity of 100 tons per day; $24,000 with 200 tons capacity and $36,000 with 300 tons capacity.

GOVERNMENT WORK.

Moline, Ill.—Bids were opened Nov. 30 at the U. S. Engineer Office, Chicago, for building a high bridge across Rock River, and, according to local press reports, the contract has been awarded to the Milwaukee Bridge & Iron Wks., Milwaukee, Wis. Appropriation, $25,000.

Ft. Berthold, N. D.—Press reports state that Owen & Hill, of Minneapolis, have secured the contract for the school building and water system at Ft. Berthold, N. D., Indian agency, at $34,780.

Washington, D. C.—Bids are wanted Dec. 27 for gas and electric light fixtures in the U. S. post office building. O. L. Spaulding, Acting Secy., Treas. Dept.

San Francisco, Cal.—Bids are wanted Dec. 29 for a boiler plant, pumps and certain modifications and repairs to the power plant and heating apparatus, etc., of the U. S. appraiser's building. James Knox Taylor, Supervising Arch., Treas. Dept., Washington, D. C.

Toms River, N. J.—Bids are wanted Dec. 21 for constructing a life-saving station on Berkley Beach. S. I. Kimball, Gen. Supt. U. S. Life-Saving service, Treas. Dept., Washington, D. C.

New York, N. Y.—Bids are wanted Dec. 17 for enlarging the wiring system and extending the electric light system at the Navy Yard. Mordecai T. Endicott, Ch. Bureau Yards and Docks, Navy Dept., Washington, D. C.

Boston, Mass.—Bids are wanted Dec. 13 for a power plant for rope manufacturing, two horizontal tubular boilers; also for iron pipe, specials, valves, etc., at the Navy Yard. Edwin Stewart, Paymaster Gen. Bureau of Supplies and Accounts, Navy Dept., Washington, D. C.

MISCELLANEOUS.

Philadelphia, Pa.—Bids are wanted Dec. 15 for abolishing grade crossings on the line of Van Kirk St., at Philadelphia & Trenton R.R. Thomas M. Thompson, Dir. Dept. Pub. Wks.

New York, N. Y.—The following bids were opened Dec. 7 by the Department of Sewers for dredging in New York Bay, at the foot of 49th St., in the Borough of Brooklyn: Dubois Bros., 822 President St., Brooklyn, $2,065; William H. Taylor, Jr., 22 Emery St., Jersey City, $1,610.

Philadelphia, Pa.—The Council's City Property Committee has decided to report with a favorable recommendation the bills appropriating $50,000 for the improvement of League Island Park, and $15,000 for Westmoreland Park.

New Orleans, La.—It is stated that bids are wanted Dec. 12 by the State Board of Engineers for 100,000 cu. yds. levee work on the Salem levee, East Carroll parish.

Orders for single copies, to complete files, must give the date of each issue required, and must be accompanied by remittance at rate of twelve cents for each copy desired. Single issues of Volume XXXVIII. will not be obtainable after January 1st, 1899.

THE ENGINEERING RECORD.
Volume XXXIX. Number 3.

TABLE OF LEADING ARTICLES.

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THE COMMERCE OF THE PORT OF NEW YORK.

For several years past merchants of New York have been claiming that the harbor facilities of the port were so deficient that foreign trade was being shifted to other ports. Figures have been printed in "The Engineering Record" and other technical journals showing that to some extent this claim is true. It is but natural, however, that with the development of a country of the size of the United States, having such varied resources and opportunities for commerce with nations in a still undeveloped condition to the south of it, the relative importance of the various ports of entry should vary from year to year. The port of New York, however, occupies a unique position in having a magnificent harbor and a geographical location which makes it the natural outlet for the commerce of a large portion of the country. One of the most thorough students of the resources and capabilities of the port is Mr. George S. Greene, Jr., for many years the chief engineer of the New York Dock Department. In a recent address before the State Commerce Commission he did not take the despondent view of New York's foreign commerce which some merchants of the city have professed to hold, but stated on the contrary that the port was in a very fair condition, and its commerce could be improved without any war against the railroads and the present system of warehousing. To show just how much falling off there has been in the port's foreign commerce, Mr. Greene stated that in 1877 New York had 53.7 per cent. of the imports and exports of the whole country. In 1882 the maximum, 57.9 per cent., was reached, and then there was a fall to 52.7 per cent. in 1890. From that date until 1896 there was a gradual rise to 54.8 per cent., but in 1897 there was a fall to 51 per cent., the decrease in this year being due to the diversion to other points of cotton and food materials valued at $23,000,000. The average percentage of the foreign trade of the country which this port has held in the last twenty-one years is 55.

It will be seen from these figures that although a considerable part of the money of New York and the best energies of some of her citizens who are engaged in the transportation business have been spent, in what must be assumed to have been a shrewd manner, to improve the shipping facilities of other ports, nevertheless. New York has practically held its own. It would be hard to say, in view of these facts, that the management of the port and its facilities for handling goods are so bad as they have been pictured. Mr. Greene points out very clearly that railroads from all parts of the continent connect with lines to the shores of the harbor. Most of them have terminals at the water's edge, and instead of building tracks along the shore to different points, they run their cars on barges holding from eight to twelve each and transport them to any point on the shores of the port or alongside vessels which are ready to receive their contents. This method is a continuation of the track over a roadbed which has cost nothing for right-of-way or construction and demands no expense account for maintenance. Moreover, it avoids the necessity of occupying great areas with tracks, and damaging and obstructing streets in the manner which would otherwise be necessary to give the same facility for handling merchandise. Mr. Greene says that the common belief that tracks connecting with trunk railway lines are desired on piers is entirely erroneous, and he cites a case of fourteen piers on the North River, of which but two have at any time been connected with the tracks of the New York Central Railroad, although such a connection could be made by any of them any time in the last twenty years. He also states that the impression that the charge for transferring freight in the port is high is entirely at fault, and was probably due to a misconception of the deduction of 3 cents per 100 pounds, made by some roads, before apportioning the remainder of their total charge for freight according to the trackage and other elements of cost of transportation and delivery. That is, the total rate is fixed and the same to the shipper, however it may be divided among the different roads and terminals.

Among the complaints against the management of the harbor is the frequent one that the wharfage charges in New York are so high as to force some lines to lease docks on the New Jersey shore of the port, thereby entailing upon the New York merchants the extra cost of transferring their goods over the river, which would be avoided were they delivered on New York docks. Mr. Greene states that the revenues of the Dock Department amount to about $2,000,000 a year, of which sum less than $300,000 is derived from the steamship lines engaged in foreign commerce which have their terminals on the portion of the North River water front between the Battery and West Eleventh Street, the section where the competition for dock facilities has made the rentals highest. The total value of the exports and imports of the port of New York for 1897 was $1,036,000,000, which makes the rentals derived from steamship companies using these high-priced wharves less than one-thirtieth of 1 per cent. of the value of the port's foreign commerce. "If, therefore, by any means and without injustice to the city's creditors, these rentals could be abolished the effect would be small on the whole commerce of the port, though greatly beneficial to those few lines which could obtain the free piers." The remedy which is suggested for the situation of the wharf front near the business center of the city is to provide piers which will accommodate the largest vessels now building or proposed, along the North River from Eleventh to Twenty-third Streets. Such a plan will require the appropriation of a large amount of private property, which will take several years in addition to the time spent in actual construction, and while there is at the present moment no strong demand for such new, large piers, Mr. Greene believes that by the time the plan can be executed there will be no lack of competition for them.

One feature of the physical condition of the port which seems to demand immediate attention is the improvement of the channels leading from the ocean. The draft of vessels has been increasing rapidly; the largest vessels running to and from the port in 1888 drew but 27 feet, while to-day 29 feet may be called the ruling depth. Furthermore, vessels are now building which will have 32 feet draft, and it is obvious that as these are the cheapest ocean carriers, they must be provided with proper wharves and piers if the freight they transport is to come to this harbor. The channel across the bar at Sandy Hook has already been deepened from 24 to 30 feet, and the Corps of Engineers of the United States Army has prepared plans for increasing the depth to 35 feet, which await only the action of Congress before being put in execution.

It has already been stated that the loss of trade to the port in 1897 was confined almost wholly to cotton, breadstuffs and provisions, particularly the latter two. Mr. Greene holds that the enlargement of the Erie Canal, always a prominent feature in the prosperity of New York, would doubtless tend to increase greatly the percentage of exports of these commodities from the port, particularly if the enlargement is of such a nature that vessels or barges traversing the canal can also be used in lake navigation.

In view of the fact that the foreign trade of the country passing through the port of New York last year was only about 4 per cent. below the average of 21 years, that the natural advantages of the port are very great and have been improved somewhat, and that an excellent system of receipt and delivery of freight in all parts of the harbor is well established, Mr. Greene does not consider it advisable to seek for other and very expensive methods of handling the merchandise reaching the port, but suggests the improvement of the wharf front on Manhattan Island between West Eleventh and West Twenty-third Streets, the deepening of the channel at Sandy Hook and the enlargement and improvement of the Erie Canal, as the best methods of improving the commerce of the port. Some of these works would, of course, be done by the city and some by the state, while the channel must be improved by the country. The importance of having the best of facilities for export trade in the New York harbor is, however, very largely a national question. The resources of the country are being developed so rapidly that not only New York, but other ports, should be brought to a condition of reasonable efficiency under broad-spirited guidance which will see that they are developed harmoniously and with due regard to the future as well as the present needs of the whole country.

THE ETHICS OF CERTAIN CHICAGO PAVING CONTRACTS.

On April 17, 1894, a contract was drawn between Messrs. G. W. and W. T. S. Crichfield and the Bermudez Asphalt Paving Company, a Chicago corporation, which led to considerable litigation and finally, in October, to a decision of the Supreme Court of Illinois that throws the searchlight of publicity on the methods employed by one corporation to obtain or increase its business in Chicago. The terms of this interesting contract have been summed up by Judge Magruder substantially as follows:

Section 1 provided that the Crichfields were to act as agents of the company to promote its asphalt paving business in the city of Chicago, and were to devote their whole time, attention and best energies in and about such business as the company might direct for the period of one year from the date of the agreement. Section 2 provided that the company should pay to the Crichfields 17½ cents per square yard for asphalt paving promoted by them for which a contract had been made between the company and the city. It further provided for a payment of certain excesses in the prices of curbing and gutters, which it is unnecessary to go into in this place. If the Crichfields promoted any work, but the company failed to se-

cure a contract for it, no payment was to be made; while on the other hand if they promoted a given amount of asphalt paving, curb and gutter, they were to be paid for it, provided the company secured the contract for it or for an equal amount of work. Section 3 provided that the payment of commissions was to be made on the basis of the estimated amount of work for each contract at the time it was awarded by the city. The next section guaranteed G. W. Crichfield $120 a month and W. T. S. Crichfield $80 a month, these guarantees to constitute a lien in equity on any work for which ordinances were passed prior to the expiration of the period of the contract. Section 5 provided that all incidental expenses and trouble which the Crichfields incurred in promoting asphalt paving, "or in aiding and assisting in the election of officers," or in any other matter pertaining to the promoting of pavement, curbs and gutters was to be borne by the company. The same section stipulated that work of the Crichfields should be in favor of Bermudez asphalt or any other material directed by the company.

Under the terms of this interesting contract, the Crichfields did considerable work and received a large sum of money. As luck would have it, however, they disagreed with the company over the final payment of about $5,000, and accordingly brought an action against the company for this sum. The case was carried to the Supreme Court, and there it was stated that the only question it was necessary to discuss in the matter was whether the contract sued on was one the courts should refuse to enforce.

The precise nature of the services which the contract contemplated may be better understood after reviewing some of the provisions of the laws governing street improvements. When a public street is to be paved in Chicago, the first step is the passage by the Common Council of an ordinance for the improvement. The Council then appoints three of its members, or other competent persons, to report in writing to the Council the estimated cost of the improvement. If the Council approves the report it may order a petition to be filed in the County Court for proceedings to assess the cost of such improvement in the manner provided by the act. Any person interested in any real estate affected by the proposed assesment may file objections to the report, and where no objections are filed within the specified time, default may be entered and the assessment affirmed by the Court. The judgment which is finally rendered by the Court on the assessment is certified by the clerk of the Court, together with the assessment roll, to the officer of the city authorities authorized to collect special assessments. It is specially provided: "All persons taking any contract with the city or village and who agree to be paid from special assessments shall have no claim or lien upon the city or village in any event except from the collection of special assessments made for the work contracted for." Another section provides that: "All contracts for the making of any public improvement to be paid for in whole or in part by a special assessment, and any work or other public improvements, when the expense thereof shall exceed $500, shall be let to the lowest responsible bidder in the manner to be prescribed by ordinance; such contracts to be approved by the Mayor or President of the Board of Trustees; provided, however, any such contract may be entered into by the proper officer without advertising for bids and without such approval by a vote of two-thirds of all the aldermen or trustees elected."

Judge Magruder, who wrote the opinion of the Supreme Court, considers that the meaning of the expression in the contract "to solicit and promote the asphalt paving business in the city of Chicago" is to solicit by the exercise of influence and other means the passage of ordinances and the letting of contracts by the members of the Common Council of that city. This interpretation of the agreement is confirmed by the testimony of the parties. Mr. G. W. Crichfield said that the methods adopted for promoting such business included "the influencing of a public sentiment in favor of that kind of improvement which will result in the passage of ordinances, the making of assessments and the making of contracts." He said that he took whatever steps he deemed advisable, honorable and fair to secure the paving of streets with asphalt. He admits that in some cases he saw aldermen to get them to favor the passage of ordinances and was occasionally present at the Council meetings when these ordinances were considered. Mr. W. T. S. Crichfield testified that he usually followed the ordinance up, to see "that it was properly drafted, and to see that it was passed and that the proceedings were straight, and that when the assessment was ready, if any objections were filed against the paving of the streets with asphalt, he would make an endeavor to get the objectors to withdraw the objections and get the assessment confirmed and get the contract passed."

This testimony is especially significant when read in connection with Section 5 of the contract previously mentioned, and the following facts brought out by the evidence: "This part of the contract may be fairly interpreted to mean that members of the Common Council were to be elected who should favor the awarding of paving contracts to the company. The evidence shows that George W. Crichfield received under this contract from the company $5,432 and that W. T. S. Crichfield received $4,240, making $9,672. The evidence tends to show that they also received other moneys besides those thus mentioned. In addition to this they claim in this case $5,115.41."

The Supreme Court ruled that there are some striking features of this agreement which stamp it as being against public policy. A special assessment for a public improvement under the Illinois statutes is a species of taxation, and is authorized only as an exercise of the taxing power. A special assessment should not be levied except for a needed public improvement. The idea of making a contract to promote the levying of a public assessment, not to secure to the public a needed improvement but to enable a paving company to get a job, is not only against public interest, says the court, but is abhorrent to all proper ideas of justice and honor. Hence it was ruled that any contract by which parties agree to obtain ordinances by solicitation and the exercise of influence on public officials with a view of obtaining contracts resulting from the passage of such ordinances, is against public policy and will not be enforced by the courts. "It makes no difference whether the parties were actually guilty of bribery and corruption under the contract or not. If the performance of the obligation imposed by the contract has an evil tendency or furnishes a temptation to use improper means, the contract is illegal and contra bonos mores. One of the striking features of this contract is that, with the exception of the monthly allowance to be paid to the Crichfields, the compensation to be received by them is contingent on their success in obtaining the necessary legislation for the levying of special assessments and in securing the paving contracts consequent thereupon."

The Supreme Court of the United States long ago decided that contracts for the use of influence to be brought to bear on legislators are void, and it is hard to understand how any parties could put enough reliance in a document of this sort to make it the basis of a suit. In Marshall v. Railroad Company, 16 How. 314, a special contract was sued on whereby the plaintiff was employed to attend the sessions of the Virginia Legislature in order to superintend any proceedings to obtain the right of way through the state on behalf of a railroad company. It was in this case that the United States Supreme Court said: "Bribes, in the shape of high contingent compensation, must necessarily lead to the use of improper means and the exercise of undue influence. Their necessary consequence is the demoralization of the agent who covenants for them. * * * The use of such means and such agents will have the effect to subject state governments to the combined capital of wealthy corporations, and produce universal corruption, commencing with the representative and ending with the elector. * * * It is an undoubted principle of the common law that it will not lend its aid to enforce a contract to do an act that is illegal, or which is inconsistent with sound morals or public policy, or which tends to corrupt or contaminate by improper influences the integrity of our social or political institutions. * * * The sum of these cases is that all contracts for a contingent compensation for obtaining legislation, or to use personal or any secret or sinister influence on legislatures is void by the policy of the law."

The Illinois court says that the contract under consideration was one providing for a contingent compensation for obtaining ordinances for paving. An ordinance passed by the Common Council providing for the paving of a public street is a species of legislation as much as an act passed by the Legislature, though the body passing it is subordinate in its character and created by the Legislature itself. The rule, therefore, which makes void a contract for a contingent compensation for obtaining legislation is held to apply as well to the Common Council of a city as to the Legislature of a state.

It was claimed during the trial that the expenses and trouble contemplated by Section 5 of the contract may not have been incurred or suffered. In other words, the means provided for in that section for accomplishing the purpose of the contract need not necessarily be resorted to, and may not be resorted to. But the court decides that the section is as much a part of the contract as any other, and that therefore the whole contract is rendered null and void by the illegality of this particular section.

The claim was also made by counsel that the conditions of modern life are widely different from those of the times immediately preceding us, and that, in view of the revolution in business methods which has taken place in modern times, what was decided to be against public policy in the past generation may be a common and ordinary method of doing business today which is approved by the common sense of man. On this head the opinion of the court reads: "That which is against public morals and public decency should be subject to the condemnation of the courts in all generations. Righteousness is the same to-day as it was yesterday. The refinements of modern civilization may have increased the forms of bribery and corruption and made them more dangerous and insinuating, but they are none the less subject to the reprobation of honest men." The counsel further urged that as no question had been raised as to the validity of the contract in the lower courts nor by objections to the introduction of evidence, this particular phase of the agreement was not before the court. It was decided, however, that where a contract is against the common good, it is unnecessary for the defendant in the case to plead this objection.

It seems hardly necessary to add that the court found that Messrs. Crichfield had no legal hold on the Bermudez Asphalt Paving Company for the $5,115.41 they claimed was due them under their contract with the company for lobbying services.

Municipal Gas Works are being erected in Vienna on a tract of about 74 acres. The works consist of four holders of 3,100,000 cubic feet capacity each, a house 750 feet long and 200 feet wide for the inclined retorts, and two houses 270 feet long and 65 feet wide for the condensers and scrubbers, besides the smaller structures necessary for such a plant.

THE AMERICAN ROTARY KILN PROCESS FOR PORTLAND CEMENT.

[By Frederick H. Lewis, M. Am. Soc. C. E.]

It is probable that in the great group of primary manufactures nothing is attracting more general attention and interest at this time than the rotary kiln process for cement. To compare it with the Bessemer process, which so enormously increased the output and decreased the cost of steel, would be to exaggerate the facts, yet, dealing with smaller factors, the rotary kiln is advancing the cement industry in America on quite similar lines. The facts in regard to the production of different types of cement kilns are as follows:

Intermittent kilns	15 to 30 barrels per day
Continuous shaft kilns......	40 to 80 " " "
Rotary kilns	120 to 180 " " "

In conjunction with this large output from rotary kilns there is an even more marked decrease in the labor cost, not only in the manipulation of the kilns, but in the preparation of raw materials and in the handling of clinker. In fuel consumption, on the contrary, rotary kilns are not economical, for reasons which will appear later. A comparison in this respect would be about as follows:

Intermittent kilns require	25 to 35 per cent. of fuel (coke)
Continuous shaft kilns require	12 to 16 per cent. of fuel (coal)
Rotary kilns............	30 to 40 per cent. of fuel (coal)

Dismissing intermittent kilns as an obsolete type, a comparison of costs under American conditions between rotary and continuous shaft kilns would be somewhat like this, the figures being only for handling kilns and those kiln accessories which differ in the two processes:

	Rotary Kiln.	Continuous Shaft Kiln.
Labor cost per barrel...	2½ to 4 cts.	12 to 14 cts.
Fuel " " " ...	11 to 15 cts.	5 to 6 cts.

To complete the comparison, there must be added to the figures for shaft kilns the further sum of 1.25 cents per barrel, representing the interest on the greater cost of a shaft-kiln plant. It requires five shaft kilns to equal the product of two rotaries, while the cost, kiln for kiln, is rather less in the rotary plant. From the data presented there is apparently a present economy of several cents per barrel in favor of rotary kilns, with the economics of the process by no means yet exhausted. It will be seen, too, that the rotary kiln is advancing the industry on exactly those lines which have established economical production in other great industries in America, and which are necessary under American conditions, viz., the substitution of fuel and power for labor.

Under the stimulus of a suitable process, the American Portland cement industry is developing at an extraordinary rate. The rotary kilns already installed and operated have an annual capacity of quite 3,000,000 barrels, and the new plants building and projected seem likely to double this capacity within a twelvemonth. In 1899 the greatest cement producing plant in the world will be that of the Atlas Cement Company, now operating 29 rotary kilns in the Lehigh Valley and building others.

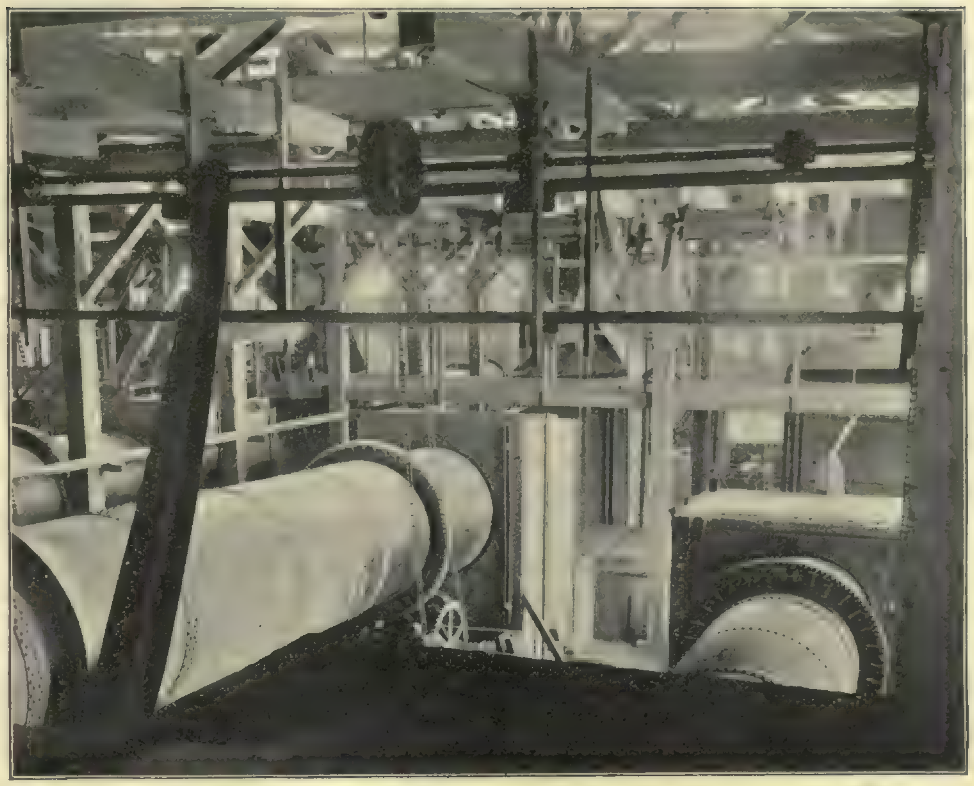


FIGURE 4.—INTERIOR OF KILN BUILDING, WARNERS, N. Y.

The introduction of these kilns abroad is receiving general attention from progressive men, and at several points experimental rotary kilns are under way, while one large enterprise is being exploited.

Rotary furnaces for one purpose or another have been used for many years, hence there is nothing new or novel in this general type of furnace. In 1885, however, Mr. Frederick Ransome patented in England a plant of this kind for cement making purposes. An American patent was issued to him in the following year, and in Figure 1 will be found a copy of the drawing attached to his American patent. His claim under this patent is substantially for the calcination of cement in a rotary furnace by means of gas. His device, as will be seen, is a cylinder made of boiler iron and lined with fire bricks. It is set at a slight inclination to the horizontal, carried on roller supports at two points, and turned by rack and worm. The wet raw materials usually employed in England had to be previously dried and ground and were introduced into this kiln in the form of powder. The forward movement of the material resulted, of course, from the revolution of the inclined cylinder. The material, which was carried up the sides by the motion of the kiln, fell forward under the action of gravity through an angle represented by the pitch of the kiln. Thus it slowly advanced in a zigzag course from one end to the other.

In type this kiln is quite the same as those now employed here. But as built in England they were much smaller in diameter and much shorter than those now used. These kilns were very fully exploited at the Gibbs works at Gray's on the Thames, some 30 miles below London, and kilns of Ransome's design were built at a number of other places in England. They were, however, found practically unsuccessful, chiefly because of the balling of clinker on the lining and the inequality of the product. It was also probably much more expensive in fuel than was anticipated. For these reasons the process was abandoned in English cement works.

The Atlas Cement Company in this country was organized at the time Ransome was introducing his kilns in England, and, becoming interested in his system, introduced it in this country first in a plant on the Hudson River near Rondout, and later, with more favorable raw material, at Coplay, in the Lehigh Valley of Pennsylvania. The hard, dry raw materials found at Coplay were admirably suited to the rotary kiln process. Nevertheless many prac-

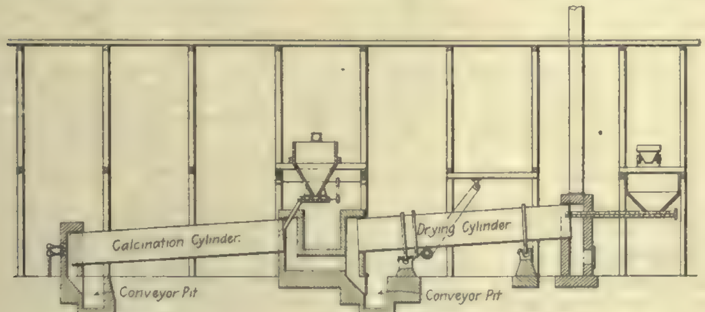


FIGURE 3.—FIRST KILN FOR WET MATERIALS, WARNERS, N. Y.

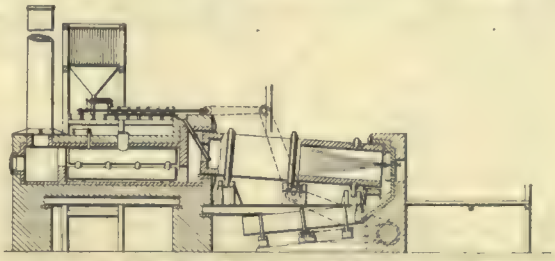


FIGURE 5.—KILN PROPOSED BY GIRON, 1893.

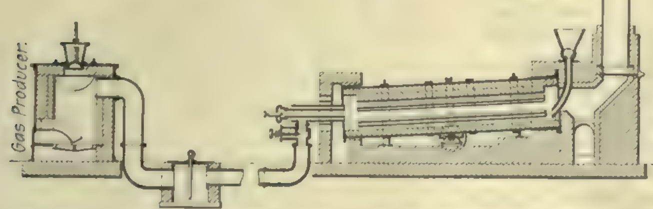


FIGURE 1.—THE ORIGINAL ROTARY KILN; RANSOME'S PATENT OF 1885.

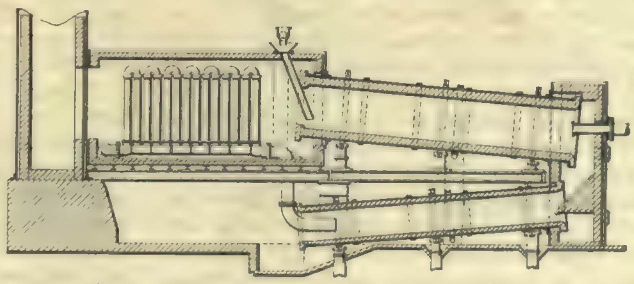


FIGURE 2.—NAVARRO'S IMPROVED KILN OF 1891; FIRST AMERICAN PRACTICE.

tical difficulties were encountered, and there was an immense amount of expensive experimenting required before correct and economical practice could be established with rotary kilns. Without in any way detracting from the work of others, the chief factor in the successful development of the rotary process has unquestionably been the Atlas Cement Company, and to its proprietors the credit may be freely accorded.

Figure 2 illustrates the patent taken out in 1891 by Mr. J. F. de Navarro, of the Atlas Cement Company, for a system of regenerating the heat of the kilns and securing greater economy in fuel. It will be seen that there is a hot air stove in the chimney flue and an auxiliary cylinder for receiving and cooling clinker. The air for combustion passes first through the stove and then over the hot clinker, reaching the kiln in a heated condition. It is stated in the patent that this regenerative system is to be used in conjunction with gas fuel. This would indicate that gas was still employed as fuel in 1891, and, further, that it was expensive, very much more so, no doubt, than had been claimed in England, where the coal required for the gas producers had been estimated to be 16 to 20 per cent. of the cement produced. Not

ment Company, before the Engineers' Club of Philadelphia, in April, 1893. (See the "Proceedings" of the Engineers' Club of Philadelphia, Volume x., number 3.) It shows the cooling cylinder for clinker which appears in Mr. de Navarro's patent of 1891, but in place of a hot-air stove in the chimney flue, Mr. Giron has substituted a boiler. It is interesting to record that in spite of these suggestions for utilizing waste heat very little has been practically accomplished in this direction. The kilns are now used with little or no attempt to utilize the heat of chimney gases, while the heat of the clinker is utilized to a very limited extent, and, as a matter of fact, when the latter is done its purpose is more to cool the clinker than to utilize its heat. Indeed, it can be shown that if the entire heat of the clinker could be regenerated to heat the air required for combustion, it would only heat this air to about 250 degrees Fahrenheit. Practically, of course, no such result could be expected. The chimney gases, however, present much greater possibilities for the regeneration of heat, and practical results in this direction are to be expected in the future.

In the paper mentioned above, Mr. Giron claimed great advantages from a preliminary

carbonic acid would effect much economy of fuel, especially since the temperature required to clinker the cement remains the same.

It is interesting, however, to find that Mr. de Navarro has taken out a patent for the preliminary calcination of raw materials, as shown in Figure 6. This device is extremely ingenious, in that it not only proposes to drive off the carbonic acid, but to collect and utilize it. It consists of a revolving drum, heated externally by a coal fire. The cement mixture passes through the drum and the carbonic acid which is expelled is drawn out by an aspirator and collected in the receptacle shown to the right of the drawing. The material, free from carbonic acid, is carried by conveyor to the rotary kiln at the left. So far as the writer knows this device has not been practically applied on any large scale.

As showing the state of the art in England, Figure 7 is reproduced here from a review of English cement practice written by Messrs. Stanger & Blount, of London, for the "Mineral Industry" of 1896. This is the Stokes process for wet raw materials. The calcination cylinder and the cooling cylinder are readily understood. The peculiarity of the device is in the large drying drum. This is 12 feet in diameter

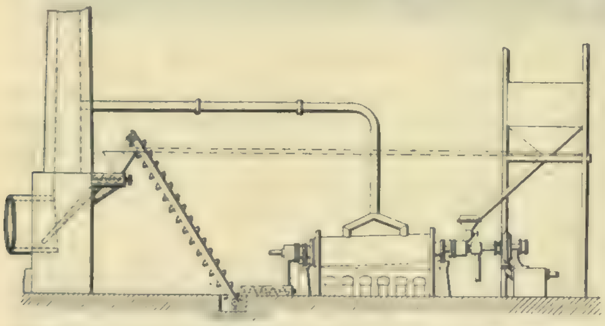


FIGURE 6.—NAVARRO'S PRELIMINARY CALCINATION SYSTEM 1896.

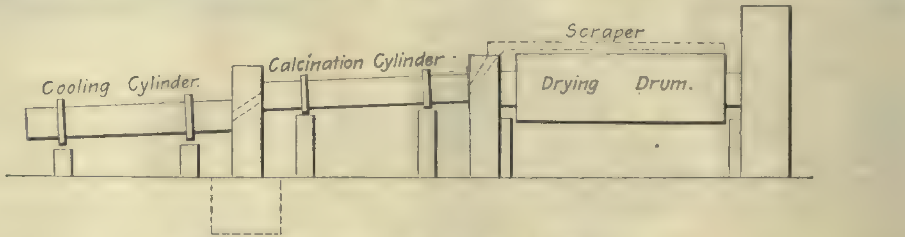


FIGURE 7.—STOKES SYSTEM FOR WET MATERIALS.

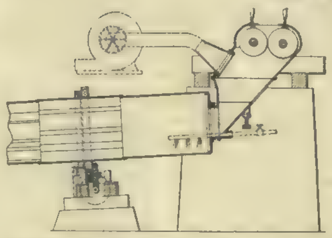
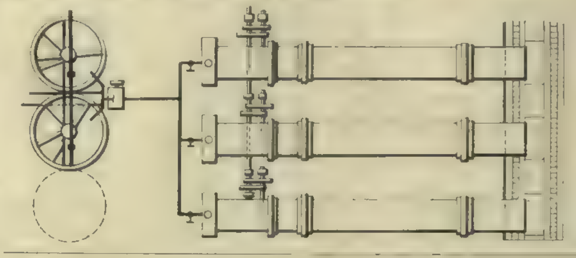


FIGURE 9.—CRUSHING AND SPRINKLING DEVICE OF FIGURE 8.



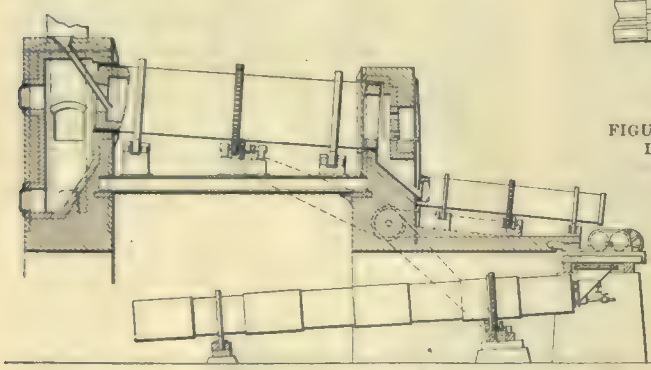


FIGURE 8.—HURRY & SEAMAN'S KILN SETTING, 1895.

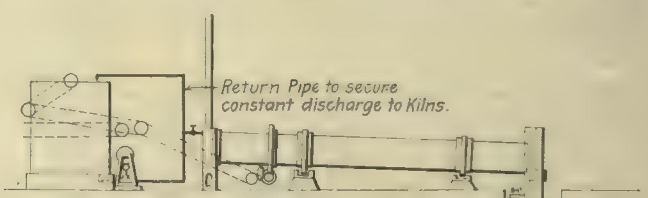


FIGURE 10.—RECENT AMERICAN KILN FOR WET MATERIAL.

long after this, crude petroleum was substituted for producer gas as fuel for rotary kilns, evidently with advantage, since it superseded gas entirely and was the only fuel employed from about 1892 to 1896. Oil is still used, but is being displaced in turn by powdered coal, which is more economical.

In Figure 3 will be found a general sketch of the first application of rotary kilns in America to wet raw materials, as built by the Warner Portland Cement Company in 1892. It will be seen that Ransome, employing wet raw materials, expected to dry them by some separate process. At Warner's this was improved upon by utilizing the high temperature of the chimney gases. In this plant the clay and marl were dried in separate cylinders, and then mixed by weight and the mixture ground to powder before introduction into the kilns. The kilns and drying cylinders were each about 40 feet long.

Figure 4 is a photograph of the interior of the Warner's plant, in which the drying cylinder occupies the foreground of the picture.

Figure 5 illustrates another scheme for effecting economy of fuel in rotary kilns, a matter which has received almost continuous attention. This figure is taken from a paper read by Mr. Giron, formerly superintendent of the Atlas Ce-

calcination of the raw materials, sufficient to drive off the carbonic acid, before they were introduced to the kiln proper. He said: "The absence of carbonic acid gas in the materials facilitates wonderfully the operation of the rotary kiln. The output of burnt cement is doubled and the consumption of oil reduced nearly one-half, compared with the amount required for raw materials. This combination will prove economical where coal is cheap and crude oil expensive." If this view is correct it is of the highest importance, but an examination of the facts in the case leads to the conclusion that Mr. Giron probably based his opinion on insufficient data. It is true that when operating on raw materials in their natural state, 200 pounds of volatile matter must be lifted out of the chimney for every barrel of cement produced. But when it is considered that the products of combustion, including the nitrogen and the free air which are inevitably present, amount to something like 2,000 pounds per barrel of cement, the relative importance of the volatile matter in the cement mixture is seen to be small. When, too, it is considered that at least two-thirds of the theoretical value of the fuel is lost by radiation, dilution and as unutilized heat, it is difficult to believe that the absence of

and 40 feet long. It is unlined, and the products of combustion passing through it, come in direct contact with the metal shell. The wet slurry is deposited continuously on the descending side of the drum as it slowly revolves, while a scraper conveyor removes the (supposedly) dried slurry which forms a crust on the ascending side. This device fairly represents the advance which has been made in England since Ransome first brought out his kiln in 1885. At the present time there is practically no manufacture of cement in rotary kilns in England, and if they are presently introduced there they will be built on American plans.

Figure 8 shows the type of kiln setting patented in 1895 by Messrs. Hurry & Seaman and employed as a process of manufacture by the Atlas Cement Company. The purpose of this arrangement is to cool and cure the clinker regularly and rapidly. Dismissing the kiln proper, which in the drawing presents no peculiarities, there are seen to be two auxiliary cylinders for cooling clinker. The first of these receives the clinker as it falls from the kiln, and is set so as to induce a draft over the hot clinker into the kiln. From this cylinder the clinker falls on water-cooled crushing rolls, discharging by a chute into the lower cooling cyl-

inder. A strong draft is induced through the lower cylinder, so as both to cool and dry the clinker. The detail of this arrangement is shown in Figure 9. In this drawing is shown a sprinkling device below, in addition to the sprinkling which takes place at the crushing rolls. This scheme is excellent, both as a means for cooling and curing clinker and as a labor-saving device for handling it. It constitutes an important improvement in the rotary kiln process.

Figure 10 illustrates the extremely simple scheme now adopted for burning wet raw materials in rotary kilns. The wet slurry contained in the tanks shown to the left of the drawing is introduced into the kiln by a pump. The motion of the kiln and the heat it contains successively accomplish the drying of the slurry, the expulsion of the carbonic acid and the clinkering of the cement. The hot clinker drops in a slender stream from the lower end. The simplicity of the device is such that no one would have thought of it at the outset. This arrangement was gradually reduced to its present form in the course of some years' manufacturing with wet raw materials at the Sandusky plant, in Ohio. Most of the features shown in the drawing were thus developed at Sandusky.

Figure 11 illustrates in section the type of kiln and kiln setting ordinarily found now in plants operating on dry raw materials. In essentials it differs very little from Ransome's. The kiln is very much longer and larger than in early practice, the fuel is powdered coal, the handling of the plant is entirely by mechanical means, the kiln has been reduced to an efficiency, and an economy which are greater, under American conditions, than any other, and its further possibilities in this direction are considerable.

The rotary kiln is uneconomical in fuel for several reasons. The first of these, no doubt, is the introduction of a large excess of air at the lower end, due to some extent to the necessity for revolving the kiln. The second is the loss by radiation from the large surface of the iron shell. This can be remedied by heavy linings, since it is desirable to keep the shell cool, and therefore impracticable to cover it with non-conductors. The third is in the free escape of gases at high temperature to the chimney. Considering, then, the first and third, there are evident opportunities for economy, both at the front and at the back of the kilns. Generally there is more draft induced than is necessary, and more chimney area than is required. The volume of gas passing through under good conditions of combustion, without excessive dilution of air, is not large, and the velocity of the gases passing through is slow. Per se these conditions favor both the generation and the regeneration of heat, and it may safely be predicted that there will be a development of economy in both.

Very vague notions are entertained of the rapidity of calcination in rotary kilns. It is commonly assumed that the material passes through in half an hour. The transit of the material through the kiln is due to its falling in a vertical plane under the action of gravity from the side of the kiln as it revolves. Assuming that the kiln has a pitch of half an inch per foot, that its diameter is 4½ feet inside the lining, and that in falling the material passes over an arc of 90 degrees, then at each quarter turn of the kiln (90 degrees) the material will fall forward 1⅛ inch, or for each full revolution 5⅛ inches. If the kiln is 60 feet long the time of transit will then be $60 \times 12 \div 5\frac{1}{8} = 140$ revolutions. It could not possibly move any faster, as any time occupied in falling would be lost in revolving. Revolving at one turn a minutes, which is the ordinary speed, between two and three hours are thus indicated as the time of transit. This being so, a kiln producing 6½ barrels of cement per hour will carry a charge in transit of about 4 tons of material.

Compared with shaft kilns of either the intermittent or continuous type, which require from three days to a week for the process of calcination, the rotary process is extraordinarily rapid. It might be, and has been, assumed that this was a disadvantage, and that the slower processes were better, and there was not lacking in the earlier work of rotary kilns some grounds to sustain this view, but the view now generally entertained, both by experts at home and those from abroad, who have examined the process, is that with a correct and homogeneous mixture the rapid calcination is an advantage.

The chemical union seems to be more perfect and the percentage of active cementing material rather greater. For example, in shaft kilns under slow calcination there is generally a certain percentage of clinker which disintegrates, falling into inert dust, without hydraulic activity. When the percentage of lime runs a little too low there is a considerable quantity of this dust. Now, this phenomenon does not occur with rotary cement clinker, or, at least, is extremely rare, indicating a chemical union which is stable, and a greater percentage of active hydraulic material in the product.

The high temperature of the rotary kiln is peculiarly adapted to the hard raw materials of the Lehigh Valley, which are comparatively free from fluxing salts, and it has worked well with similar wet raw materials in Ohio and Michigan. Whether it can be as successfully applied to materials containing the high percentages of fluxes which are found in some of the European mixtures is perhaps questionable. It is possible that for such materials shaft kilns are better. With this exception, however, the rotary kiln seems to have advantages for American conditions which cannot be questioned.

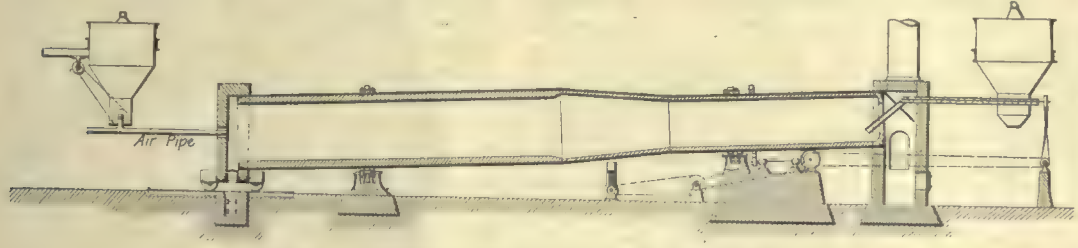


FIGURE 11.—RECENT AMERICAN KILN FOR DRY MATERIALS

BROOKLYN CAISSONS, NEW EAST RIVER BRIDGE.

The work now in progress at the site of the new East River Bridge comprises the building of the substructures for the anchorages and towers on the New York and Brooklyn shores. The designs of the structure so far as contracted for and the principal features of much of the plant installed and methods of operation have been illustrated and described in "The Engineering Record" of May 29, November 6 and December 25, 1897; September 18, February 5, May 7 and June 18, 1898. The tower caissons are among the largest and deepest yet built, and their design and the method of sinking them and plant installed includes special and interesting features differing materially for the two towers. The work on the New York caissons was illustrated in "The Engineering Record" of November 6, 1897, and that at the Brooklyn tower is described herewith from the notes and data secured by a visit while the work was in full progress, and its different stages could be best observed.

There are here two caissons each 63x79 feet square, one 53 feet high and the other 39 feet high, set 97½ feet apart, center to center, up and down stream. Each caisson is built principally of 12x12-inch timber, which forms solid outside walls and the roof of a working chamber 7 feet high, above which the space is divided by numerous intersecting horizontal timbers laid "cob-house" form, and arranged to give a truss action by 3x12-inch planks spiked on diagonally. The caissons were sunk to maximum depths of 81 and 95 feet, and their sides were extended by the heavy walls of timber cofferdams so as to keep always above high water, and permit the construction of the interior masonry as the caisson sunk. Full details and plans and specifications for them were published in "The Engineering Record" of May 29, 1897, and a more condensed outline, together with an account of the launching of the northern one, was published in "The Engineering Record" of December 25, 1897.

The handling and controlling of the caissons in the currents, which reached a velocity of six miles an hour, proved a serious problem. The finished caisson had dimensions of 79x67 feet by nearly 60 feet above the bottom of the river and weighed over 5,000 tons when submerged. Anchors, mooring piles or tug boats were not considered practicable, and radical measures were taken by the construction of heavy timber piers that nearly surrounded the caisson, as shown in Figure 1. These piers were essentially of permanent dock construction, built with 24-inch vertical and spur piles 75 to 90 feet long and driven in 50 to 70 feet of water. In the case of the deepest water about 6,000 yards of riprap were required to furnish protection from scows and to give stability to the piles. The center pier occupied the entire space between the two caissons, and was constructed as shown in Figure 2. The south pier was built before

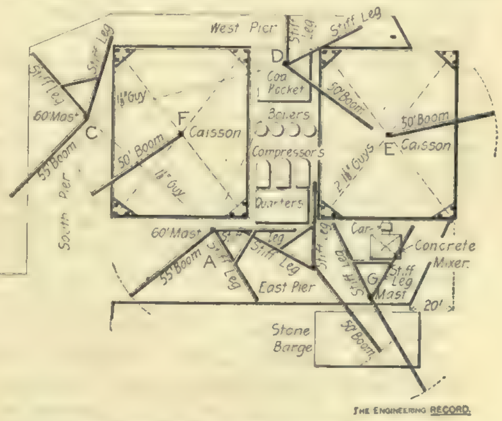


FIGURE 1.—PLAN OF BROOKLYN CAISSONS.

the caissons were, and served as a breakwater to resist the pressure of 60 feet of water with a swift current which impinges on its outer face. The south side of this pier is protected by an outer double row of heavy piles driven in contact with each other and penetrating 10 feet into the river bottom, where they are protected by a mass of riprap containing about 2,000 cubic yards. After both caissons were located in horizontal position the west pier was built outside them to serve as a fender, leaving them directly accessible to the river only at the north and on the east side of the east pier, where materials are received and supply barges moored. All the piers are decked over, and their floor provides working and storage platforms, and location for the steam plant, machinery, etc. Nearly the whole area of the caissons and piers was commanded by six stiff-legged derricks, most of them having capacities of 20,000 pounds for a radius of 40 to 60 feet. Each derrick was operated by an individual double drum hoisting engine run by steam from the central battery of boilers, and was also revolved around its vertical axis by means of a rope wound upon a 10-foot horizontal wheel at the foot of the mast.

Each end of this rope was led to a separate spool of the hoisting engine. Most of the derricks had two stiff legs and a mast which was noticeable for a height greater than the length of its boom. The booms were all trussed with an iron center post and a ¾-inch tension rod on each side, and rigged with a four part topping lift and a four part hoisting tackle of ⅝-inch steel rope, besires a ½-inch whip line at the point of each boom. The back legs were built up of eight 12x1½-inch planks each, bolted together in vertical planes and stiffened by cross braces and diagonal plank. Derricks A and B were used chiefly for handling stone, mortar and timber, Derrick C for handling timber. Derrick D for unloading coal, Derricks E and F for handling the concrete and masonry supplies, and derrick G for serving the concrete mixer. Besides these derricks and those in use at the anchorage, there are six other principal derricks in the contractor's yard on shore adjacent to the piers, and two floating derricks. These latter were improvised by boring a hole through the hammer of a pile driver and pivoting to it a 70-foot boom. Derricks E and F have 60-foot masts and 70-foot booms, and are each guyed in four directions by nearly horizontal lines to the tops of triangular pyramidal wooden towers that were erected for the purpose in the corners of the caissons. The guy rope passed vertically down through each tower and was made fast to the timbers of the caisson below. The progress of the work has been as follows: South caisson begun August 12, 1897; launched, October 9; sunk to the bottom, January 13, 1898; pressure put on the working chamber, February 8; bed rock first encountered, about April 12; concreting of chamber begun, June 7; concreting finished, June 21; masonry begun, February 15; masonry substantially finished in October; north caisson begun, October 20, 1897; launched, December 15; sunk to the bottom, March 13, 1898; air permanently put on, July 5; concreting of chamber begun, October 24; concreting finished, November 4; masonry begun, July 26; masonry finished to the under side of the coping, December 13.

The south caisson was equipped with six material shafts and one man shaft, and a system of pipes, as indicated in Figure 3. There are six 4-inch sand pipes, three 4-inch water pressure pipes and one 6-inch air pressure pipe, carried vertically down through the roof of the working chamber. All of them have flange and gasket joints above and below the deck timbers. Most of the material on the north caisson was removed through the sand pipes, so that the excavating shafts were not much used. When not in service they were kept securely closed by wooden covers bolted on top and heavy wooden diaphragms bolted on the bottom at the caisson ceiling, so as to prevent danger of a blowout if the top should be injured. When in use the upper cap was removed and replaced by a special Moran excavating lock, built by the Variety Iron Works, Cleveland, O. This lock permitted a bucket of spoil to be hoisted from the caisson chamber and emptied alongside without detaching it from the hoist line of the center derrick. Until the caisson was sunk to a depth of over 60 feet the men entered its chamber through an ordinary shaft and air lock with an interior ladder, but when the caisson had descended farther and the pressure became heavier a steam elevator was provided to lower the men nearly to the roof of the working chamber. The man lock was kept at the bottom of the air shaft, and the material locks, when used, at the top of the excavating shaft.

The south caisson was sunk in water 53 feet deep, and when loaded with about 3,000 cubic yards of concrete penetrated without excavation to an average depth of less than 1 foot in the soft mud and silt which, together with the offensive, slimy deposit from the sewers, formed the bottom at this place. Its center was located within a few inches of the required position, and the sides were at first as much as 2 feet out of plumb at the top. Air pressure was not put into the chamber and no excavation was begun before the concreting was finished in the upper part of the caisson. The caisson penetrated through about a foot of mud, 13 feet of sand and 6 feet of blue clay before it reached the main bed of hard, stratified clay, resembling rotten rock. In this distance the sides of the caisson were brought vertical by eccentric loading and local excavation, and a maximum progress at the total average rate of about 4 inches a day was made in the sinking up to the time that the bottom of the clay was reached. This slow progress was due chiefly to the numerous large boulders encountered under the cutting edge. Delay was also caused by waiting for stone, the laying of which progressed at a rate slower than the sinking of the caisson, and by the failure of prompt payments by the city. In this caisson the excavation was carried down first in the center of the pit, and when the earth had been removed to a depth of from 4 to 8 feet below the cutting edge there, it was excavated around the sides so as to undermine the cutting edge and allow the caisson to descend at once under control rather than to sink gradually and constantly. This method enabled a large amount of the work to be done actually below the cutting edge, so that the men had plenty of head room, and a working space unobstructed by the braces and bulkheads that crossed the working chamber.

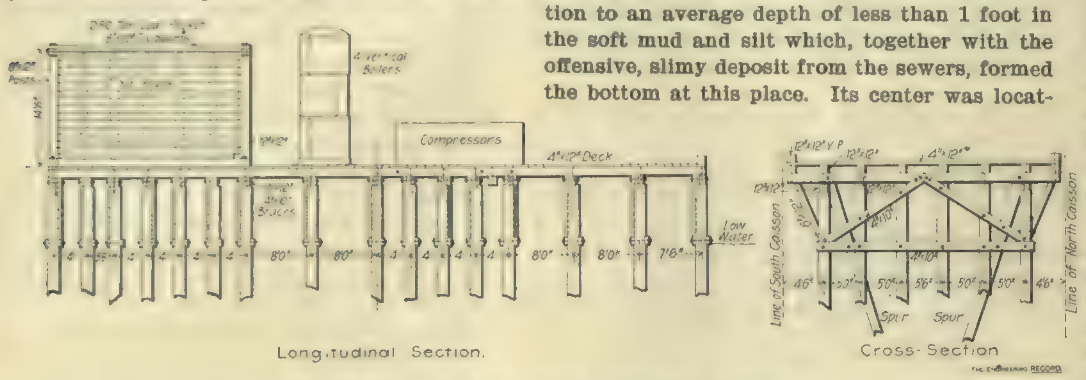


FIGURE 2.—PROTECTION PIERS, BROOKLYN CAISSONS.

When the caisson reached a hard stratum it was blocked up in low places with timber crib work and wedges under the solid timber bulkheads, which were designed for this service rather than to strengthen the walls. Its descent was thus controlled when it might otherwise have been subject to great strain or distortion by the irregularities of the bottom. Some boulders and loose rock up to one or two yards size were encountered, and blasted when too large to be loaded whole into the buckets. Clay, mud and sand was dug up with picks, spades and mattocks, and washed down with a ¾-inch jet of water at 100 pounds nominal pressure. The mud thus formed collected in sumps, and was blown out from time to time through the sand pipes, which were valved just below the roof of the caisson, and continued down with a 45-degree bend and 8-foot section of iron pipe that was inclined at an angle of 45 degrees to the vertical, and terminated at the bottom in another one-eighth bend, to which was attached 15 feet of flexible 4-inch hose. When not in use the valve was shut and the end of the pipe was also closed by a piece of board kept in place by the leakage of the air pressure. When in use the board was removed and the open end of the hose was submerged in the sump, and held by a laborer, who kept the mud and water agitated around it. In order to decrease the specific gravity of the water column in the sand pipe and enable it to rise over the top of the cofferdam above the water surface with an interior pressure in the caisson only

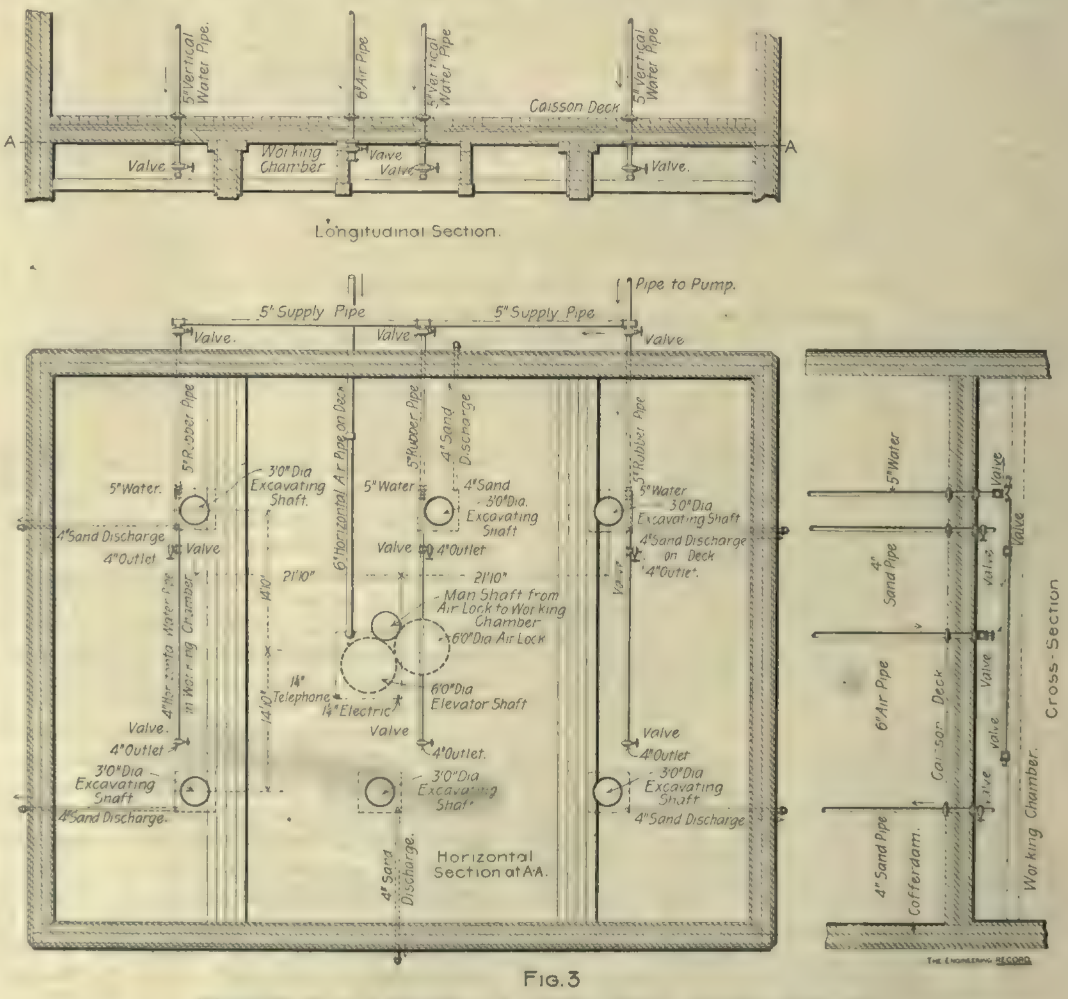


FIG. 3

BROOKLYN CAISSONS OF NEW EAST RIVER BRIDGE.

L. L. BUCK, M. AM. SOC. C. E., CHIEF ENGINEER; DEGNON-M'LEAN CONSTRUCTION CO., CONTRACTORS.

equal to the hydrostatic head from the river surface, a small hole about ½-inch in diameter caisson ceiling, and caused a sufficient aeration of the water inside. When not in use this hole was plugged with clay. At other times aeration was effected by slightly wedging apart the adjacent flanges at one side of a joint in the discharge pipe. A swinging wooden flap valve was hung over the horizontal end of the air pressure pipe to serve as an automatic check or safety valve, and prevent the escape of air in case of breakage in the connections above.

The work done in compressing the air developed so much heat that the receiver in the engine house became too hot to be touched. In order to reduce this air to a comfortable temperature for the men in the caisson, a ¾-inch water pressure pipe was tapped in to the bottom of the air pressure pipe just above its delivery into the caisson, and a small jet of cold water was constantly sprayed into the compressed air, where its evaporation absorbed enough heat to cool the air sufficiently in moderate weather. In extremely warm weather more effective cooling was accomplished by taking the compressed air supply from the receiver through a 4-inch pipe connected with a coil of 1-inch pipe, submerged in the East River under the pier. These pipes had a combined area equal to that of the 4-inch supply and a length of 4,500 feet. After passing through the coil the air was still further cooled by being allowed to expand in a 6-inch pipe delivering to the working chamber. This gave on June 18 last a temperature of 77 degrees at the pipe outlet in the working chamber, as compared with 90 degrees at the same time at the outlet of an uncooled supply pipe direct from the same receiver. Records show the general temperature of the working chamber to have been 81 degrees, that in the air lock when the door was first opened into the working chamber, 95 degrees, and at the termination of exhaust, 67 degrees.

(To be Continued.)

A 61-INCH CAST-IRON PIPE LINE.

The line of the Sudbury aqueduct, which was built about 20 years ago, to convey water from the Sudbury River, at Framingham, Mass., to Boston, is crossed near Wellesley by the valley of Rosemary Brook. This depression is about 1,800 feet wide, and, at the deepest part, is about 50 feet below the gradient of the masonry aqueduct. Instead of carrying the aqueduct across the valley, Roman fashion, on arches, two inverted siphons of 48-inch cast iron pipes were laid between chambers, forming the ends of the two portions on the high land at each side. Provision was made in these chambers for a third 48-inch line, to be laid whenever needed, and these three 48-inch lines were expected to have a capacity equivalent to that of the masonry portion of the aqueduct.

The two 48-inch lines are the pipes upon which Mr. Desmond FitzGerald, M. Am. Soc. C. E., performed a series of careful experiments, in 1894, to determine the friction losses and the effects of tuberculation. The measurements made showed that by scraping off the tubercles or lumps of rust formed over and around minute perforations in the interior coating of the pipes, the flowing capacity of the mains could be made nearly equal to that when new, an increase of about 30 per cent., at ordinary velocities, over the capacity of the mains as tuberculated by 16 years' use with Sudbury River water.

In order to be able to utilize the full capacity of the aqueduct to convey the larger quantity of water now required for the new metropolitan system, the third line of pipes has been laid, during the present season, by the Metropolitan Water Board, which now controls the Sudbury River works. Computations indicated that in order to have the benefit of the full capacity of the aqueduct, about 108,000,000 gallons per day when clean, the third main would have to be larger than 48 inches. Adopting the Chezy formula, measurements gave as a close approximate value for the coefficient for the two 48-inch pipes in their present condition, $c = 120$. These pipes were scraped and cleaned, one in November, 1894, and the other in February, 1895.

Having regard for renewed tuberculation in process of time, c was assumed as 110; and on this basis three 48-inch pipes would discharge 80,000,000 gallons per day. The corresponding value of c for 60-inch pipes would be 114; and a main of this diameter, together with the two 48-inch mains, would carry about 100,000,000 gallons per day, when the pipes were considerably tuberculated. By connecting the 60-inch main to the 48-inch wall pipes in the siphon chambers with 48-inch to 60-inch increasers proportioned like the adjutage, or downstream cone, of a Venturi meter, it was judged that the loss of head due to enlargement would be almost nil. The entry loss of head is practically obviated by the bellmouth shape of the chamber end of the wall pipes. For the final computation, then, it was assumed that there would be no loss of head at entry, and that the loss in the 60-inch line, due to velocity, would be that due to 60-inch connections at each end; c for the 48-inch pipes was taken as 120 and for the 60-inch as 130, the idea being that a condition of the interior of the pipes necessary to justify such large coefficients could be maintained by occasional scrapings. With these assumptions, the discharge of the siphon was computed to be 109,000,000 gallons per day.

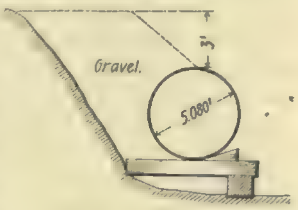
An attempt was made to approximate the losses in the 60-inch line, caused by the 48-inch wall pipes and the 48-inch to 60-inch increasers, by using the tables for losses in Venturi meters, published by the Builders' Iron Foundry of Providence, R. I. A result of 0.06 foot at each connection for a velocity of 5.5 feet, or a loss of 0.12 foot of head for the two ends, was obtained. Correcting the computed capacity of the siphon for this loss gave 107,000,000 gallons per day, which is about equal to the capacity of the aqueduct. The necessity for considering the losses of head due to entrance and velocity, arises from the fact that the mains under consideration are not long pipes, as the term is generally understood, the ratios of length to diameter being 450 and 360, for the 48-inch and 60-inch pipes respectively, instead of 4,000, a commonly accepted minimum for long pipes.

The 60-inch fixtures at the foundry where the pipes were to be cast were of such size as to give an external diameter of 63⅝ inches and a thickness of 1 13/16 inches. Owing to the small head on the line, about 55 feet, 1¼ inches, was considered a sufficient thickness, and so the actual bore of the pipes became 61⅛ inches. The thickness of a pipe of this size, for 55 feet head, as computed by the formula used in designing the smaller pipes laid by the Metropolitan Water Board, would be 1.12 inches. Although so thin in proportion to the diameter, the pipes were made, transported and laid without breakage, and were exceptionally true in shape. A 12-foot length weighed five tons, or an average, including bell, of 833 pounds per foot. The barrel of the pipe weighed 765.5 pounds per foot. About 110 pounds of lead were required for each joint, the lead being half an inch thick and 2¼ inches deep.

To minimize the frictional resistance of the 61-inch main, the internal joint spaces between the bottoms of the sockets and the spigots were carefully filled, from the inside, with Portland cement mortar, after the pipes were all laid and calked. This gives a practically continuous and smooth interior surface.

In the spring of 1897 Mr. T. C. Atwood made some experiments at the Massachusetts Institute of Technology, on the deflection and breaking strength of cast-iron pipes from 6 inches to 48 inches in diameter, under loads concentrated at the extremities of a diameter. (See "Technology Quarterly," Sept., 1897.) Plotting some of the results with deflections for ordinates and diameters for abscissas, and extending the curve for a load of 10,000 pounds per linear foot of pipe, seemed to indicate a deflection of 0.3 inch for 60-inch pipe 1.2 inches thick. The load on the proposed pipe line was to be about five feet of earth, equivalent to 2,500 pounds per linear foot. Considering this concentrated, as in Mr. Atwood's experiments, and assuming the deflection to be proportional to the loads, the probable deflection was estimated to be 0.075 inch.

During the progress of the pipe laying the deflections of the pipes were measured under a variety of circumstances. In one case, a pipe lying beside the embankment was partially covered by the earth thrown from the trench, as shown in the sketch.



The diameter was measured, where indicated, before and after the removal of the earth, as 5.080 feet and 5.086 feet, respectively, showing a difference of 0.006 foot or 0.072 inch.

The pipes were shipped on cars with a block under each end of each pipe and a vertical brace inside the pipe over each block. Measurements of six pipes showed that they were sprung by the braces about 0.01 foot at the spigot and 0.002 at the bell. The vertical braces were discarded after the first few shipments, as unnecessary. Observations taken in two pipes while on a wagon, being hauled over a rather rough road, showed a maximum vibration in length of diameters of 0.005 foot.

The vertical and horizontal diameters of a number of pipes were measured as the pipes lay on skids; the pipes were then rolled 90 degrees and measured again between the same fixed points. These measurements showed that the change in diameter, due to rolling, was about one-half times as great at the bell as at the spigot, with a maximum change of 0.01 foot in length of diameter at the spigot, or 0.005 foot variation from a true circle. Observations taken throughout several revolutions gave the same readings for any given diameter in recurring positions, showing the pipe to be perfectly and instantly elastic within these narrow limits.

To ascertain whether any sag occurred in the pipes in course of time as they lay on skids, measurements of diameters were repeated at the end of a month, and found identical in every instance.

For another test, several diameters were measured after the pipes were laid and jointed, but not backfilled, and again after backfilling to a depth of 4 feet over the top, the earth being tamped under the pipes and to a height of 2 feet on the sides of the pipe, but the remainder loose as thrown in. In the former condition, the mean vertical diameter was from 0.005 foot to 0.01 foot less than the mean horizontal diameter, or the same as when the pipes lay on skids in the yard. This slight flattening was not noticeable in spacing the joints for yarning. The maximum shortening of the vertical diameter and corresponding lengthening of the horizontal—due to 4 feet of gravel cover—say 1 cubic yard per linear foot of pipe line—was 0.01 foot. Hence it appears that the greatest total effect on a 61-inch cast-iron pipe 1¼ inches thick, of its own weight combined with 4 feet of gravel cover, the pipe being empty, is a deformation of the true circle by a variation in diameter of about 0.015 foot.

Mr. Frederic P. Stearns, M. Am. Soc. C. E., is chief engineer of the Metropolitan Water Works, and Mr. Desmond FitzGerald, M. Am. Soc. C. E., is engineer of the Sudbury Department.

THE CLEVELAND WATER-WORKS TUNNEL.

Work on the construction of the new 5-mile intake tunnel for the Cleveland, O., Water-works is steadily progressing, and nearly half its length of 26,000 feet has now been built. The first section of the tunnel has been extended 6,500 feet from the shore shaft, and headings have been driven in both directions about 3,000 feet from the foot of the shaft at temporary crib No. 1. Temporary crib No. 2 has been completed and its shaft sunk. One of the two tunnel eyes has been turned in the brickwork at the foot, and, after this section of the tunnel has been drifted about 100 feet and the other one equally advanced, the air-lock will be removed from the shaft and a separate lock will be placed in each tunnel, when the work will be prosecuted from both headings. The permanent steel intake pier, 100 feet in diameter, has been grounded in position and completed above water level to the height of the main floor. It is now being filled with permanent stone ballast. After this is placed, the upper parapet or bulwark walls and the inside house and light tower will be built, to enable the contractor to sink the shaft and begin the last section of the tunnel. It was thought probable that this crib would sink several feet into the soft bottom, but it has so far penetrated it only about 14 inches and stopped, and has shown no perceptible displacement during the late severe storms. Some irregularity of sinking operated, however, to throw it sufficiently out of plumb to give a slope of about 1 per cent. to the deck. This was apparently due to the uneven consistency of the bottom, which was manifested by considerable upheaval outside the lower edge, where it is supposed that the plastic material had been forced out and up. To check and remedy this tendency an increased amount of riprap has been filled in there as a counterload.

As it was observed that the surging of the material boats moored to the caisson to discharge supplies had a tendency to bend the steel shell plate inward, it was thought best to provide additional resistance for such action and also against ice pressures. Therefore an annular space about 4 feet wide and 8 feet deep was excavated in the stone ballast just inside the outer wall of the caisson, reaching to a depth of 4 feet below the water line. This space was rammed full of concrete and backed up against selected stones carefully placed against its vertical inner surface, and their interstices grouted with mortar. This produced in effect a circular arch 8 feet high and 4 feet thick, well bonded with the filling and calculated to distribute and resist any shock to which the crib may be subjected and to prevent its deformation. Near the landing stairs this concrete reinforcement is carried up to the floor level through the adjacent eight sections of the crib. The arrangement of the crib and the general features of the tunnels and shafts may be better understood by referring to the descriptions published in "The Engineering Record" of May 22, 1897, and May 7, 1898. The present force employed by the contractors comprises a dozen or 15 men completing the intake pier, and about as many at work in the shaft of crib No. 2, besides nearly 100 in the shaft and tunnels at crib No. 1. All are lodged and boarded at their respective cribs.

Although the tunnel drifts are being excavated under about 20 pounds pneumatic pressure, the subterranean gas, the presence of which was indicated by the test borings, is found to have sufficient pressure to overcome the air pressure and enter the tunnel. It is of a compound nature, very light, and contains a considerable portion of methane. It is colorless, odorless and tasteless, and, although it sometimes enters with a hissing sound, constant tests are necessary to detect its presence. The contractor's men explore for it with safety lamps with a flame so arranged as to burn clear in pure air and to show a distinct blue cap in the presence of gas. The height of this cap is directly proportional to the percentage of gas, and forms so accurate an index that the amount may be gauged by measurement on the lamp tube with the accuracy of a fraction of 1 per cent. The chief engineer's staff also test for gas with lamps and habitually take into the tunnel at every visit a dozen common pint "pop" bottles with patent rubber stoppers. The bottles are filled with water and are used for collecting samples of the air at any given locality or height in the tunnel. A bottle is held in the required position, inverted, and, when opened, the water escapes and the bottle is filled with air, gas or whatever composes the atmosphere at that point. Samples are taken in various places as required and labeled to correspond. As the closed bottles are under considerable pressure, this is relieved when they are taken out of the tunnel by immersing them inverted in a tub of water and carefully opening the stopper to allow a portion of the air to escape. The bottle is then closed under water and is taken to the chemist for analysis.

Pneumatic pressure is maintained in the tunnel by a 4-inch compressed-air pipe, running from the compressors through the air lock to the working face. This fresh air continually displaces the foul air in the heading, which is forced backward and is removed by admission to the air lock, and exhaustion there as the lock is used. When an increased amount of gas is noted, it is immediately flushed out by increasing the supply of compressed air and by making a free outlet through the air lock by opening the valve in a 2-inch by-pass pipe, which permits a constant flow of air from the tunnel to the free atmosphere.

CLEANING CATCH-BASINS, YONKERS, N. Y.

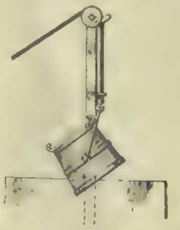
The need of a simple, economical and sanitary method of cleaning catch-basins has been long felt by municipal authorities having charge of such work. The usual method is to fill a pail or small bucket with the sludge, and raise it by hand or a windlass placed over the opening. Usually the bucket is emptied on the street and the accumulation of mud eventually shoveled into carts. This is slow, makes a disagreeable mess on the street, and requires a double handling of the material, while if the pail is small enough to be emptied directly into a wagon waiting for the purpose, the work is slow indeed.

CLEANING CATCH-BASINS, YONKERS.

There are nearly 600 catch-basins in Yonkers, and the cost of keeping them clean by the old method was so great as to exceed the appropriation for the purpose; so the commissioner of public works, Mr. Samuel L. Cooper, M. Am. Soc. C. E., and the foreman of street cleaning, Mr. F. W. Keys, studied the problem for a time and finally designed the apparatus shown in the accompanying illustration. It has been in constant use without any change whatever for over two years, and has reduced the former cost of the work by more than a half.

Two carts and two laborers, costing $9 a day all told, keep the basins clean without other assistance. Each cart holds about 30 cubic feet, and can be filled, dumped and driven back again once an hour, making eight loads a day's work, as a rule. When the haul to the dump is short, they do much better.

The operation of the apparatus is very simple. There is a fixed windlass on the front of each cart, but the light A-crane is lifted off the axle on which it rests as soon as the cart is filled. There is but one crane for the two carts. The cart backs up to the basin, as shown in the illustration, the crane is put in place in a few seconds, and the rope run over the pulley at the top. The man on the sidewalk guides a bucket into the basin, where another man fills it and hooks it to the end of the rope. Then the man on the cart winds the bucket out of the basin, the cover-hole of which it is just small enough to pass easily. The winding continues until the collar of the hook engages the stop at the pulley on the crane. Further winding raises the crane to a vertical position, shown in the adjoining diagram, and by releasing the windlass the bucket is dropped until the hook at the bottom engages a rod between the legs of the crane and the bucket is turned over so its contents are dumped into the cart. The man on the sidewalk then pulls the crane back with the rope, removes the empty bucket and drops the hook to the man inside the basin, who has meanwhile filled a second bucket passed down to him by means of a short rope.



The apparatus is manufactured by Thomas Hill, 48 Railroad Avenue, Jersey City, N. J., who also makes the steel-bodied carts used with it. The device has been patented by Messrs. Cooper and Keys.

An Old Mortar, from Tintern Abbey, has been analyzed recently and Mr. John Hughes gives the result as follows in a recent issue of the "Builder:" Water lost at 212 degrees Fahrenheit, 1.33; combined water and loss on ignition, 2.40; lime, 18.45; magnesia, 0.66; potash, 0.43; soda, 0.72; oxide of iron, 1.95; alumina, 1.90; sulphuric acid, 1.21; carbonic acid, 12.90; gelatinous silica soluble in alkali, 6.05; sand, 52. As a matter of interest this analysis may be compared with one of the mortar of Hadrian's Villa at Tivoli, near Rome, which is stated in Cummings' "American Cements" to have given the following results: Lime, 15.30; magnesia, 0.30; potash, 1.01; soda, 2.12; carbonic acid, 11.80; peroxide of iron, 4.92; alumina, 14.70; silicic acid and sand, 41.10; organic matter, 2.28; water, 5.20.

Water-Works Taxes are occasionally remitted in return for free water for city purposes, and the arrangement has been upheld by the United States Circuit Court, under conditions reviewed in "The Engineering Record" of April 23, 1898. A case was recently before the Supreme Court of Minnesota which was decided adversely to such remittance. The Little Falls Electric & Water Company agreed to provide free of charge 12 fire hydrants and water for the city buildings in return for freedom from city assessments and taxes. The court has ruled, 77 N. W. Rep., 40, that "this is neither uniformity or equality of taxation, nor taxing property according to its true value in money. Whether the water-works are worth $10,000 or $100,000, the city, in lieu of all taxes and assessments, receives the same consideration in either case, no more and no less, viz.: a supply of water for its public buildings and the use of 12 hydrants for fire protection. This substitute for taxes has no relation to the value of the property in money, and would eventually result in want of uniformity and equality of taxation. The city had no authority to exempt this property from taxation or to commute the tax by accepting services in lieu of it."

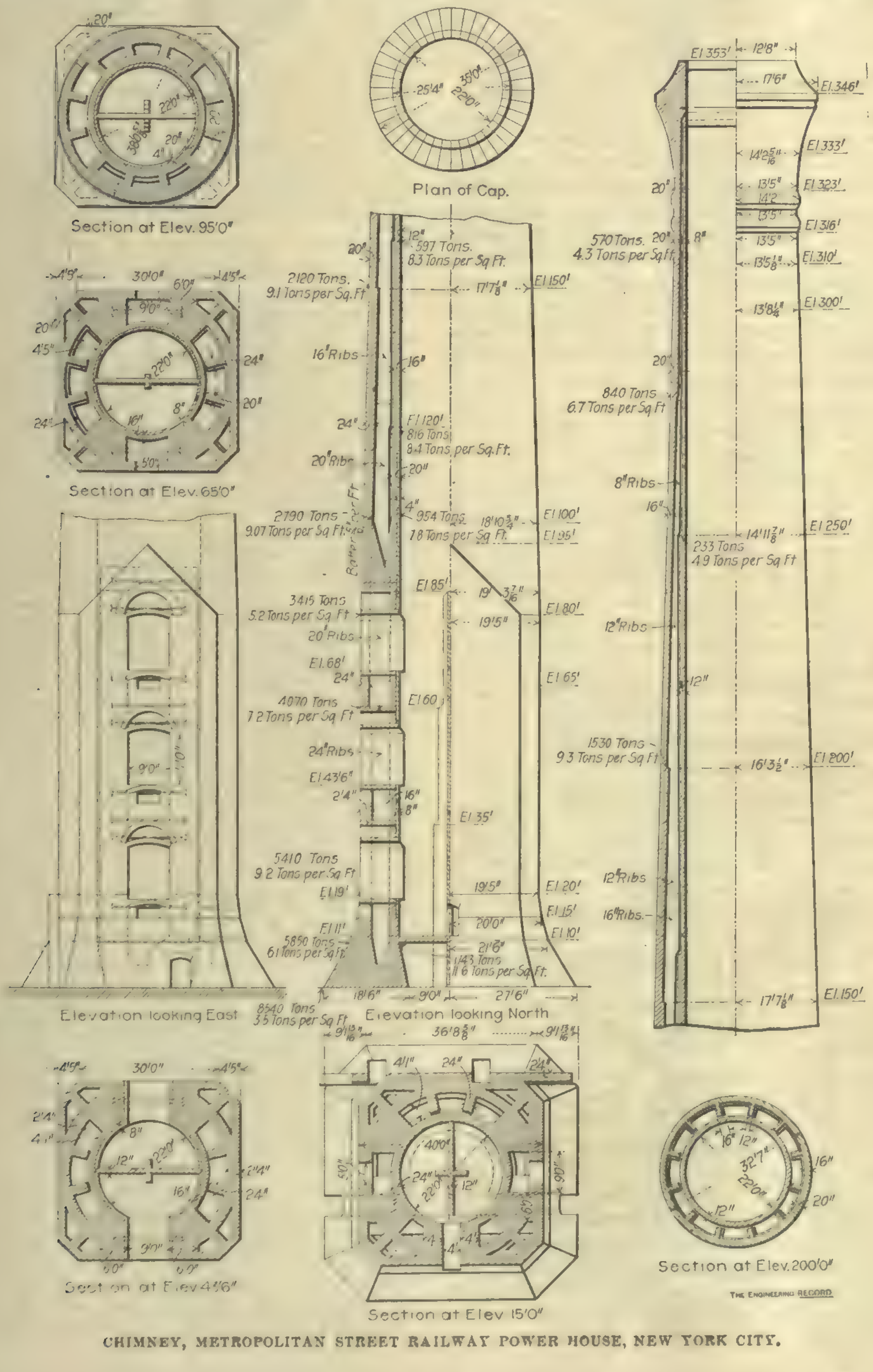
NEW YORK'S NEW CHIMNEY.

There is now being built in New York City for the Metropolitan Street Railway Company a new central power station, which, it is safe to say, will be the largest in the world. The station is to supply power sufficient to run all the surface cars of the various lines in the boroughs of Manhattan and the Bronx, New York City, and has been designed to develop for that purpose 70,000 horse-power. The stations of the company now in operation will be abandoned therefore as soon as the present conversion of the horse and cable lines to the underground trolley system has been perfected, and the consequent increase in power demand calls for enlarged facilities. The ultimate purpose is to operate all cars electrically, with the possible exception of the cross-town cars, which, as the result of satisfactory experiments, may be driven by compressed-air motors.

The new station is being erected on the block bounded by Ninety-fifth and Ninety-sixth Streets, First Avenue and the East River. The site was originally low ground, being covered at one time by the water of the East River, but had been filled in at a later period. A number of borings were made to determine the character of the strata below the earth and ash filling, averaging, respectively, about 10 and 15 feet in depth. Below the filling, blue clay or mud was found to an average depth of 35 feet, beach sand to about 45 feet, fine red sand from 45 to 55 feet, and, from this down, clay was present as far, at least, as 80 feet. Rock was found in one trial at a depth of 125 feet.

The chimney for the station, now practically completed, stands 353 feet above its foundations, and it is, therefore, the tallest chimney in the United States. Its internal diameter is 22 feet, and in that dimension it is the largest chimney in the world. Rankine's formula was used in determining its capacity, and in designing the chimney it was assumed that the wind pressure would be equivalent to a pressure of about 40 pounds per square foot of diametrical area. The total weight of the chimney is 8,540 tons, and 3,400,000 red bricks were used in the construction.

In building the foundations, which cover an area of about 85 feet square, the earth and ash filling were removed to a depth of 20 feet below the determined level of the station floor, taken as datum, and piles were driven to a depth of about 40 feet over the entire area. The piles are upon 2-feet 6-inch and 2-feet 3-inch centers, and a total of about 1,300 were driven by means of pile-drivers suspended from derrick booms. At a depth of 40 feet it was found that a 2,500-pound hammer falling 20 feet drove the piles about one inch, on an average. In driving the last 20 or 30 piles, the resistance was so great that they could not be driven over 15 feet. The piles were cut off 1 foot above the top of finished ground, or at a grade of — 19. An immense concrete block was laid upon them, 85 feet square and 20 feet thick, of one, three and five Giant Portland cement-concrete. Cement mortar used in the brickwork was made of one part Giant Portland cement and two parts saud.



CHIMNEY, METROPOLITAN STREET RAILWAY POWER HOUSE, NEW YORK CITY.

The construction of the chimney from the base up can be readily seen from the accompanying drawings. It is located close to the wall separating the engine and boiler rooms of the station, and divides the boiler room in two parts. Smoke flues lead from the boilers to the chimney from opposite directions, and as there are three stories in the boiler house upon which the boilers are to be installed, there are six large openings to the chimney, two on each of the three floors. The chimney is built of two concentric shells, separated from each other to allow for differences in expansion, and the outer shell is stiffened by 12 interior longitudinal ribs projecting radially toward the inner shaft and leaving a clearance of ½ inch. The inner shaft, conveying the hot gases and smoke, has a constant diameter, as has already been mentioned, of 22 feet, and the outer dimensions of the stack range from a square base, 55 feet on a side, to a neck of 26 feet 10 inches in diameter, 316 feet above. The cylindrical exterior of the chimney is given a batter of 3⅛ inches in 10 feet.

The two shells rise from a common brick base resting on the concrete, and are practically a single structure up to a few feet above the smoke flue openings. These openings are 24 feet 6 inches, one above the other, and 4 feet below the first opening, at the 15-foot elevation, the shaft is lined with an 8-inch thickness of fire brick to a height of 90 feet, which is about 10 feet above the third-floor opening. Beyond this for 25 feet the fire brick is only 4 inches thick, and from the 115-foot elevation upward the walls are of common brick. The weakening caused by the openings is overcome by the double-arch construction and the use of tie-beams of channel iron, as shown. A 12-inch brick wall, 85 feet high and provided with a buttress, will also be noticed. This divides the lower part of the shaft into two parts, separating the two tiers of smoke-flue openings, and prevents any trouble likely to arise otherwise, should but one of two diametrically opposite openings be discharging smoke. The inner shell is built in five sections from the basal thickness of the wall, which is 24 inches, to an 8-inch wall at its top, 340 feet high. The outer shell, as far as thickness is concerned, ranges in five sections, from 28 inches to 16 inches. The fourth section, from the 200 to the 280-foot elevation, is 16 inches thick, as shown, and the wall thickness then becomes 20 inches. The successive gradations of thickness up to this point conform to the requirements of the limiting stresses allowed, but the enlargement is made, aside from providing for the coping, to bring the two shells in closest proximity, so that both may assist in resisting lateral strains. The gap between the two shells near the top of the chimney is protected with an apron of sheet-iron 4 feet wide and provided with a flange at the top imbedded in the brickwork. The top of the chimney is protected with an iron cap formed of 40 cast-iron sectors, bolted one to the other. They are made to envelop the top brickwork, and are anchored by vertical tie-rods to an annular steel ring about 28 inches in diameter and imbedded in the brickwork about 14 feet below the cap. Ten lightning-rods point upward 6 feet above the top of the chimney, and are connected to a copper ring, which is provided with two descending conductors of copper, each 1x3/16 inches in cross section. These conductors are also connected to the iron top.

Two other steel rings are also encased near the top, one about 342 feet and another about 313 feet from the base, to prevent any tendency to disintegration resulting from incipient cracks.

The drawings show at various elevations the total weight supported, and the corresponding stress per square foot of sectional area. The pressure intensity of the outer shell is on the average greater than that in the interior shaft, being about 9 tons per square foot. The unit load at the concrete base is only 3.5 tons for the whole weight of the chimney.

The chimney was designed by the Engineering Department of the Metropolitan Street Railway Company, which furnished the information incorporated in the preceding description.

THE DESIGN OF PIPING FOR ELECTRIC POWER HOUSES.

An examination of current practice in the design of the piping for connecting the various parts of an electric, or, in fact, any kind of a power station or steam plant, will show that the opinions of engineers differ greatly upon this important subject. That the subject is an important one few will doubt, and it is the more surprising therefore that the design of steam piping has not been given the attention that it deserves in the engineering societies and technical press. It is the intention of "The Engineering Record" to bring up this subject, even at the risk of repeating some of the principles that were laid down in the article "Good and Bad Steam Piping in Office Buildings," which appeared in the issue of January 2, 1897, and in the subsequent letters of the engineers who discussed it.

As far as the general relative arrangement of engines and boilers is concerned, electric power house construction has resolved itself into three distinct and standard types in which nearly all stations may be classed. These types are as follows: That in which the boilers and engines are placed back to back, with a dividing wall between; that with the boiler and engine rooms end to end, with the engines and boilers lying in the same direction; and that in which the power house contains two or more stories, with the engines placed below the boilers, or vice versa. The principal consideration governing the selection of the type of power house is that of the cost of real estate and the shape of the property upon which it is proposed to erect a station. As far as the piping is concerned, the back to back type is without doubt the one most to be preferred, on account of the short and direct connection between the engines and boilers, and the ease with which it can be enlarged. With the engines and boiler rooms placed end to end the condensation losses in the steam piping are greater, and this type of station, as far as the piping is concerned, is not easily enlarged. Stations with two or more stories, with the engines above or below the boilers, are only used when the high cost of real estate prevents the purchase of the larger area needed for those of the first or second type. Two-story stations are more expensive, both as to first cost and cost of operating.

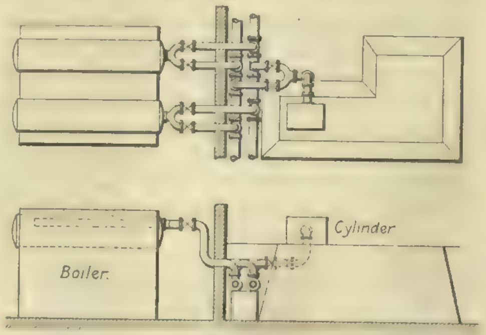


FIG. 1

In designing the steam piping for any type of station certain fundamental principles should always be observed. The system should be so designed that there will be as few water pockets in the system as possible, and where they must occur the pockets should be made of ample size, so that the water that collects in them will not be picked up and carried along with the rapidly moving current of steam. Furthermore, their proper drainage should be provided for.

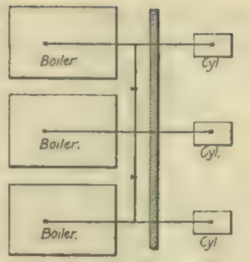


FIG. 5

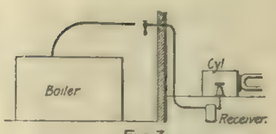


FIG. 3

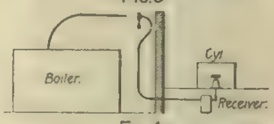
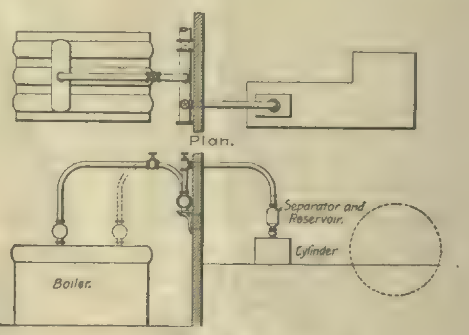


FIG. 4

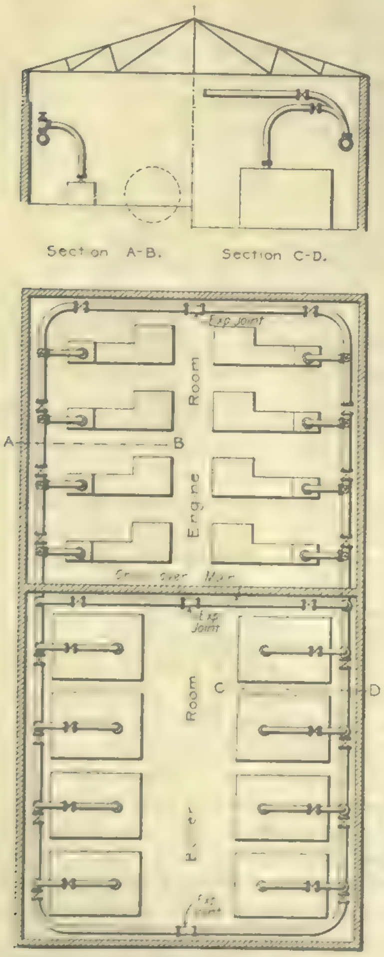
The steam piping for that type of station in which the engines and boilers are placed back to back and separated by a wall, usually consists of a feeder from each boiler, connected with a main supported by the boiler room wall and also connected to each engine. Sometimes the steam piping is put in in duplicate, the two systems dividing at a double nozzle or Y on the boilers, and converging at a similar Y close to and connecting with the throttle valve of the engine.



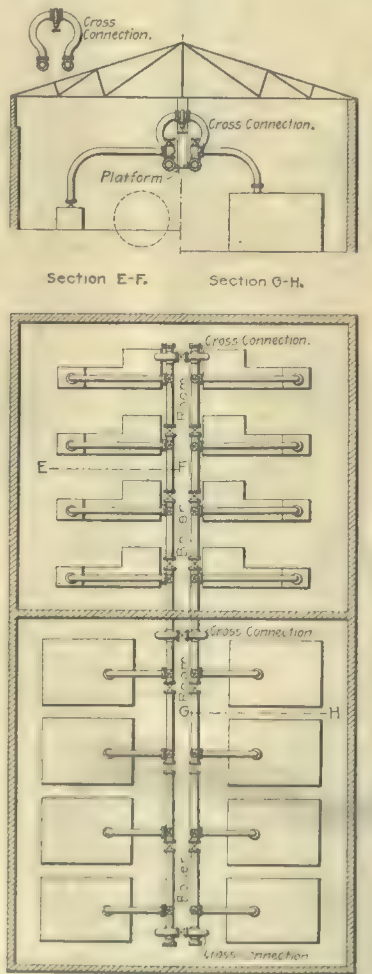
Elevation.
FIG. 2

There are three types of duplicate systems: First, that in which there are two sets of pipes, each being sufficiently large to be used alone. One only is intended for use at a time, the other being held in reserve for use in case of an accident. Second, one set of pipes large enough for the station and used ordinarily, and a second set, considerably smaller and costing less, but which could be used while repairing damages to the larger set, in the event of an accident. Third, two small sets of pipes of a combined cross sectional area equal to that of the pipes of a single system, both sets being always in use except in case of accident to one, when it is intended to use the other by raising the boiler pressure to increase its carrying capacity, until repairs are made to the set damaged.

Duplicate systems were used much more frequently in the early days of electric power house construction than they are at the present time. In fact, the opinion is fast becoming universal that a duplicate system is an expense that is unnecessary if the single system is properly designed. The system comprising duplicate sets of large mains is hardly ever installed, on account of its great first cost and large condensation loss, due to the fact that both systems, on account of the leaks that are bound to occur in the valves, are constantly filled with steam. The use of the second and third duplicate systems, that with one large and one small set of pipes, and that with two small sets in constant use respectively, is not to be encouraged. In the former the first cost, condensation loss and cost of repairs, are all greater than in the single system. In any duplicate system there are almost double the number of valves that require packing, and double the number of joints that need constant attention that there are in the single system. Mr. George H. Davis, in the "Street Railway Journal," of July, 1896, gives reasons for favoring the duplicate system with small pipes, shown in Figure 1. Besides enumerating advantages common to a properly designed single-pipe system, he states that the cost of labor and repairs are 50 per cent. less with the two small pipes than it is with a single pipe of their combined area; also that there is greater provision against a shutdown with the duplicate system.



Plan.
FIG. 6



Plan.
FIG. 7

THE DESIGN OF PIPING FOR ELECTRIC POWER HOUSES.

It is intended to take up later the liability of a shutdown in a well-designed single system. Mr. Davis underestimates the cost of repairs on a small pipe, as compared with one twice its cross sectional area. But even if the relative cost of repairs is as he puts it, there are twice as many joints where leakage is likely to occur in the duplicate system as there are in the single system. Furthermore, the inner circumference of the pipe joints, where the leaks begin, is considerably greater in two pipes than it is in one large pipe equal in area to the combined area of the other two. The combined area of two 5-inch pipes is about equal to that of a 7-inch pipe, but the combined length of their inner circumferences is 40 per cent. greater than the inner circumference of the larger pipe. Moreover, the condensation loss is greater in the small-pipe duplicate system than it is in a single system of the same carrying capacity.

To show what the condensation loss in steam pipes of various sizes amounts to, calculations were made to present some data upon the subject. From the tests by George M. Brill (Transactions, A. S. M. E., Vol. xvi.) upon the loss of heat in steam pipes, with steam at 110 pounds pressure, and from the tests by Prof. Charles L. Norton (Transactions A. S. M. E., Vol. xix.) upon the change in the rate with which the heat is transmitted with a change in the difference in temperatures, it is evident that 1 square foot of pipe surface, with steam of 150 pounds pressure, would emit about 800 heat units per hour. If the pipe covering prevents the loss of 80 per cent. of this heat, and if the boilers evaporate 8 pounds of water per pound of coal, costing $3 per short ton delivered, the cost of condensation in 10-foot lengths of pipes of various sizes for the year's time, will be as given in the following table:

Size of pipe ..	6″	8″	10″	12″	14″	16″	18″	20″
Cost in dollars.	5.36	6.97	8.71	10.57	12.18	13.76	15.40	16.94

In considering the usual back-to-back type of station the engine-room floor is usually a little higher than that of the boiler room. In the single system the boilers are connected to a main, from which pipes lead to each engine. The main and as much of the piping as possible should be located in the boiler room, for the reason that if an explosion occurred in some section of the pipe that was in the boiler room, it would be possible, after the steam pressure falls, to cut out the damaged section and operate the rest of the plant. If the engine room, on the other hand, was the scene of the explosion and became filled with steam, the electrical apparatus would, in all probability, be unfit for service without considerable overhauling. Furthermore, an explosion in the boiler room is not apt to be as fatal as if a pipe or fitting in or under the engine room gave way, for the reason that the boiler room is generally more open and there is a greater chance for the men to escape.

The effect of the heat from the steam pipe, if placed in the engine room, would tend to make the room uncomfortable to the men employed there, whereas, if it was in the boiler room it would affect no one, as the firemen are exposed to a current of air passing into the furnaces that would not be affected by the presence of some additional steam piping.

If the main is supported by a bracket on the boiler-room wall, the feeder from the boiler should rise out of the boiler with a long bend and cross over and drop into the top of the main. If the main is of large size the side connection might answer, but the top is very much to be preferred. It is still the belief of a few engineers that this feeder should so unite with the main that the condensation in the main will flow back to the boilers by way of the feeder. To provide for this, it has sometimes been the custom to connect to the bottom of the main, or to the side of an eccentric tee with the branch so situated as to bring the bottom of the main and feeder on the same level. Both these methods are very bad and dangerous, as the condensation will not flow in the opposite direction to a current of steam traveling over a mile a minute, as it does in steam piping designed at the present day. Consequently, water hammer is apt to occur with disastrous results.

The eccentric tee is particularly bad, as the steam from the boiler is, upon entering the main, given a very rapid helical motion, and is apt to carry with it the condensation at the bottom of the main, until it comes opposite a nozzle connected with a pipe leading to an engine, when the water is drawn through the pipe by the steam and so reaches the engine and makes trouble.

The connection from the main to the engine should invariably start at the top of the main, and this is the most important point to be remembered. Another also equally important point is to have the valves in the pipes connecting the boiler and the main and engine and main so situated that condensation cannot collect on either side of the valve if it be closed or open. With these requirements in view, the different arrangements that will conform with them will be considered. Figure 2 shows a part plan and section of the back-to-back type of station. The feeder from the boiler rises, and with a long radius bend crosses over to a gate valve, from which a long turn bend drops into the top of the main. The feeder to the engine rises to an angle valve, from which a bend crosses to a separator of large volume near the engine cylinder mainly to provide a reservoir of steam close to the engine, and also to furnish an additional safeguard against water finding its way into the cylinder.

Instead of the gate valve and bend in the feeder connecting the boiler and main, an angle valve with a straight drop into the main could be used, as in the connection leading to the engine. If this connection is used, the expansions or contractions of the pipes connecting the engines and boilers with the main tend to rotate the latter in opposite directions. The vertical connections to the top of the main may be quite short if the bent pipes are of long radius, for contraction or expansion would then be taken up by a change in the radius of the bent sections. If the bent sections of the pipe are short and of small radius the vertical connections should be longer, so that the vertical pipes will bend slightly, and take part of the expansion of the connecting pipes. Some engineers prefer a semi-circular bend connecting the boiler and main with the valve in the highest point, as shown in the dotted line in the elevation shown in Figure 2. The only objection to this is that when the nozzle on the boiler is near the front, the valve in the feeder is some distance away from the valve in the pipe supplying the engine, and it is therefore rather inaccessible. With both valves close to the main they are easily reached from a light walk, suspended from the roof trusses. Another advantage of placing the valve close to the main is that the condensation is less when the valve is closed.

Some persons insist upon placing a valve immediately above the boiler nozzle, but there is no good reason for doing so. The objection to the valve in that location is that water is apt to collect over it. Of course, with two valves in the feeder, it is supposed that both are closed when the boiler is out of service so that condensation could not occur in the feeder and collect over the valve on the boiler nozzle, but the valve near the main might leak, or, through neglect, it might not be closed. "The Engineering Record" has reported one or two instances where ignorant persons were sent on top of a boiler to open a valve over the boiler nozzle. They did not know enough to open the small drain for the pocket over the valve, and immediately began to open the valve, with the result that the water blew out an elbow, killing men, and another so-called mysterious steam-pipe accident went down in history. The only safe way to place a valve in a steam pipe is to locate it so that a pocket cannot form. It might be mentioned here that a globe valve cannot be placed in a horizontal pipe without forming a pocket, and therefore should not be used in such situations.

If the connection to the engine is made under the engine-room floor, the pipe to the engine can be run through the wall and drop to the basement of the engine room, as in Figure 3, or drop in the boiler room, as in Figure 4, in each case rising from the top of the main. A separator of large volume, also acting as a steam reservoir, should be placed close to the engine, and from this the pipe should rise to the throttle valve. The reservoir is of particular value in this case, because of the long connection between the steam main and engine.

For the purpose of discussing the reliability of the single-main system in a station where the engines and boilers are placed back to back, Figure 5 is shown. The station is equipped with three units, two being sufficient to handle the maximum load. A boiler or pair of boilers is supplied for each engine, and the main is divided into independent sections by valves. About the only combination of events that could possibly cripple the plant would be to have one of the units laid off for extensive repairs, and a steam pipe accident occur in the piping connecting the engine and boiler of one of the other two units. Such an occurrence would be so unlikely, however, that "The Engineering Record" does not believe a duplicate system necessary. Suppose the plant contained four units, and that three, when running at their most economical load, were necessary to meet the average load. If it should be impossible to run one engine, and an accident to the steam pipes should prevent one of the remaining engines from running, the chances are that for a short time the two available units could work at 50 per cent. overload and furnish all of the current required during the short period of maximum demand. Of course, as the number of units increase, the chance of an accident to the steam piping of a single-pipe system would be less likely to cripple the plant.

If the power station has the engine and boiler rooms placed end to end, as in Figure 6, the arrangement of piping shown there is probably the safest. It is arranged on the ring or loop system, and valves are so placed that if an accident occurs, the damaged section may be cut out and the steam carried around through the system in the opposite direction. In the station shown, expansion joints are placed in the three connections crossing the engine and boiler rooms. In a station of this size the expansion in the mains running lengthwise of the engine and boiler rooms could be taken care of by anchoring the mains at the middle, so that the expansion would be equally divided between the two ends of the mains.

If the mains were very long, it would, perhaps, be best to put expansion joints in the middle of each main, and anchor them midway between the expansion joint and the ends of the main. The arrangement shown in Figure 6 is about the only one possible if coal-handling machinery is placed over and between the boilers. If this machinery is so located as to not interfere, the piping might be arranged as in Figure 7. Each main is of sufficient size for half the plant, but in case of an accident the damaged part could be cut out without crippling more than one or two engines and boilers. All valves in the mains would be easily accessible from a central platform. The only difficult part of the system is arranging for a flexible connection between the two mains for a cross connection at each end and at the boiler-room wall. These connections must be of long radius, to permit a difference of expansion in the

mains. The connections rise as shown to a gate valve, with its stem downward. This would be a dangerous position for the valve if the pipes on both sides of the valve did not drop and thus prevent a water pocket from forming.

In a station where the boilers are over the engines there is no reason why the arrangement shown in Figure 8 would not fill the requirements. There are two mains in the boiler room, one in the rear of each row of boilers. They are cross-connected at each end. The pipe to each engine rises from the top of the main to a valve, and from this drops with a double bend into a separator of large volume in the engine room opposite each engine. The separator and vertical pipe should be supported so that there will be no undue strain upon the bend above, which would be free to move with the expansion and contraction.

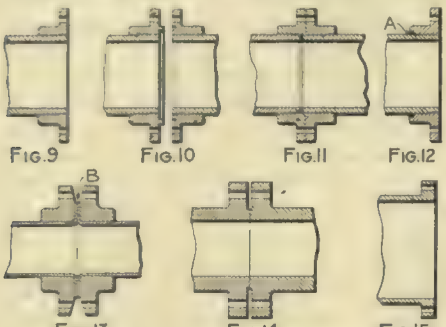


FIG. 9 FIG. 10 FIG. 11 FIG. 12
FIG. 13 FIG. 14 FIG. 15
THE ENGINEERING RECORD.

In regard to the kind of fittings in the connection between a boiler and a steam main, or the main and the engines, long bends made of wrought iron pipe should be used, for several reasons. First, they reduce the friction very much; second, their use reduces the number of joints likely to leak; third, such a connection is very much more flexible than one composed of two straight pieces of pipe connected by an elbow. Their greater flexibility is of great advantage in taking care of expansion after the piping is in place, and, furthermore, they are much easier to connect when erecting the piping. No matter how much care is taken in facing off square the flanges, it almost always happens that the flanges of the boiler nozzles are not in perfect alignment or exactly horizontal, so that a considerable strain is introduced in the piping in forcing the abutting flanges to a seat.

It is much better to make the bends in the piping out of wrought iron than copper, although the latter has been used to some extent. At the temperature the copper is subjected to in brazing the joint, the fibrous nature that copper acquires in rolling is destroyed, and a serious reduction of its tensile strength and ductility results. Commodore Melville, Chief of the Bureau of Steam Engineering, U. S. Navy, calls attention to this in his report for 1892. He also gives the results of tests upon copper steam pipe, in which the actual breaking strength varies from about 60 to 80 per cent. of calculated strength. Recent failures of copper pipes in marine service, and the report of Professor Arnold, referred to in "The Engineering Record" of July 30, showing that the brazing in the pipe was disintegrated by an electric action, brought on by the presence of fatty acids in the pipe, all go to demonstrate the unreliability of copper. The British Board of Trade recommends the use of wrought iron or steel pipes in place of copper.

A book could be written about different types of flanges that have been designed to prevent leakage. The most common form of flange connection is shown in Figure 9. The flanges, which are of wrought iron or steel, are screwed on to the end of the pipe, and struck with a hammer around the inner circumference. When this is done the pipe is put in a lathe and the flange faced off square with the axis of the pipes. Sometimes the flanges are riveted on to the pipe, as it is hardly possible to cut a thread on a pipe over 18 inches in diameter. In this type of flange, corrugated copper gaskets are very frequently used.

In the flange shown in Figure 10, which is used to a considerable extent, there is a circular tongue and groove as shown, the groove containing a ring of copper as a gasket. The principal objection to this flange is that in places where the piping is concentrated and the connections short, it is difficult to spring the flanges apart a sufficient amount to take out a section of pipe for repair or otherwise. The objection to any screwed flange is the tendency for steam to leak through the joint between the flange and the pipe. Figure 11 shows a joint in which the pipe is screwed into the flanges far enough to press against metallic packing in the form of a ring, the idea being to keep the steam away from the thread of the flanges. To prevent leakage through the thread the joint at A, Figure 12, is sometimes calked with a tool, and in other cases the flange is recessed to receive lead or other calking material, as shown, but it does not help matters for any great length of time. An effort to overcome the leakage between the flange and the pipe is shown in Figure 13. The sketch from which the cut was made was furnished by Mr. George I. Rockwood, M. A. S. M. E., who designed the flange. The pipe is a steel boiler flue and the flange is slipped over it, and the end of the pipe heated and flanged as shown. The faces of the flange are cut away so as to calk the joint at B. The joint is said to have been used with considerable success.

Riveted steel pipe has been used to some extent in power houses, and an excellent example is given in the paper by Captain Charles H. Manning, in a paper before the American Society of Mechanical Engineers (Transactions A. S. M. E., Vol. xv.) and printed in part in "The Engineering Record" of July 28, 1894. Riveted steel is seldom used for piping, mainly on account of its cost and tendency to leak steam and water.

Cast-iron has been used by some engineers. The stations of the Edison Electric Illuminating Company in New York City use cast-iron

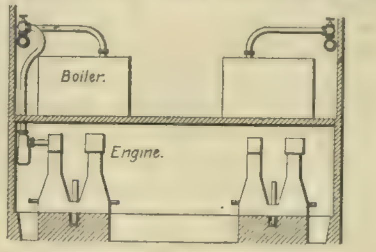


FIG. 8

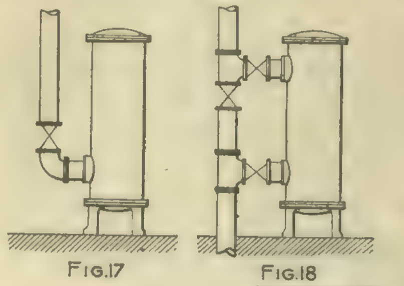


FIG. 17 FIG. 18
THE ENGINEERING RECORD.

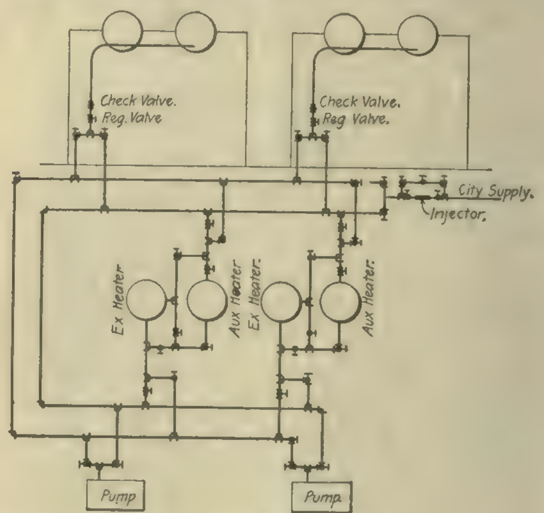


FIG. 16

THE DESIGN OF PIPING FOR ELECTRIC POWER HOUSES.

piping almost exclusively and with very satisfactory results. Mr. John Van Vleck, who designed the system, informed "The Engineering Record" that the piping was made of the best charcoal iron, containing 3 per cent. of aluminum to prevent blow holes from forming in the casting. The flange is cast on to the pipe, as shown in Figure 14. The flanges have raised seats and the joints are ground, no gaskets of any kind being used. Mr. Van Vleck states that in making these joints a pipe was set on end and an iron strap put around the flange to be ground, so as to hold in its proper position the flange of the pipe or fitting that was to be ground to fit it. Emery was placed between the flanges and the upper fitting turned by means of a stick of wood fastened to the upper fitting, two men walking around with the stick until the joint was finished. Two men could grind a 14-inch flange in about half a day.

The following table shows the sizes in inches of the cast-iron pipe in the Duane Street station:

Inside Dia. Pipe.	Dia. Flange.	Dia. Bolt Circle.	No. & Size of Holes.	Thickness of Pipe.	Thickness of Flange.
16	26¼	23¼	20 1⅜	1⅞	3½
14	24	20⅞	16 "	1¾	3¼
12	21⅝	18¾	16 "	1⅜	3

This company used copper bends to connect the engines and boilers with the mains, but recently they have been using bent wrought iron pipe with a wrought iron flange welded on the end of the pipe.

Wrought-iron pipe with forged wrought-iron flanges welded on the end of the pipe, shown in Figure 15, has been introduced within the past year and seems destined to play an important part in the steam piping of the future. The process of manufacture has been developed by the National Tube Works Company, which stated that, in making the pipe, a forged wrought-iron flange is bored out and forced on to the end of the pipe. It is then heated in a furnace and welded by means of a hammer. The flange is then faced and the bolt holes bored out. The piping is usually put together with a corrugated copper gasket, and is made of various size, from 6 to 30 inches in diameter, with the probable early production of pipe up to 36 inches in size. The flanges are made to conform in dimensions with the standard flange schedule adopted several years ago by the American Society of Mechanical Engineers and the Master Steam Fitters' Association. It is said that with pipes from 6 to 10 inches and from 10 to 15 inches in diameter, pipes with welded flanges cost about 25 per cent. and 10 per cent. more, respectively, than they do with screwed flanges. Over 15 inches in diameter welded flanges are cheaper.

The care of drips is an important consideration in the piping of a plant, yet it is one that is frequently very much neglected. All high-pressure drips, those draining the steam main, the steam separators, the jackets of the steam cylinders, and reheating receivers between the cylinders of steam engines, can be led to a small receiving tank and automatically controlled pump that returns the water to the boilers. If these various drips are likely to be under different pressures, each should be trapped into the receiving tank. In some instances the condensation in the steam main has been run by gravity into the boilers, but as some of the high-pressure drips in other parts of the plant cannot be treated in this way, it is better probably to run them all to a receiver and pump as suggested.

The drip from exhaust piping in non-condensing plants and from all engine and pump

cylinders contains too much grease to attempt to save the heat that it contains. These drips should be individually trapped into a main going to waste.

An important part of a steam plant is the ease with which valves may be controlled. In the new plant of the Boston Electric Light Company, in Boston, Mass., which was described in "The Engineering Record" of November 19, 1898, each valve is controlled from the floor of the engine or boiler room by means of a system of shafts connected by miter gears. A valve in the supply to each engine is located in the boiler room, but these valves are controlled from both the engine and boiler rooms. The best way of reaching the valves in a main bracketed from the boiler-room wall seems to be by means of a light platform hung from the roof trusses. Large valves beneath the engine-room floor should have their stems in a vertical position and controlled by a floor stand.

The feed system for the boilers may well be in duplicate throughout, partly for safety and on account of the fact that with a duplicate system boiler tests may be made at any time. With a duplicate feed system the engines may also be tested, if the station is of the type shown in Figure 5. A system of connecting and cross-connecting a pair of boiler feed pumps with the feed-water heaters and with boilers is shown diagramatically in Figure 16. Although many of the valves are shown as angle and globe valves, gate valves should be used throughout, also long radius elbows to reduce the friction. In some condensing plants a pair of feed-water heaters is provided for each engine, and the diagram is made for such an installation. As shown in the sketch, each pump feeds into a pair of mains, both of which connect with a pair of feed mains extending along the front or rear wall of the boilers. The connections are so made that the water from any pump or pumps may pass directly to either of these mains, or first pass through either one or both of the feed-water heaters. One feed-water heater warms the feed water with the exhaust steam of the main engine, which, of course, is at a temperature of about 140 degrees Fahrenheit, and the other heater receives the steam exhausted by the air and feed pump, if a steam-driven feed pump is used, and raises the temperature of the feed from 140 to about 200 degrees Fahrenheit. When used in this way the water is passed through the two heaters in succession, and provision has to be made for doing this. Either heater may be by-passed if desired. A water meter, capable of measuring hot water, if the pumps handle hot water, should be placed upon the discharge of each pump, so that the water passing through any pump may be measured, whatever may be the course of the water before reaching the boilers. It would be well, if meters are to be used, to provide means for passing the water that flows through them into a barrel, so that the meter can be occasionally tested. A meter is a particularly valuable adjunct of every steam plant, and, if occasionally calibrated, it forms an easy means of checking its efficiency.

The two mains supplying the boilers can either be carried in a covered trench along the boiler fronts or along the rear of the setting. If the boilers are of the water tube type they are usually set in batteries of two each, and the feed mains cannot be carried along the fronts over the fire doors, as is the practice with horizontal tubular boilers. With the mains in a trench in front, the connections leading to the boiler and the valves are at the front of the boiler and more convenient than if the mains are in the rear. With the mains at the rear, the valves and boiler connection are sometimes placed on the side wall of each pair of boilers.

Water pipes from an injector and from the city supply—the latter for use in filling an empty boiler—should be connected so as to supply any or all boilers. They might be connected as in Figure 16, supplying either one or both of the mains at the boilers. A globe valve should be placed on the feed piping leading to each boiler, for the purpose of throttling the feed. A check valve should be placed in this pipe, as shown. Brass piping should be used for feed piping, on account of its neater appearance and greater durability.

Two methods of connecting feed-water heaters of the closed type are shown in Figures 17 and 18. In Figure 18 the entire current of exhaust steam is passed through the heater. A by-pass is provided, as shown. In the first method, shown in Figure 17, there is but a single connection to the heater, it being supposed that steam will flow into the heater as fast as condensation occurs. The objection to this system, and it has been found a serious one, is that air sometimes finds its way into the heater, and it is difficult to get it out, even if automatic air valves are provided. The connection shown in Figure 18 is much the best of the two, even though it does cost a little more. Occasionally the system is modified by having smaller connections leading to the heater, so that only part of the exhaust steam flows through the heater.

In exhaust piping in condensing plants the greatest care should be taken so that there are no pockets between the engine and condenser in which water can collect, for it is impossible to drip them, on account of the vacuum in the pipes. Many engine accidents have occurred through neglect of this principle. A condensing engine usually exhausts through a closed feed-water heater, and beyond this the pipe leads to the condenser. A branch pipe leading to the atmosphere should contain the relief valve, which is intended to open and permit the steam to escape to the atmosphere if an accident occurs in the condenser. The exhaust from an engine leading to the atmosphere is frequently of galvanized spiral riveted pipe. Gate valves should be used in the exhaust pipes.

In non-condensing plants, sometimes all engines exhaust into a single main, connecting to a single feed-water heater. It is better, however, to have a separate heater and free exhaust for each engine. It is safer and makes it possible to test any unit under its normal working condition, provided, of course, the feed system is in duplicate, and the high pressure piping connecting the engine and boiler, or boilers, of the particular unit to be tested, may be separated from the remainder of the system. Although this discussion pertains more to the general design of a power house than to the piping, yet it concerns the piping, and has therefore been mentioned.

In non-condensing plants the feed-water heater should be protected by a grease separator, which will prevent a considerable portion of the grease from accumulating upon the tubes of the heater, and thus impairing its efficiency. If the steam exhausted by any engine is condensed in a heating system or in a condenser, and is returned to the boilers, a feed-water filter should be provided. This subject was discussed quite fully in "The Engineering Record" of October 29, 1898.

LARGE GRAIN ELEVATOR, LOUISVILLE, KY.

The large grain elevator of the Ballard & Ballard Flouring Co., Louisville, Ky., which has now been in operation for several months, possesses points of interest to engineers. It consists of two steel cylinders, each 50 feet in diameter, 70 feet high to the apex of the roof, and holding 200,000 bushels. Between the two cylinders, which are 12 feet apart, is the elevating machinery. Railway tracks run in front of the elevator, and across the tracks is an old storage warehouse, from which the power for running the machinery is obtained. The line shaft drives a six-grooved pulley, from which five ropes transmit 75 horse-power to the elevator. From the driving pulley the ropes rise to a guide pulley in the top of the warehouse, and from there cross over to the top of the elevator and drive a 72-inch receiving pulley mounted upon a shaft carrying other pulleys, from which ropes lead to the elevator. Figure 1 shows a cross section through the elevator and warehouse.

Grain is shoveled from the cars into the pit alongside and below the track, and from this pit the elevator B raises the grain to a large stationary hopper 11 feet 6 inches square, 10 feet high, and provided with a conical bottom, from which it is deposited in a weighing hopper. A chute from the bottom of the hopper conveys the grain to the boot of a second elevator A, which raises it to two 16-inch Caldwell screw conveyors, each of which transports the grain at the rate of 2,500 bushels an hour to the openings in the tops of the steel storage tanks. If desired the grain may be passed down through a 10-inch chute from the top of this elevator to a 30-inch conveyer belt, which carries the grain at a high rate of speed across a bridge connecting the elevator and the warehouse. When it reaches the end of the bridge the grain is shot across an open space to remove the dust, into

STEEL TANK GRAIN ELEVATOR, LOUISVILLE, KY.

a hopper, from which it is bagged. The grain may also be passed from the bottom of the weighing hopper directly into a separator for cleaning, and then either into the tanks, across the belt conveyer to the warehouse, or back into cars on the tracks.

The grain is drawn from each storage tank by means of a 10-inch pipe controlled by a 10-inch Chapman gate valve, leading from the bottom of the tank to the grain pit, from which it is elevated to the storage hopper, weighed, and then passed into the elevator A, which discharges the grain through the chute C D to the cars. If it is not desired to weigh the grain, it may pass from the grain pit to the elevator B and from that directly into the cars by the chute E D. It is also possible to change the discharge from the weighing hopper to the boot of the elevator B, so that the grain may be raised by it and discharged into the cars.

The American or continuous-rope system of power transmission is employed, and the slack of the rope is taken up by the tension carriage shown in the detail in Figure 1, between the warehouse and the elevator. Figure 2 shows the construction of one of the elevators. Each tank is built of 12 rings, each 5 feet high. Beginning at the bottom the rings are of 19, 16, 13, 11, 9 and 8-pound steel. The bottom of the tank is of 13-pound and the top of 6-pound metal. The bottom is riveted to a 4x4½-inch angle extending around the circumference of the tank. The roof is conical, with a rise of 10 feet in the

center, and supported by 20 steel trusses converging to a heavy annular casting having an opening in the middle 26 inches in diameter, through which the grain is forced into the tank. The roof trusses are supported on and riveted to a continuous angle-iron carried around the inner circumference of the shell, and 12 inches from the top. A ladder is provided on the inside of each tank and also between them.

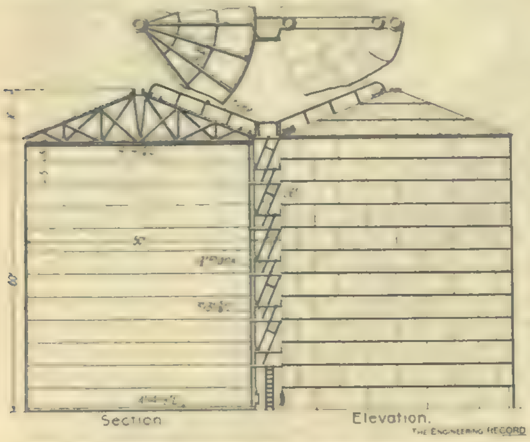


FIG. 2—CONSTRUCTION OF ELEVATOR TANKS.

A flange is placed in each tank at a distance of 3 feet 6 inches above each of the six platforms, to allow of inspecting the grain. The flange is shown in detail on Figure 3. It will be noticed that a lip projects from the flange downward and inward, to prevent grain from falling out when the door on the flange is opened. A manhole is placed near the bottom and in the top of each tank. There is also a 4-inch pipe flange on the side of each tank, for the purpose of washing out and flooding the tanks during test of the joints. All joints in the tanks are lapped. The tanks upon completion were given two coats of Dixon's graphite paint. The horizontal seams are single and the vertical seams double riveted.

The design of the complete plant was made by Charles A. Baechtold, M. E.; the steel tanks and roofs were built by J. F. Reeder; the elevating machinery was constructed by the National Foundry & Machine Co., Louisville, Ky.; screw conveyers, spouting, etc., were made by the H. W. Caldwell & Son Co., of Chicago; and the Link Belt Machinery Co., of Chicago, supplied the belt conveyers.

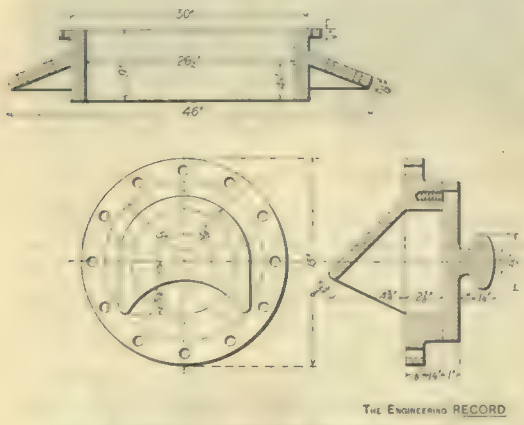


FIG. 3—DETAILS OF INSPECTION FLANGE.

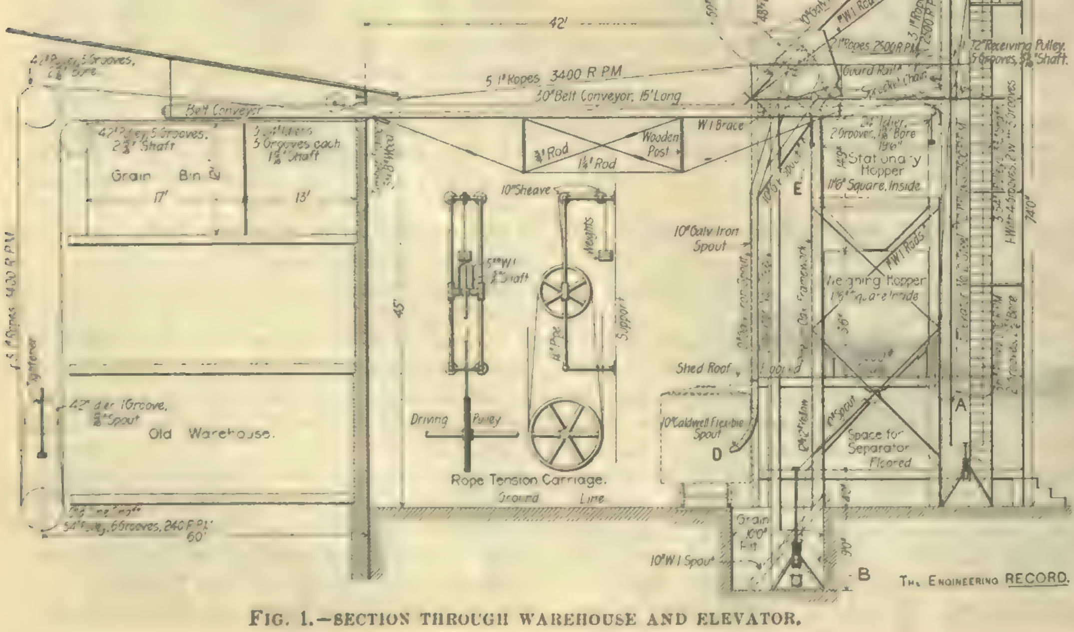
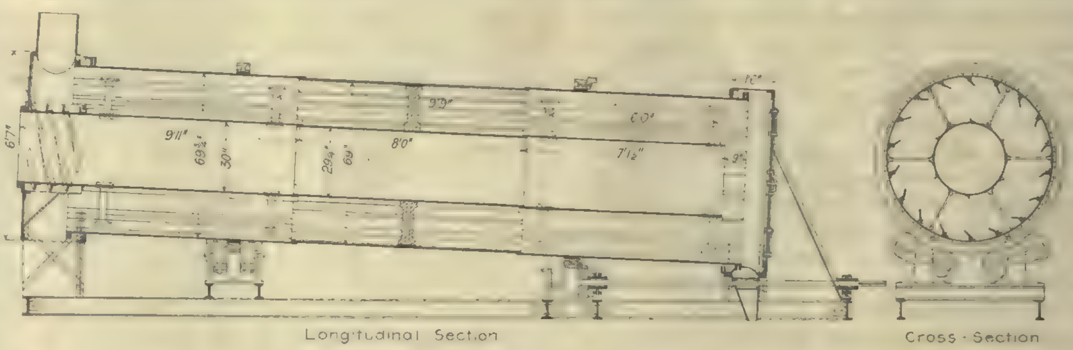



FIG. 1.—SECTION THROUGH WAREHOUSE AND ELEVATOR.

THE RUGGLES-COLES DRYER.

The accompanying cut shows a longitudinal and cross-sectional view of a new dryer for driving moisture from sand, blast-furnace slag in the manufacture of cement, and for other similar purposes. The machine consists of two concentric cylinders of steel plates with butt joints, both being inclined slightly as shown. The inner cylinder is supported by six radial arms in the middle, and at each end by two sets of adjustable arms, which permit a difference in the expansion of the two cylinders without straining them. The makers call particular attention to this feature, which is patented. The inner cylinder at the upper end extends beyond the outer cylinder, passing through the head of the latter, as shown, and is connected by a flue to the furnace, where the heat for drying is obtained. Oil may be used for fuel, if desired. The material to be dried is fed into the hopper, and on the extended end of the inner cylinder is a helical conveyor, which feeds the material through the stationary head into the rotating cylinder.

Two heavy cast-steel turned bearing rings are fastened to the large cylinder, and these roll upon eight cast-steel wheels, fitted into self-adjusting rockers, as shown; and the lateral thrust is taken up by four of them. The cylinder is rotated by gearing, and the material is carried up in the turning by brackets riveted to the inner side of the outer shell, until it reaches the top, where it is dropped through the current of heated air. The hot air enters the central shell, passes to the lower end, and then returns through the annular space between the shells to the outlet at the upper end. The material is thus being constantly dropped through the heated air, as the dryer rotates. It will be noticed that the fresh material first comes in contact with the inner shell, where it is hottest, and overheating of the shell is thereby prevented. The dried material is discharged from the lower end. The head of the machine is provided with a series of dampers to regulate the temperature of the incoming air, and by mixing the gases from the furnace with cold air, they are reduced to the lowest temperature necessary to evaporate the moisture, and fuel is said to be thus saved. The gases on leaving the dryer are exhausted by a fan. The whole apparatus, except the fan, is secured to a rigid frame of I-beams, which the makers believe very essential to smooth running and durability. It is claimed that the dryer is exceedingly compact for its capacity, and that the cost of repairs is very low. It is stated that one of these dryers, with an outer shell 24 feet long and 70 inches in diameter, dried about 200,000 pounds of sand containing 4½ per cent. of moisture in 7¾ hours, and that 84.6 per cent. of the fuel consumed was realized in driving off this moisture. The dryer is made by the Ruggles-Coles Engineering Company, 39 Cortlandt Street, New York City, from which further information may be obtained.



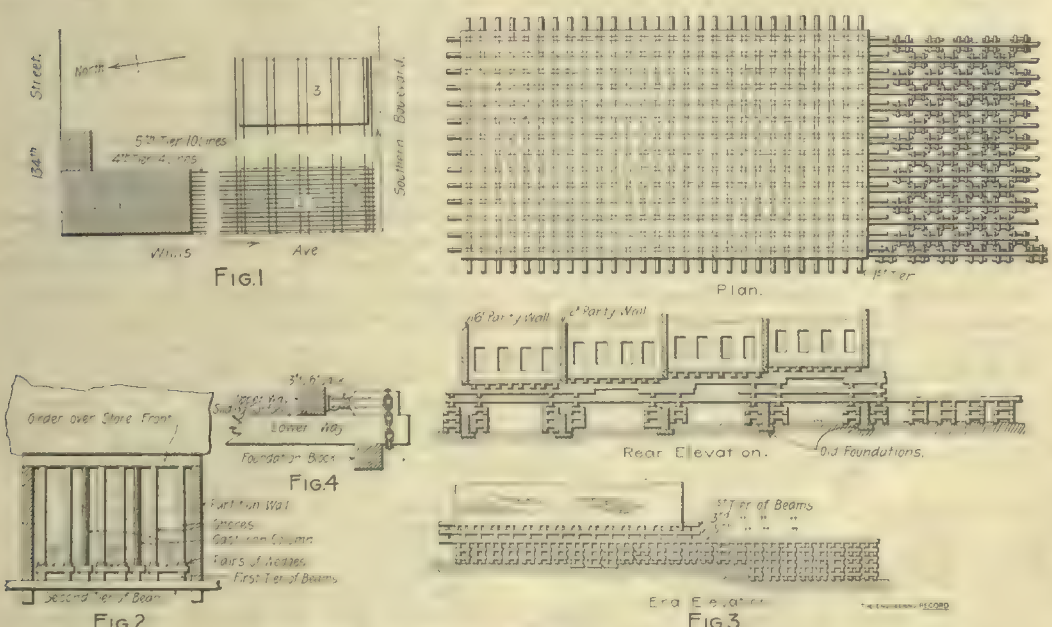
THE RUGGLES-COLES DRYER.

MOVING A FIVE-STORY BRICK BLOCK.

The southeast corner of Willis Avenue and One Hundred and Thirty-fourth Street, Borough of the Bronx, New York city, was recently occupied by a five-story brick building 100 feet front and 65 feet deep, comprising four separate stores with flats above them and fronting west on Willis Avenue. The construction of the Willis Avenue Bridge across the Harlem River made it necessary to appropriate the site of this building for the approach structure, and as the houses were valued at about $15,000 each, it was decided to save them by moving them bodily to an adjacent site in the middle of the south side of the same block, where foundations were accordingly prepared to receive them in a new position fronting south. The whole block, having an estimated weight of about 3,000 tons, was moved 75 feet south and 35 feet east in about three weeks by a simple system of skidding and the use of a large number of ordinary jack screws. The original position of the building is shown at 1, Figure 1; the position at the end of the first moving operation at 2, and the final position at 3. The different sets of timbers which served for stationary skids in the first and second operations are indicated by single lines, marked fourth and fifth tiers, respectively.

Each of the store fronts in the lower story has two brick party walls and two intermediate

cast-iron columns carrying the second story girder, on which the brick wall of the upper front rests. A vertical 12x12 inch shore was set close to each side of each party wall and each side of each column, making six in each store front. The foot of each shore was supported by pairs of wooden wedges from a short 12x12 inch sill running across each opening in the store front, parallel to and in the plane of the front wall, Figure 2. Each end of each of these 12 short sills rested on a transverse needle beam about 60 feet long and running horizontally eastward, in two or three lengths, through the building and through holes cut in the brick work of the east wall. These 28 needle beams constituted the first tier and rested in turn on a cross layer of 14 lines of north and south timbers parallel to the front wall of the building, which also extended continuously through the block from end to end and projected through the walls. Underneath this second tier of timbers was a third tier of 10 lines, one line each side of each party wall, parallel to and directly underneath the first tier. Underneath the first tier was a fourth tier, exactly corresponding to the second and acting as skids upon which the building was moved 75 feet south. A fifth tier of 10 lines corresponded to and afterward served as skids upon which the building was moved 35 feet west. It rested on crib work blocking, built up from the ground about 12 feet below the level of the store floors, as indicated by the general plan and elevation diagrams, Figure 3. The lower three tiers of timber, namely, the first, second and third, were built under the original location of the building and the fourth extended 75 feet south of it, as far as it was desired to move the building in that direction. All of the timbers were 12 inches wide, from 12 to 16 inches in height, and from 20 to 60 feet in length. The different sections of the long lines were laid close together in the same horizontal plane and overlapping a few feet at each section. They were carefully leveled and aligned, but were not bolted or otherwise fastened together. When all was in readiness about 350 jack screws were set under the needle beams and the building was raised by them about 1 inch, and the old foundations cut away. The fourth tier of timber was wedged up tight under the third tier with soap between their adjacent surfaces and the building was lowered to rest upon the new timber work. In raising the building two men were stationed at each third tier timber, and at the blowing of a whistle turned the first jack screw in that row one turn, then proceeded to the next screw on the same beam, gave it one turn, continuing until all the screws had been turned up the same amount. At the repetition of the signal they again began simultaneously to give the screws a second turn, and this operation was continued until the building was sufficiently raised.



ARRANGEMENT OF TIMBERS FOR MOVING A BRICK BLOCK.

The first movement of the building to the south was made using the third tier of beams, that is, 10 lines running east and west, for upper ways, and the fourth tier, 14 lines, running north and south, for lower or stationary ways.


MOVING A FIVE-STORY BRICK BLOCK.

The adjacent surfaces of these two tiers were lubricated with soft soap. Twenty-one jack screws were chained to the lower ways, as shown in Figure 4, so as to take bearing on the upper ways. They were then simultaneously screwed up as for the raising of the building, and at each signal the building moved three-sixteenths of an inch. The greatest distance moved in one day was 9 feet 8 inches, and the whole 75 feet to the south was moved in 17 days. When the building had been moved as far as required to the south the jack screws were shifted to the fifth tier of timbers, which then became the lower ways and the fourth tier of north and south lines, which had previously been the lower ways, now became the upper ways, and was pushed by the jacks to the east. Only 10 jack screws were required for this service, which was accomplished in four days, and the buildings were left parallel to their original positions, instead of being revolved 90 degrees, as was at first contemplated. In the operations described, all the timber down to the fourth tier moved with the building, but below the fifth tier it was stationary, except as it was taken up after the building had been moved from above it and laid down in advance to again receive the approaching building. All of the tiers were laid exactly horizontal and were supported by ordinary timber crib blocking. After the moving was completed the needle beams were jacked up from the crib work, so as to release the lower tiers of beams, which were removed, and the new foundation walls were completed and the building lowered safely 3 feet 10 inches into position upon them by reversing the operation of the jack screws already described. The work was conducted so as to avoid all unnecessary injury to the building, and with such care and skill that no cracks were visible in the brick walls and not even a window was broken. About five weeks was required from the time the first shoring and needle beams were placed until the building was jacked up to receive the new foundation, and a force of about 20 men accomplished the entire work. The moving was designed and executed by Mr. Fred Damm for a contract price of about $10,000.

FAILURE OF BUILDING FOUNDATION PIERS.

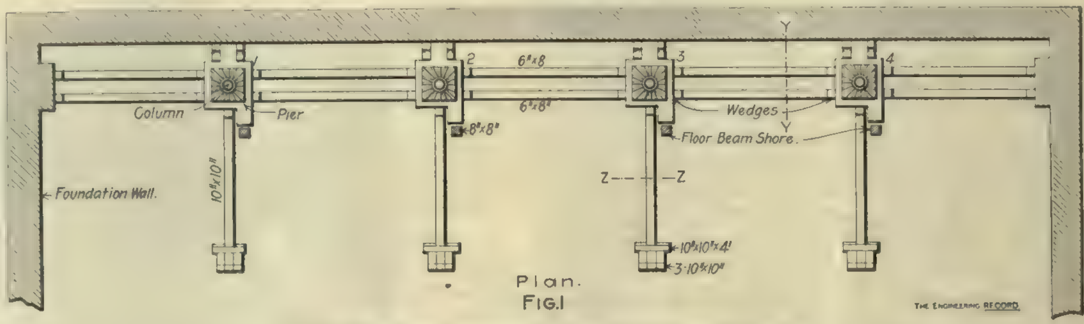
The Rothschild Building is a large commercial structure at Fulton and Jay Streets, Brooklyn, N. Y., which has recently been condemned as unsafe by the building department of that borough. It was reported to be in a critical condition, and as it had attracted public attention and been the subject of alarming statements in the daily press an examination was made by "The Engineering Record" and the facts determined as follows: The building is eight stories in height above the basement and cellar, and is 120 feet deep, with an oblique front of 110 feet on Fulton Street. The first two stories on Fulton Street have large display windows and a light iron sheathing in front. The wall above and for the other parts of the building is of brick and the columns are all of cast-iron. The floors, beams and girders are of wood. In the front wall, four 14-inch round columns are carried up to the third story above the street, where each supports at the center a double cantilever girder consisting of three parallel 20-inch I-beams, on the top of which is built a brick pier 8 feet long and 20 inches wide in extreme dimensions. The column terminates at this level and the pier above, which is faced with brickwork 4 inches thick on all sides, and therefore has an effective cross section of only 1 foot by 7 feet 4 inches, supports its proportion of the entire dead and live load of the six upper stories. Elsewhere throughout the building the floor girders and joists are supported by interior columns and by the main brick walls. The building was erected in 1892, and the lower

stories have been occupied as clothing stores and the basement as a bowling alley, but it is said that the stories above the second floor have never been leased.

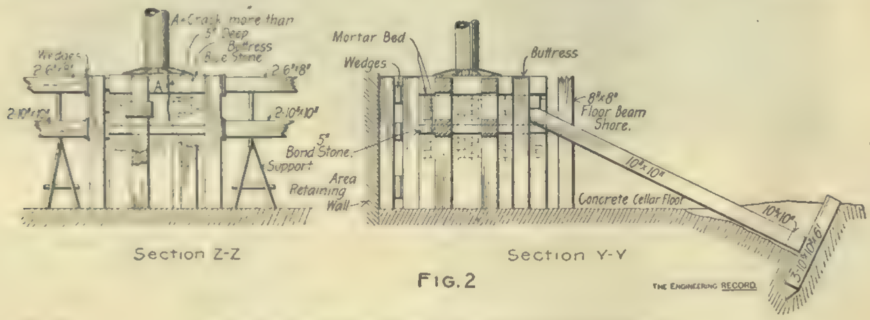
Since its construction this building has been subjected every six months to a rigid inspection by the Building Department, and a year ago a careful examination of the foundation piers failed to show either cracks or settlement. In the next inspection these piers were not specially examined, but in the last inspection a few days ago it was seen that they were breaking and settling and energetic measures were taken to prevent additional failure, and insure the safety of the public. Traffic has been diverted from the sidewalk in front of the building and police guards stationed there. The front wall has been braced by double rows of inclined timber shores in the street. The piers have been secured as well as possible, and vertical shores are being arranged inside to relieve them of floor loads. Gauges have been established, and observations are frequently made and recorded of the progress of the movement in the piers. By these precautions, the danger of a possible collapse has been avoided, and the examination will enable a determination of how much of the superstructure it is necessary to remove.

Each of the four short columns in the lower part of the Fulton Street wall carries a calculated dead load of 400,000 pounds to its 5-foot square brick pier, which is about 7 feet high above the concrete floor of the cellar. It is not known what the size or character of the footing below the floor is, but it is assumed that the piers rest on the coarse dry gravel and sand that prevails in the vicinity. The piers are built of common red brick, laid up in poor, soft, friable mortar that can easily be picked out of the joints. At about the middle of the exposed height there is a horizontal bond stone 5 inches thick, set on a bed of mortar from ½ to 1½ inches in thickness. The tops of the piers are capped with blue stone flags from 12 to 13½ inches in thickness, set in mortar beds from ½ to 1½ inches thick. On top of the cap stones are set cast-iron pedestals 45 inches square and 1¼ inches thick, each of them reinforced by 16 radial vertical webs begining about an inch and a half from the outer edge of the plate and terminating at the column seat about 3 inches above the top of the plate. These beds are set in mortar about one-quarter of an inch thick, and one of them is broken in two across the middle. The inside edges of its pieces are depressed so that the column takes bearing only at the extremities of its transverse diameter, and leaves a space over the crack in which a test wedge has been inserted. All of the cap stones are broken across through the center, and one of them is broken in both directions so as to make four pieces. All of the brick piers have bulged outwards in every face, one of them as much as an inch and a quarter, and all but one of the piers have vertical cracks through the brick in the uper part of one or more of their faces. In one pier there is a vertical crack extending continuously through the cap stone and down 3 feet into the brickwork. It is about ¼ inch wide at present and admits a good sized probe at least 15 inches long. Thirty-nine bricks have been broken through in this face of the pier, and the crack has had slips of paper pasted over it by the department engineer to determine any further extensions.

To secure the piers vertical timbers have been placed against their faces on every side and strongly braced by two double lines of continuous horizontal timbers carried across the building and wedged against the retaining walls at the ends. Similar vertical bearing pieces on the front and rear sides of the piers are secured by wedges against the retaining wall of the vault and by inclined braces to reaction posts set in the floor, as shown in Figures 1 and 2. Each pier is built with a small spur on the inside to receive the floor beams, and adjacent to this lines of vertical shores have been set to carry the floor loads. Observations throughout the building show serious settlement and cracking in the other foundation walls, and large deflections in some of the floor beams. One of the foundation walls, which is 40 inches wide, was apparently carried up for some distance above the basement floor with a width of only 28 inches, after which an inside extension 12 inches thick was built against the face without any bond or connection whatever, and without a common binding stone or cap over its top. Above this the full thickness of the 40-inch wall was built upon both lower portions, being bonded through in the ordinary manner. This now shows cracks above the original line of separation of the two portions of the substructure, which, it is thus evident, have settled separately. The character of the design is further emphasized by the fact that the floor panels 20 feet square are carried on single floor beams of 20 feet span that are in some places made of 10x12-inch pine timbers, and in no cases are larger than 12x12 inches. The work of securing the piers as above described has been done under the direction of Commissioner John Guilfoyle, and has been carried on day and night by the emergency force in charge of Mr. P. A. Fairbault, C. E., to whom acknowledgment is made for courtesies extended and information given.



PLAN OF REINFORCEMENT OF BUILDING FOUNDATIONS.

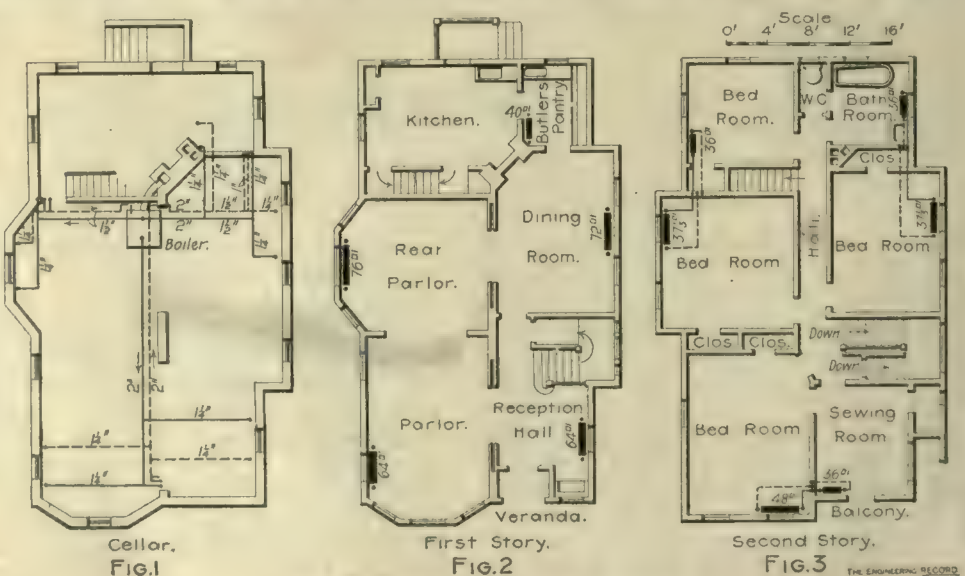


SHOWING OF PIERS OF A BROOKLYN BUILDING.

HOT-WATER HEATING OF A RESIDENCE.

The residence of Mr. W. Clive Crosby, on Eightieth Street, near Third Avenue, in that section of the Borough of Brooklyn, New York City, known generally as Bay Ridge, is heated by hot water, and the system will be of interest, since certain connections to some of the radiators are probably new. The accompanying floor plans will serve to show the heating system, Figure 1 showing the cellar and Figures 2 and 3, the first and second floors. The house has also an attic, and while hot water is not at present used there, provision has been made for so doing at some future time.

A single-casting hot-water boiler is placed in the basement, as shown. Three nearly horizontal flow-mains, grading upward from the heater, supply the radiating surface. First floor radiators are supplied by separate branch flow connections at the basement ceiling, and separate return connections travel back, joining with the horizontal return-mains, which drop at the heater. On the second floor there are six radiators, grouped in three pairs. Each pair is supplied by a single riser, from which horizontal flow branches lead under the floor to each radiator. The return branches from the radiators do not unite at the floor level, but drop independently within the wall and alongside of the flow riser, joining the return mains in the basement. The object of this method of dropping the returns is to provide equally good circulation through each radiator, and such should be the case, inasmuch as each has a separate column of water, measured from the horizontal return-pipe of the apparatus to the radiator, of a lower temperature than that of the common supply, and consequently of a greater density and weight. This difference of weight, of course, causes a flow of water until



HOT WATER HEATING OF A RESIDENCE.

such a velocity is reached that the difference of pressure due to the difference in the weights of the water columns is equal to the frictional resistance offered to the flow of water by the radiator and connections. Where two return connections from two radiators on the same level unite in a common return at about that same level, it is often found that the circulation through one radiator is much more feeble than in the other. This is the result of increased resistance in one radiator, either from longer connections or obstructions in the radiator itself, so that the velocity through one is less than that in the other, under the same conditions.

"The Engineering Record" is indebted to Mr. William J. Baldwin, M. Am. Soc. C. E., who designed the system, for the information regarding this installation.

ENGINEERING SOCIETIES.

The New England Water-Works Association held a meeting at Boston on December 14, at which the subject of pumping engines was discussed. In opening the meeting, President F. F. Forbes, of Brookline, Mass., called attention to the rapid extension of the use of triple-expansion pumps in the last 11 years, and presented the following figures of the capacity in gallons of such engines made during each year: 1886, 6,000,000; 1888, 123,500,000; 1889, 29,000,000; 1890, 29,000,000; 1891, 37,000,000; 1892, 96,250,000; 1893, 97,000,000; 1894, 60,500,000; 1895, 116,000,000; 1896, 187,375,000; 1897, 435,750,000. Mr. Forbes then drew some interesting comparisons between the results obtained at different times at the low-service pumping station at Brookline. In 1890, before the installation of a triple-expansion engine at that place, 322,767,796 gallons of water were pumped with a total consumption during the year of 1,141,175 pounds of coal. In 1894, when a triple-expansion engine was in use part of the time, 481,633,366 gallons of water were pumped and 998,107 pounds of coal consumed. In 1897, with a triple-expansion engine in use all the time, 6u5,174,048 gallons were pumped and only 761,826 pounds of coal consumed. The programme printed last week was carried out with some slight modification.

PERSONAL.

Mr. J. H. Mabbett has been appointed water commissioner of Saratoga, N. Y.

Mr. Willard A. Smith, of Chicago, has been apointed director of the department of transportation and civil engineering of the United States commission to the Paris Exposition.

Messrs. Wilson Brothers & Company, architects, civil and consulting engineers, announce a reorganization of the firm, which after February 1 next will consist of the following members: Messrs. Joseph M. Wilson, Henry W. Wilson, John McArthur Harris and Howard S. Richards.

Messrs. W. J. Fryer, George A. Just, M. Am. Soc. C. E.; Robert A. McCafferty and Cornelius O'Reilly, of Manhattan; Rudolph L. Daus and Bernard Gallagher, of Brooklyn, and Daniel Callahan, of Queens, have been appointed a commission to prepare a new building code for New York City. Assistant Corporation Counsel Morgan and Building Commissioners Brady, Guilfoyle and Campbell are ex-officio members.

Major General William Ludlow, United States Volunteers, Lieutenant Colonel, Corps of Engineers, U. S. A., has been appointed by the President military and civil governor of Havana City. Gen. Ludlow was at one time the engineer commissioner of the District of Columbia and has also served as the head of the water department of Philadelphia, and his experience in these positions will undoubtedly be of advantage in the interests now committed to his charge. His duties will include the reorganization of the present civil guard into a municipal police force, the establishment of a civil government and the cleaning of the city.

OBITUARY.

Mr. Charles H. Denison, who died in Springfield, Mass., December 13, was an inventor who was known by his improvements in wood-working machinery and water filters.

Mr. Edmund S. Whittaker, who died at Principio Furnace, Md., December 13, had been for many years interested in the iron industries in Pennsylvania, Maryland and West Virginia.

Mr. George Richardson, superintendent of the Bridgeport Hydraulic Company, died in Bridgeport, Conn., December 12. He was the son of the founder of the Hydraulic Company and from his boyhood had been identified with the water-works. He had invented many useful appliances, and had been superintendent of the company since 1869.

CONTRACTING NEWS

OF SPECIAL INTEREST TO

CONTRACTORS, BUILDERS, ENGINEERS, AND MANUFACTURERS

OF ENGINEERING AND BUILDING SUPPLIES.

For Proposals see page 'x.

WATER.

Millvale, Pa.—The Borough Clerk has been authorized to advertise for bids for an emergency pump for the water-works.

Hintonburg, Ont.—The Village Council has adopted plans prepared by C. H. Keefer, of Ottawa, for a municipal system of water-works to cost $55,000.

Allison, Ia.—H. C. Parsons, City Clk., writes that a vote will be taken Jan. 9 on the question of constructing water-works.

Canby, Minn.—M. B. Haynes, City Engr., of Mankato, has been engaged, according to reports, to prepare plans for a water-works system to cost $10,000.

Liverpool, N. S.—It is stated that a municipal water and light plant will be built at a cost of $31,000.

Philadelphia, Pa.—See "Miscellaneous."

Lisbon, O.—E. C. Cooke, C. E., of Ceveland, has reported plans for improving the water supply. Estimates of cost on three different plans are as follows: For a deep well system, with boilers, building, etc., $8,850; for a mechanical filtering system, $12,850, and for filter beds complete, $10,000 to $12,000.

Indianapolis, Ind.—See "Public Buildings."

Mankato, Kan.—It is proposed to call a special election to vote on the issue of $20,00(water-works bonds.

Wenatchee, Wash.—It is stated that about 5 miles of pipe will be required to convey water from Canyon No. 2 to the proposed reservoir site.

Berkeley, Cal.—Local reports state that the proposition to bond the town to purchase and maintain a municipal water-works plant will probably be submitted to a vote. Estimated cost, $450,000.

Birmingham, Ala.—Local reports state that a company has been organized with a capital of $4,000,000 to construct a new system of water-works to supply Birmingham and the Birmingham district.

Cleburne, Tex.—It is stated that water-works bonds to the amount of $58,000 have been sold.

McElmo, Colo.—The McElmo Water Supply Co. has been incorporated with a capital of $500,000. The directors are Morris B. Colt of Alamosa, John H. and Ernest Knabel of Colorado, and others.

Pratt City, Ala.—At a recent meeting of citizens it was resolved that the Legislature be asked for authority to issue $25,000 for a water-works system.

Vailsburgh, N. J.—The Common Council has voted to rescind the resolution to purchase the plant of the West End Land & Improvement Co. for $16,000.

Allegheny, Pa.—The lowest bid received for a 250-h.p. boiler and stoker for the Howard St. pumping station was from William F. Patterson, of Erie, Pa., at $5,298.

Holly Springs, Miss.—Walter G. Kirkpatrick, Engr., Jackson, Miss., writes that two or three 8-in. wells 500 ft. deep are to be sunk.

Elgin, Ore.—It is stated that bonds to the amount of $12,000 will be issued for water-works.

Pawnee, Cal.—The Pawnee Water Storage Co. has been incorporated by Willard Teller, Harper M. Orahood and Clayton C. Dorsey. The purpose of the company is to divert the waters of the South Platte River, to construct, own and operate all intakes, feeding canals, and to construct reservoirs. Capital, $25,000.

Port Costa, Cal.—It is stated that the Port Costa Water Co. has been incorporated for $250,000 by G. W. McNear, P. H. Bowles, G. W. McNear, Jr., and others.

Sheridan, Ind.—It is stated that the Sheridan Light & Water Co., composed of Ft. Wayne capitalists, has been granted a 30 year franchise to construct a system of water-works at an estimated cost of $35,000.

Avondale, Ala.—We are informed that Avondale, a suburb of Birmingham, proposes expending $25,000 for water-works. Jno. R. Ellard, Mayor.

McLeansboro, Ill.—Owen Ford, Consulting Engr., of St. Louis, writes that all bids opened Dec. 10 for completing the municipal water-works system have been rejected. New bids will be received about the middle of January.

Clayton, N. Y.—F. L. Hall, Village Pres., writes that the proposition to build water-works and a sewerage system carried at the election held Dec. 6, also that bids are about to be asked. Appropriation, $50,000.

Watertown, Conn.—E. W. Wheeler, Secy. Watertown Water Co., writes: "We have only organized; nothing definite yet as regards actual work."

Chicago Junction, O.—Bids are wanted Jan. 5 for $10,000 water-works extension bonds. Louis Simmermacher, Village Clk.

West Union, W. Va.—Bids are wanted Jan. 6 for $6,000 water-works bonds. Geo. W. Bland, Mayor.

Darlington, O. T.—Bids are wanted Jan. 5 for a water system for the Arapahoe boarding school at Cheyenne and Arapahoe Indian Agency. W. A. Jones, Commr. of Indian Affairs, Washington, D. C.

New Orleans, La.—See "Sewerage and Sewage Disposal."

Pelican Rapids, Minn.—It is stated that the city has voted $14,000 bonds for electric lighting, water-works, etc.

Rockford, Ill.—Superintendent Kimball asks for an appropriation of $7,000 for three miles of new pipe to be laid next year and $1,000 for meters.

Harrisburg, Pa.—Local reports state that the proposition to purchase new pumping engines at a cost of $75,000 will probably be submitted to the voters at the February election.

Jamesburg, N. J.—At a recent meeting of citizens specifications for a water system were approved, and it was voted to ask the Council to call for bids on the same.

Cullman, Ala.—W. H. Jones, City Clk., writes that at the election held Dec. 12 it was voted to ask the Legislature now in session for authority to issue bonds for water-works and an electric light plant.

Enid, Okla.—Mayor Joe Meibergen writes that the city contemplates putting in a system of water-works.

Stanberry, Mo.—It is stated that $3,000 bonds have been voted for a tank and steel tower. W. A. Erwin, Mayor.

Conneautville, Pa.—It is stated that an election will be held in February to vote on the question of issuing water-works bonds.

Eldora, Colo.—The City Trustees have granted a 20-year franchise to the Eldora Mining, Milling & Power Co. to put in water and electric light works.

Kansas City, Mo.—The citizens have petitioned that immediate steps be taken toward improving the reservoir property at 21st and Holly Sts. Estimated cost of repairing reservoir, $25,000.

Watervliet, N. Y.—At an election held Dec. 12 the taxpayers approved the proposition of the Water Board for a new system of water supply from the Deepkill. Estimated cost, $234,493.

Crookston, Minn.—It is stated that $30,000 bonds have been sold for improving the water-works and sewerage and for a city building.

Dravosburg, Pa.—Permission has been secured from the War Department for the American Water Co., which is composed of McKeesport capitalists, to lay its mains under the Monongahela River at Dravosburg. The company intends to supply the territory for miles up and down the river.

Whitesboro, N. Y.—A special election will be held Dec. 19 to vote on the construction of a gravity system of water-works.

Bemidji, Minn.—Bids are wanted Dec. 31 for $7,000 water-works bonds. Ted Smith, Pres. Village Council.

West Tampa, Fla.—It is stated that Guild & Co., of Chattanooga, Tenn., have secured the contract for water-works construction for $35,000.

Jersey City, N. J.—Bids are wanted Dec. 27 for 6 in. 8 in. and 12-in. cast-iron water pipe. Geo. T. Bouton, Clk. Bd. Street & Water Commrs.

Jersey City, N. J.—The Street and Water Commissioners on Dec. 8 decided to award the contract for a new water supply to Patrick H. Flynn, of Brooklyn, the price to be $7,595,000 if the city announces its intention to purchase within a year from date of contract.

New York, N. Y.—Bids are wanted Dec. 28 for constructing and improving grounds for use of N. Y. Zoological Society in Bronx Park. The engineer's estimate of the work includes the following items: 12,500 cu. yds. earth excavation, 3,600 cu. yds. rock excavation, 45 tons of 6-in. and 4-in. cast-iron straight pipe, 1 ton cast-iron branch pipe and special castings, 3,200 lin. ft. of 4-in. and 6-in. cast-iron pipe, 1,900 lin. ft. 2-in. wrought-iron water pipe, bends, etc.; 1,500 lin. ft. 1½-in. wrought-iron water pipe, with stopcocks, boxes, etc.; also for 7,100 sq. yds. telford and 3,400 sq. yds. of macadam pavement. George C. Clausen, Chmn. Commrs. of Parks.

SEWERAGE AND SEWAGE DISPOSAL.

Mount Vernon, N. Y.—Bids are wanted Jan. 3 for 12-in. trunk pipe sewers in two districts. Wm. W. Hoyt, City Clk.

Buffalo, N. Y.—See "Paving and Roadmaking."

Riverside, Cal.—It is stated that bids are wanted Dec. 27 for a sewer in Third St. James W. Johnson, City Engr.

Ft. Wayne, Ind.—The city has under consideration plans for a sewer to carry all sewage into Maumee River. Estimated cost, $150,000 to $300,000.

West Orange, N. J.—The property owners have passed a resolution favoring the co-operation of West Orange in the construction of the proposed joint outlet sewer to Staten Island Sound.

Watsonville, Cal.—It is stated that an engineer will be employed to prepare plans and estimates for the proposed sewer system. Estimated cost, $35,000.

Kingston, Pa.—An ordinance has been passed for the construction of a terminal sewer, also for house drain sewers in several streets. Wm. P. Somers, Boro. Secy.

Denver, Colo.—The contract for sewers in North Denver Sanitary District No. 3 has been awarded to James F. Maloney for $2,641.65.

Guthrie, Okla.—The City Council has authorized the Park Committee to obtain plans and estimates for a system of sewerage.

Glenville, O.—It is stated that an additional $25,000 will be required to complete the sewerage system.

St. Joseph, Mo.—The Council has resolved that all bids for the construction of sewers in districts 56 and 16 be rejected and the city engineer instructed to readvertise for proposals for doing the work.

Clayton, N. Y.—See "Water."

Nevada City, Cal.—T. H. Carr, City Clk., writes in reference to the proposed sewerage system that W. F. Englebright, of Nevada City, has been appointed engineer to prepare plans and estimates on which the matter can be submitted to a vote of the people.

Bakerfield, Cal.—A. T. Lightner, City Clk., writes: "The question of sewerage is being discussed. Nothing definite has been done. The proposition to issue bonds may be taken up early next year."

Boston, Mass.—The contract for Devon St. sewer has been awarded to J. C. Coleman & Son for $2,673.

Oneida, N. Y.—Bids are wanted Dec. 19 for about 325 ft. of pipe sewers. J. T. Wallace, Pres. Bd. Sewer Commrs.

Davenport, Ia.—City Engineer Thomas Murray writes that the City Council has not taken any action in regard to the intercepting sewer. The proposition has been before the Business Men's Association.

North Topeka, Kan.—We are informed that the construction of a system of sewers is contemplated.

Aiken, S. C.—Bids are wanted Jan. 18 for constructing a system of small pipe sewers with a filtration plant. M. W. Woodward, Mayor.

New York, N. Y.—Bids are wanted Dec. 23 for furnishing cast-iron sewer pipe, making all connections and excavations necessary to provide sewerage system at Fordham Hospital. John W. Keller, Pres. Dept. Pub. Charities.

Crookston, Minn.—See "Water."

Sandusky, O.—The Council has passed an ordinance providing for branch connecting sewers in Jackson St. and Central Ave. A. W. Miller, City Clk.

New Orleans, La.—An election will probably be held Feb. 16 to vote on the ordinance proposing a 2½ mill tax to be applied to the building of a sewerage system, the purchase of the water supply and completion of the drainage system.

Fort Wayne, Ind.—The Board of Public Works has authorized bids to be received Dec. 22 for sewers in three alleys.

Little Rock, Ark.—Theo. Hartman, Supt. of Pub. Wks., writes that the contract for 8,050 ft. of 12-in., 8-in. and 6-in. pipe sewers has been awarded to the Arkansas Pump & Pipe Co., Little Rock, Ark., for $4,347.

Philadelphia, Pa.—The following bids were opened Dec. 15 by T. M. Thompson, Dir. Dept. of Pub.Wks., for repairing sewers, drain pipes, inlets, inlet necks, manholes and well holes and cleaning sewers, etc., during 1899; *a*, 1st Dist.; *b*, 2d Dist.; *c*, 3d Dist.; *d*, 4th Dist.; *e*, entire city: Delaplain & West, Fidelity Bldg., *a*, $2,475; *b*, $3,300; *c*, $2,525; *d*, $3,450; *e*, $10,248. P. Monaghan, 2138 Pemberton, *c*, $2,230; *d*, $3,041. B. Monaghan, 2307 Catherine, *a*, $2,490; *b*, $1,349; *c*, $3,300; *d*, $3,590. D. Peoples, 25th and Callohill, *e*, $19,000. W. B. M. Conkling, 2130 N. 21st St., *c*, $5,970; *d*, $6,890.

Rochester, N. Y.—Local reports state that William Fuller, of Rochester, has secured the contract for the North St. outlet sewer, 2,770 ft. in length, for $10,554, and Thomas Holahan, Rochester, has the contract for Pearl and Meigs St. sewer, 1,110 ft. in length, for $3,790.

Toledo, O.—The following bids for main sewer in district No. 30 (Paine Ave., etc.) were opened Nov. 21. by engineer in charge, Willis F. Brown, City Engr.. This work includes 2,370 ft. of brick sewer, from 66 in. to 84 in. in diameter, 5 manholes and 12 catch basins. Joseph Gale, $18,900; John Degnan, $22,764; Thos. Kelley, $15,466; John J. McMahon, $19,551.50; O'Sullivan & Sheehan, $30,000.40; Harry G. Jennison, $22,785.50; Alexander Dawson, $18,423.20; G. H. Bodette, $19,051.80. Bidders all of Toledo, O.

Washington D. C.—The following bids for the northerly portion of Tiber Creek and New Jersey Ave. high level intercepting sewer were opened Dec. 10 by the Commissioners D. C., as advertised in "The Engineering Record." The work consists in the construction of 2,310 linear ft. of 14 ft. x 14 ft. 3 in. D-shaped sewer, 320 linear ft. of 9 ft. x 11 ft. D-shaped sewer in C St., 85 linear ft of bell section, also connections with existing sewers. Prices given per cu. yd.:

	Excavation, etc	Brick masonry, natural cement mortar.	Vit. brick masonry, Portland cement mortar.	Concrete masonry in place.	Rubble stone masonry.
Lyons Bros., Washington, D. C.	$.80	$9.50	$18.00	$6.00	$7.00
J. K. Murphy, Washington, D. C.	.83½	7.85	14.66	3.84	6.00
Ambrose Williams, Washington, D. C	.61	8.60	15.50	4.52	5.00
T. B. Jones & Co., Baltimore, Md	.65	8.10	15.00	4.40	5.00
B. J. Coyle, Washington, D. C	.74	9.88	18.00	6.00	7.00
John Jacoby, Wilmington, Del	.70	8.20	16.00	4.30	7.00
Lenman Bros., Grand Rapids, Mich	.99½	8.39	16.65	5.35	5.75

Wilkinsburg, Pa.—The following bids for 900 ft. 20-in. pipe, 170 ft. 10-in. pipe, 192 ft. 8-in. pipe, 150 ft. sewers were opened Dec. 8 by Frease & Sperling, of Pittsburg, Boro. Engrs.: Ott Bros., 91 Federal St., Allegheny, Pa., *$1,434.20; Sweeney & Houston, 32d St., Pittsburg, Pa., $1,785.98; John Dell & Dinius Bros., Braddock, Pa., $2,209.80; W. J. Lynd, 3608 Smallman St., Pittsburg, Pa., $1,451.70.

*Contract awarded.

BRIDGES.

Schenectady, N. Y.—A petition has been introduced in Council for the opening of a public thoroughfare and a viaduct across the lands of Vale Cemetery, to cost between $30,000 and $40,000. Plans on the viaduct have been prepared by William Gifford, C. E.

Salina, Kan.—The Kenwood bridge is stated to have been condemned. The City Council has ordered it closed.

Charlottesville, Va.—The construction of a steel bridge over the Rivanna River is under consideration. Estimated cost, about $4,500.

Tarentum, Pa.—It is stated that petitions are being circulated for a joint county bridge across the Allegheny River, between New Kensington and Tarentum.

Mobile, Ala.—A bill passed the House authorizing the County Commissioners of Escambia Co. to issue $25,000 bonds for a bridge across Conecuh River.

Plymouth, Mass.—It is stated that plans have been prepared for an iron bridge over the Eel River on Warren Ave.

Algona, Ia.—It is stated that the Milwaukee Ry. will build a steel bridge over the river to replace the wooden structure.

Bristol, Conn.—The Bristol & Plainville Tramway Co. is stated to have under consideration the construction of a bridge over its tracks at Plainville.

Rensselaer, N. Y.—It is stated that bids received Dec. 6 for Washington St. bridge have been rejected, and that new bids will be received Dec. 30. C. A. Ryan, City Clk.

Zanesvile, O.—The King Bridge Co., Cleveland, O., is stated to have secured the contract for the western approach to the Monroe St. bridge, at $13,600.

Jackson, Miss.—Walter G. Kirkpatrick, City Engr., writes that on Jan. 1 the city will issue $20,000 bonds; also that a two-span Melan arch bridge and some smaller rolled beam bridges are to be built.

Denison, Ia.—Bids are wanted Jan. 4 for building and repairing county bridges during the year 1899. J. T. Carey, Co. Aud.

Fort Scott, Kan.—Bids are wanted Dec. 20, accompanied by plans and specifications, for a steel truss bridge over Mill Creek. S. S. Davis, City Clk.

Kansas City, Mo.—See "Electric Railways."

Milwaukee, Wis.—City Engineer Benzenberg has submitted to the Council plans for a viaduct 1,720 ft. long over Kinnickinnic Ave. Estimated cost, $184,000.

Tacoma, Wash.—W. D. C. Spike, Co. Aud., writes that nothing will be done in regard to building bridge across Puyallup River until after the first of the year.

St. Paul, Minn.—City Engineer Rundlett estimates the cost of repairs to Sixth St. bridge, recently damaged by a freight train, as $15,000.

Arcadia, Wis.—It is stated that the citizens voted on Dec. 5 to build a steel bridge across the Trempealeau River.

Foosland, Ill.—It is stated that the Commissioners of Brown and Bellflower townships will build an iron bridge, south of the Bellflower road, between the two townships.

Black River Falls, Wis.—The Chicago Bridge & Iron Co., Chicago, Ill., is stated to have secured the contract for an iron bridge over Black River at $2,000.

Bastrop, Tex.—The Indiana Bridge Co., Muncie, Ind., is stated to have received the contract for a bridge at Smithville for $23,500.

Deerfield, N. Y.—It is stated that the town has been granted permission to issue $8,200 in bonds to rebuild and repair bridges.

Somerville, Mass.—The Commonwealth has been petitioned to build a bridge over the Mystic River, between Somerville and Medford, to replace the present Wellington bridge.

Owego, N. Y.—It is stated that the town has voted to issue $10,000 in bonds to build an iron bridge across Owego Creek.

Kansas City, Mo.—It is stated that the Board of Public Works has ordered Engineer Wise to prepare plans and specifications for a steel bridge, which will be constructed across the Belt Line tracks on Kansas Ave.

Chatham, Ont.—It is stated that the Lake Erie & Detroit River Ry. will erect a swing bridge over the Thames River. F. H. Walker, Pres., Walkerville, Ont.

Davenport, Ia.—Thos. Murray, City Engr., writes that a committee is about to be appointed to confer with the C., M. & St. Paul P. Ry. Co. in the matter of building a viaduct over the railway tracks.

New York, N. Y.—Bids are wanted Dec. 28 for reconstructing the Blissville bridge over Newtown Creek. John L. Shea, Commr. Bridges.

Selma, Ala.—It is stated that bids are wanted Dec. 21 by the County Clerk for $65,000 bridge bonds.

Aspen, Colo.—It is stated that bids are wanted Jan. 2 for a bridge across Roaring Fork River near Basalt. Geo. W. Nyce, Co. Surveyor.

Ogden, Utah.—It is stated bids are wanted Dec. 28 for furnishing plans and constructing a steel truss bridge 140 ft. long across Weber River. Newton Farr, Clk. Co. Commrs.

Boston, Mass.—Bids are wanted Dec. 29 for building superstructure of fixed spans of the bridge on Summer St. extension across Fort Point Channel. William Jackson, City Engr.

Chicago, Ill.—The following bids for Van Buren St. approach span across the by-pass along Chicago River were opened Dec. 7 by the Board of Trustees, Sanitary District, as advertised in "The Engineering Record:" Chicago Bridge & Iron Wks., Chicago, $19,495.87; Lydon & Drews Co., Chicago, $24,895.50.

Brooklyn, N. Y.—Bids are wanted Dec. 28 for building a superstructure, including electrical equipment, for the Union St. bridge over the Gowanus Canal, for a fender-rack to protect the Union St. bridge over the Gowanus Canal, and safety gates for 5 bridges over the Gowanus Canal.

Ghent, Ky.—A charter is stated to have been granted to the Ghent-Vevay Bridge & Terminal R.R. Co. to build a bridge across the Ohio River between Ghent and Vevay, Ind., connecting the Kentucky and Indiana lines of the Black Diamond Ry. Albert E. Boone, of Zanesville, is one of the incorporators.

Colfax, Wash.—John Tobin, Co. Aud., writes that all bids for a bridge across Palouse River at Palouse City have been rejected and the project of building a steel bridge abandoned, but that it is possible the County Commissioners may advertise later for a combination bridge.

Newark, N. J.—Local reports state that all bids for the construction of stone heads for bridges over subways in Branch Brook Park have been rejected. They were from David E. Olds, $31,100; Central Construction Co., New York, $22,990, and Frederick H. Schrump, So. Orange, $20,713.

Minneapolis, Minn.—The following bids were opened Dec. 9 for widening the stone arch bridge over east channel of Mississippi River: Chicago Bridge & Iron Co., Chicago, Ill., $10,996; Hoff Bros., Minneapolis, Minn., $11,787; Penn Bridge Co., Beaver Falls, Pa., $11,240; American Bridge Wks., $14,540; Wrought Iron Bridge Co., Canton, O., $12,093; King Bridge Co., Cleveland, O., $12,200; Edge Moor Bridge Wks., Wilmington, Del., $11,840; Toledo Bridge Co., Toledo, O., $10,990; Milwaukee Bridge & Iron Wks., Milwaukee, Wis., $12,779; Wisconsin Bridge & Iron Wks., Milwaukee, Wis., $12,259; Youngstown Bridge Co., Youngstown, O., $11,969; Pittsburg Bridge Co., Pittsburg, Pa., $11,985; Gillette-Herzog Mfg. Co., Minneapolis, Minn., $11,649.

Onslow, Ia.—The following bids for a steel bridge over Maquoketa River, in Washington township, were opened Dec. 6 by F. J. Sokol, Chmn. Com. on Bridges: Clinton Bridge Co., Clinton, Ia. $3,715, $3,915; L. E. Tucker, Anamosa, Ia., $3,590, $3,490; J. B. Marsh & Co., Des Moines, Ia., $4,580, $4,180; Geo. E. King Co., Des Moines, Ia., $4,185, $3,690; Wrought Iron Bridge Co., Canton, O., $4,277; Kansas City Bridge Co., Kansas City, Mo., $4,499; Canton Bridge Co., Canton, O., $4,796; Chicago Bridge & Iron Co., Chicago, Ill., $4,617; N. M. Stark & Co., Des Moines, Ia., $5,125; Dubuque Construction Co., Dubuque, Ia., $3,240, $2,940; B. F. Parks & Co., Cedar Rapids, Ia., $4,999, $4,595.

Philadelphia, Pa.—The following bids for erecting the steel superstructure of Gray's Ferry Bridge over Schuylkill River were received by Thos. M. Thompson, Director Public Works:

	Swing span, including machinery.	East Viaduct Approach.	Superstructure complete.	Time.
N. J. Steel & Iron Co., Trenton, N. J.	$146,300	$43,500	$189,000	8 mos.
Penna. Steel Co., Phila.	132,792	34 630	167,422	8 "
Phoenix Bridge Co., Phila.	111,500	33,500	145,000	5 "
Elmira Bridge Co., Elmira, N. Y.	128 758	35,992	164,750	8 "
Carnegie Steel Co., Pitts.	147,844	38,649	186,493	......
Edge Moor Bridge Wks., Wilmington, Del.	139,872	37,640	177,000	7 mos.

PAVING AND ROADMAKING.

Atlantic City, N. J.—Bids are wanted Dec. 27 for improving certain avenues, as advertised in "The Engineering Record."

Keokuk, Ia.—Bids are wanted Dec. 31 for 3,767 sq. yds. of macadam pavement on Franklin St. G. M. Walker, City Engr.

Fargo, N. D.—Bids are wanted Dec. 19 for paving district No. 7. J. M. Rowe, City Aud.

Buffalo, N. Y.—Bids are wanted Dec. 20 for asphalt pavement on several streets, also for an 18-in. tile sewer in Geary St. R. G. Parsons, Dept. Pub. Wks.

Cape May, N. J.—The Board of Trade has appointed as a committee John W. Thompson, John Halpin, James Creswell and others, to procure the right of way for a steel esplanade to be built 150 ft. seaward of the present board walk.

Sandusky, O.—An ordinance is before the Council providing for the issue of $50,000 bonds for paving Central Ave. and a part of Jackson St. with block or sheet asphalt.

St. Paul, Minn.—City Engineer Rundlett estimates the cost of macadamizing Como Ave. at $42,745.

Baltimore, Md.—An ordinance has been introduced in the Council for asphalt pavements on several streets, appropriating $25,200.

Louisville, Ky.—It is stated that the granite block pavement in the streets near the Court House will be replaced with asphalt. Cost about $12,000.

Scottsboro, Ala.—The bill authorizing the issue of $200,000 bonds for Jackson Co. pike roads has passed both houses of the Legislature.

Braintree, Mass.—It is stated that Chas. McDermott & Son, of Brockton, have secured a $5,440 contract for paving.

Lincoln, Neb.—The City Engineer estimates the cost of 4,843 sq. yds. of asphalt pavement on Eleventh St. at $9,686.

Indianapolis, Ind.—Bids are wanted Dec. 19 for paving Miami St. with brick. M. A. Downing, Chmn. Bd. Pub. Wks.

Philadelphia, Pa.—Bids are wanted Dec. 22 for supplies and works for Fairmount and Hunting parks for the year 1899 as follows: Broken trap rock and screenings, paving, curbing and asphalt pavements, bricks, cement, terra cotta pipe, electric lights, etc. Jesse T. Vogdes, Ch. Engr. & Supt.

Chicago, Ill.—Bids are wanted Dec. 19 for replanking, repaving and rebuilding the roadways and sidewalks of Jackson St. bridge and viaduct. L. E. McGann, Commr. Pub. Wks.

Baltimore, Md.—Bids are wanted Dec. 28 for paving Forrest St. and 2 alleys in Hampden. O. W. Connet, Acting City Commr.

St. Louis, Mo.—Bids are wanted Dec. 23 for paving several streets and alleys with brick, macadam and Telford pavement. Robert E. McMath, Pres. Bd. Pub. Imp.

Lebanon, Pa.—The City Council has under consideration the proposition to pave North Eighth St. Geo. W. Hayes, City Engr.

El Paso, Tex.—It is stated that $21,000 bonds have been voted for street improvements.

Hoboken, N. J.—It is stated that paving contracts have been awarded as follows: To the Utica Asphalt Paving Co., Utica, N. Y., two streets for $13,008, and to the N. J. Mexican Asphalt Co., three streets for $10,262.

Council Bluffs, Ia.—The contract for paving Harrison St. and Washington Ave. has been awarded to E. A. Wickham, Council Bluffs, at $1.27½ for Council Bluffs brick.

Hamilton, O.—It is proposed to pave several streets, the material used to be chosen by property owners.

Waterford, N. Y.—A petition is being circulated for brick paving on Broad St.

Elkhart, Ind.—It is stated that the Council has decided to have plans and estimates prepared for 40,000 sq. yds. of brick paving. D. F. Cordrey, City Eng.

Petersburg, Va.—The city is about to pave its streets at an expense of $100,000. Samuel M. Gray, of Providence, R. I., is consulting engineer.

Philadelphia, Pa.—The Councils Committee on Paving has approved the ordinance for repaving numerous streets in the 32d ward; cost about $23,000.

New York, N. Y.—See "Water."

Cincinnati, O.—Bids are wanted Jan. 7 for macadamizing Montgomery Pike. Address J. A. Stewart, 518 Johnston Building.

St. Joseph, Mo.—The Common Council has been petitioned to pave 13th St. with brick. J. R. Rackliffe, City Engr.

Reading, Pa.—It is stated that the New York Security & Trust Co. has offered to take the next issue of paving bonds, amounting to $100,000.

Cortland, N. Y.—It is proposed to pave Tompkins St. with macadam.

Newark, N. J.—The contract for regulating, grading and curbing Orange Park has been awarded to Ludwig Batt, of South Orange, on his bid of $22,524.50. Other bidders were: Wright & Lindsley, Orange, $29,766; O'Connor & McManus, Newark, $31,075.75; Fell & Minahan, Orange, $26,030; F. C. O'Reilly, Orange, $29,080.50; John F. Shanley, $39,161.

Houston, Tex.—Bids are wanted Jan. 9 for about 19,000 sq. yds. paving on Main St., as advertised in "The Engineering News.

Zanesville, O.—It is stated that bids are wanted Dec. 23 for paving North Seventh St. with brick. Chas. N. Bainter, City Clk.

Benton Harbor, Mich.—It is proposed to pave Pipestone St., probably with brick. S. Brown, S. E. Daigneau and B. L. Hall, Street Com.

Philadelphia, Pa.—The following bids were opened Dec. 15 by Dir. Thomas M. Thompson, of the Dept. Pub. Wks., for repairs to streets paved with cobble, rubble and granite blocks during 1899, the figures in parentheses designating the districts of the city for which the bids were made:

Thos. Cunningham, 1211 Wharton St.; (8), $11,000; (11), $15,000.

Michael O'Rorke, Fidelity Bldg.; (1), $39,500; (2), $32,300; (3), $19,000; (4), $32,450; (5), $27,500; (6), $34,850; (7), $38,000; (8), $10,000; (9), $7,500; (10), $20,000; (11), $13,500; (12), $13,500; (13), $17,000; entire city, $305,150, equivalent to 17 cts. per sq. yd.

David McMahon, Germantown; entire city, $455,000, equivalent to 20½ cts. per sq. yd.

Mack Paving Co., Fidelity Bldg.; (1), $41,000; (2), $34,000; (3), $22,500; (4), $33,000; (5), $37,000; (6), $39,000; (7), $14,000; (8), $15,000; (9), $31,280; (10), $20,000; (11), $15,000; (12), $15,000; (13), $20,000; entire city, $350,500, equivalent to 23½ cts. per sq. yd.

The following bids were opened at the same time for the maintenance of unpaved and macadam highways during the year:

Clark & Co., 809 Union St.; (4), $44,995.

R. P. Bennis, Germantown; (4), $38,400.

David McMahon, Germantown; (1), $6,300; (2), $14,800; (3), $40,000; (4), 38,500; entire city, $94,800.

J. F. Shanley, 14 S. Broad; (1), $7,500; (2), $16,500; (3), $39,000; (4), $36,000; entire city, $98,000.

G. A. Vare, Betz Bldg.; (1), $6,900; (2), $16,990; (3), $46,400; (4), $42,400; entire city, $112,690.

Bids received for resurfacing streets with sheet asphaltum during the year were as follows; prices given per sq. yd.: Alcatraz Paving Co., Witherspoon Bldg., $2.49; Penna. Asphalt Pav. Co., Fidelity Bldg., $2.47; Vulcanite Paving Co., 1712 Market St., $2.40; Richardson & Ross, 30th and Race Sts., $2.59.

POWER PLANTS, GAS AND ELECTRICITY

Springfield, O.—J. H. Miller, Gen. Mgr., Springfield Light & Power Co., writes: "It is our intention to extend our circuits into new territory; will not add to station before spring, if then."

Dalton, Ga.—The citizens are stated to have voted Dec. 10 to issue $7,000 electric light bonds.

Cammilus, N. Y.—It is stated that the Globe Milling Co. will put in a dynamo and light their mill and other buildings. This plant may be used for street lighting in the near future.

West Concord, Minn.—E. H. Van Ornum is stated to be interested in the construction of an electric light plant.

Rogersville, Tenn.—An ordinance is stated to have been introduced in Council, granting Webster & Spears a franchise for an electric light plant.

Wellington, Kan.—The matter of issuing bonds for an electric light plant is said to be under consideration.

Tipton, Ia.—It is reported that the Tipton Electric Light Co. contemplates installing a steam heating plant, to furnish commercial steam heat.

Bradford, Ill.—The Bradford Electric Light Co. has been incorporated; capital $10,000. Incorporators, Robt. Thompson and Daniel H. Phoenix.

Annapolis, Md.—The Council is stated to have adopted an order to enter into a contract with the Annapolis Gas & Electric Light Co. for lighting the city for 5 years on plans and specifications to be planned by Chas. G. Edwards, an electrician, of Baltimore, and the Street Committee.

Merrill, Wis.—The Water-Works Co. is reported to have decided to install a dynamo and engine for lighting the water-works station.

Hartford City, Ind.—The municipal ownership of the electric light plant is stated to be under discussion.

Boscobel, Wis.—C. W. Menkhausen, City Clk., writes that the proposition to issue bonds for an electric light plant to cost $9,000 will be voted upon at the special election to be held Dec. 29.

Fountain City, Wis.—Bids are wanted Dec. 20 by H. & F. Roettiger for an electric light plant to cost $5,000. A. M. Patitz, Engr. in Charge, 1101 Pabst Bldg., Milwaukee, Wis.

Hastings, Neb.—It is reported that there is a movement here for the establishment of another electric light plant.

Canton, S. D.—The Canton General Electric Co. is reported to have decided to enlarge its plant. New machinery will be installed.

Loudonville, O.—It is reported that arrangements are being made to construct a new electric light plant here.

Wooster, O.—The Wooster Electric Light Co. is stated to be making arrangements to increase the capacity of its plant.

Coatesville, Pa.—We are informed that the contract for electric lighting has been awarded to the Coatesville Electric Light, Heat & Power Co. for the year 1899.

Monroe, Wis.—W. H. Wheeler, Pres. Water-Works Co., is stated to have introduced in Council an ordinance for the construction and maintenance of a gas plant, to cost about $21,000.

Centralia, Ill.—It is stated that the City Council will ask for bids for lighting the city with about 52 arc lights of 2,000 c. p.

Toledo, O.—See "Electric Railways."

Pine Bluff, Ark.—The Pine Bluff Electric Light & St. Ry. Co. has been incorporated; capital, $300,000. Incorporators: Thos. L. Chadbourne, Jr., of Chicago; H. H. Hunn, Sebastian Geisreiter, and others.

Boston, Mass.—See "Government Work."

Brooklyn, N. Y.—Bids are wanted Dec. 28 for installing electrical circuit and furnishing electric current for the following bridges: Carroll St. and Union St. bridges over Gowanus Canal, Washington Ave. bridge over Wallabout Canal; also for equipping the Washington Ave. over Wallabout Canal and Carroll St. bridge over Gowanus Canal with electric motive power. John L. Shea, Commr. of Bridges.

Annapolis, Md.—Bids are wanted Jan. 12 for a power house at the Naval Academy. Ernest Flagg, Archt., 35 Wall St., New York, N. Y.

Paterson, N. J.—See "Government Work."

Newark, N. J.—Bids are wanted Dec. 20 for gas and electric light fixtures at the City Hospital. L. J. Wendell, City Clk.

Eau Claire, Wis.—Bids are wanted Dec. 31 for lighting the city with electricity. J. P. Cochrane, City Clk.

Fresno, Cal.—The City Trustees on Dec. 6 decided to ask for bids for lighting the city.

Menahga, Minn.—It is reported that the question of constructing an electric light plant is being agitated.

Williamsburg, Ia.—T. T. Osborn, Recorder, writes that nothing definite has yet been done toward the construction of an electric light plant, but that work will probably be started in the spring.

Boscobel, Wis.—It is stated that the citizens will vote, Dec. 29, on issuing $9,000 bonds for an electric light plant.

Sault Ste. Marie, Mich.—The Edison Sault Electric Co. is said to be considering the construction of a power plant to develop 30,000-h.p. Wm. Chandler, Pres.

Atlantic City, N. J.—J. W. Hackney, City Surveyor, writes that plans have been prepared and submitted for the placing of conduits for city wires under the board walk along the ocean front.

Whitehall, N. Y.—See "Public Buildings."

Eldora, Colo.—See "Water."

Ellwood, Pa.—It is stated that an election will be held Dec. 20 to vote on issuing $8,000 electric light bonds.

Chicago, Ill.—An ordinance has been introduced in Council granting the Electrical Light, Heat & Power Co. a franchise to lay underground wires and furnish electricity in the 1st ward.

Logansport, Ind.—A. W. Stevens, of Logansport, is stated to have received the contract for the steam heating at the electric light plant, at $2,473.

Pelican Rapids, Minn.—See "Water."

Medina, N. Y.—A. L. Swett is stated to have received the contract for lighting the village by electricity for 5 years at $60 per light.

Cullman, Ala.—See "Water."

Savage, Md.—The County Commissioners, Ellicott City, are stated to have decided to light this village by electricity.

Revere, Mass.—A committee is stated to have been appointed to report on the advisability of erecting a gas plant.

Pasadena, Cal.—It is reported the contract for lighting the city with electricity has been awarded to Geo. H. Barker, representing the local lighting company. The plans for municipal ownership of the lighting system are stated to have been abandoned.

Dunkirk, N. Y.—The Council is stated to have entered into a 5-year contract with the Water Board Dec. 6 for furnishing electricity for incandescent lights in public buildings.

Palouse, Wash.—Chas. McKenzie, of Colfax, is reported to be interested in the construction of an electric light plant here.

Hull, Que.—It is stated that an election will be held Dec. 27 to vote on issuing $8,000 bonds for an electric light plant.

North Tonawanda, N. Y.—The Niagara Falls Power Co. is stated to have received a franchise to operate and maintain poles and wires for the transmission of electricity for power, heating and lighting purposes.

Acton, Ont.—It is stated that $6,000 has been voted for an electric light plant.

Lebanon, Ind.—The plant of the Citizens' Electric Light Co. has been purchased by Campbell, Wild & Co., who, it is stated, will improve the plant.

Liverpool, N. S.—See "Water."

Union Mills, Ind.—It is reported that an electric light plant will be installed here.

Springfield, O.—The Springfield Light & Power Co. will, it is stated, expend about $10,000 on improvements.

Evanston, Ill.—The Northwestern Gas Light & Coke Co. is reported to have decided to issue $2,000,000 bonds for improvements and extensions.

Middleport, N. Y.—The following bids for furnishing 25 arc lights of 2,000 c. p. each were opened Dec. 13 by Thos. P. Hammond, Village Clk.: S. J. Lawrence, Niagara Falls, N. Y., *$1,700; J. A. Murray, Wilkesbarre, Pa., $2,375.
*Contract awarded.

ELECTRIC RAILWAYS.

Oshkosh, Wis.—The matter of constructing an electric railway between this city and Stevens Point is said to be under consideration.

Meriden, Conn.—The Meriden, Southington & Compounce Trolley Co. is stated to have decided to petition the Legislature for permission to increase its capital stock to $500,000 and extend its line about 40 miles.

East Pittsburg, Pa.—The Monongahela & United Traction Co. is stated to have received a franchise.

Richmond, Ind.—Wm. A. Picken, of Indianapolis, representing a company, is stated to have applied for a franchise.

Kansas City, Mo.—It is stated that bids are wanted by the Directors of the Northeast Electric Ry. Co. for the construction of its line; probable cost, $250,000. A $30,000 steel bridge will be built across Agnes Ave. E. G. Vaughan, Secy. New York Life Bldg., Kansas City.

Perkasie, Pa.—The Quakertown & Doylestown Trolley Co. is stated to have received a franchise.

Pontiac, Mich.—Messrs. Lau and Winters are stated to have applied for a franchise for an electric railway from this city to Orion.

Milwaukee, Wis.—Geo. H. Sager, C. E., of Chicago, representing a company, is stated to have applied for a franchise.

East Pittsburg, Pa.—The Wilkinsburg & East Pittsburg St. Ry. Co. is stated to have received a franchise.

Birmingham, Ala.—The Birmingham Ry. & Electric Co. is said to be considering the question of extending its line. J. B. McClary, Gen. Mgr.

Hudson, Mass.—The Clinton & Hudson St. Ry. Co. is stated to have received a franchise.

Cadiz, O.—It is reported that there is a project on foot to construct an electric railway between Cadiz and the Twin Cities. The line would be 22 miles long and cost about $100,000.

Boundbrook, N. J.—The New York & Philadelphia Traction Co. is stated to have received a franchise.

Marshall, Tex.—See "Public Buildings."

Johnstown, Pa.—The Johnstown & Somerset Traction Co. is stated to have received a franchise. Morris Wolff, Pres., Johnstown.

Toledo, O.—It is reported that the Toledo, Maumee Valley & Perrysburg Electric Ry. Co. is arranging to make extensive improvements. It is stated that plans are being prepared for a $40,000 power house to be built at Miami.

Jackson, Mich.—The Jackson, Clark, Lake & Brooklyn Ry. Co. has been incorporated to build an electric road 21 miles long. Capital, $200,000. Clark Cromwell, Pres., Jackson.

Baltimore, Md.—The Baltimore & Northern Electric Ry. Co. has applied for a franchise. The company proposes to pave 2 miles of roadway in the Annex with Belgian blocks if franchise is received.

Queenstown, Md.—General Manager Troxel and Civil Engineer Uhler, of the Queen Anne's Railroad Co., are reported to be asking for rights of way for the road from Queenstown to Centreville.

Oregon, Ill.—It is reported that contracts will be let about Dec. 20 for about 30 miles of electric railway from this city to Rockford, for the Rock River Electric R.R. Co. J. B. Bertolet, Ch. Engr., Leaf River, Ill.

Libertyville, Ill.—The Chicago & Fox Lake Electric Ry. Co. is stated to have received a franchise.

Rome, N. Y.—The Rome City Ry. Co. and the Utica Suburban St. Ry. Co. have applied for a franchise to build a street railway from Whitesboro through the city. A hearing will be granted Jan. 16.

Mt. Vernon, N. Y.—The Westchester & Connecticut Traction Co. has received permission to extend its line.

Taunton, Mass.—The Taunton & Middleboro St. Ry. Co. has petitioned the Council for a franchise from the Lakeville line to the present terminus of the East Taunton St. Ry. Co.

Eureka Springs, Ark.—Z. F. Bailey, Sedalia, Mo.; B. F. Putnam, Eureka Springs, and others propose to construct an electric railway. Total estimated cost, $250,000.

Pine Bluff, Ark.—See "Power Plants, Gas and Electricity."

New York, N. Y.—The Westinghouse Electric & Mfg. Co. has received the contract for the steam and electric equipment of the power-house and street railroad lines of the Third Ave. R.R. Co. The plant will be erected on Two Hundred and Sixteenth St., with a capacity of 64,000 h. p. The electrical apparatus will be manufactured by the Westinghouse Co., at Pittsburg, and at the works of the Walker Co., in Cleveland. The Westinghouse Machine

Co. of Pittsburg will build the engines, and the erection of the steam plant will be in charge of Westinghouse, Church, Kerr & Co., of New York. Mr. Albert J. Elias, the President of the Third Ave. R.R. Co. says: "The many features of the mechanical and electrical engineering involved, all of which must operate together harmoniously, made it advisable that the work should be carried out under a single contract. It was felt that the experience of the Westinghouse Co. in manufacturing and installing the 5,000 h. p. generators at Niagara Falls, and its experience gained in other large power transmission plants, together with the experience of its associate interests in steam as well as electrical engineering, gave that company particular qualifications for the work.

RAILROADS.

Ghent, Ky.—See "Bridges."

Valdosta, Ga.—The Directors of the Atlantic, Valdosta & Western R.R. Co. are stated to have decided to extend its line to Albany.

Kansas City, Mo.—See "New Depots."

Clarksville, Tenn.—Nagle, Holcomb & Co., of Chicago, are stated to have received the contract for building 220 miles of railroad for the Tennessee Central R.R. Co., from this place to the Clinch River.

Walla Walla, Wash.—It is reported that the Summerville, Blue Mountain & Walla Walla R.R. Co. has been formed to construct a railroad 80 miles long, from this place to Union, Ore. P. J. Taylor, Pres. L. B. Rinehard, Supt. of Construction.

Atlanta, Ga.—The Atlanta & West Point R.R. Co. is stated to have petitioned the County Commissioners for a franchise through the southern portion of the county.

Seattle, Wash.—Malcolm McDougall, of Orillia, Wash., has applied to the County Commissioners for a franchise to construct a standard gauge railroad from Tacoma northward to Seattle.

NEW DEPOTS.

Kansas City, Mo.—L. F. Goodale, of St. Joseph, Ch. Eng. of the Burlington Route, is reported to be preparing plans and specifications for improvements to the terminals here, which will probably cost about $200,000.

Atlanta, Ga.—Bradford L. Gilbert, 50 Bway., New York, is stated to have completed plans for the proposed depot. In his report, he advises elevated tracks and depression of several streets; probable cost of improvements, $450,000.

Ft. Worth, Tex.—It is stated that the Texas & Pacific Ry. Co. will build a $150,000 depot. L. S. Thorne, Gen. Mgr., Dallas.

New Orleans, La.—It is reported that the Louisville & Nashville Ry. Co. will build a $50,000 depot. R. Montfort, Ch. Eng., Louisville, Ky.

PUBLIC BUILDINGS.

New York, N. Y.—Bids are wanted Dec. 23 for alterations, repairs and improvements to the 74th precinct station house, Astoria; to the station house and stable of the 41st precinct, Bronx Park, and to the station house of the 46th precinct, Borough of Brooklyn. William H. Kipp, Ch. Clk. Police Dept.

Boston, Mass.—The following bids were recently received for ventilating and heating St. Alphonso's Hall in connection with the Redemptorist Fathers' Mission Church: Andrew Lumsden & Co., 30 Oliver St., Boston, *$2,800; Buerkel & Co., 18 Union Park St., Boston, $2,868; T. B. Cryer & Co., 30 Lawrence St., Newark, N. J., $2,875; Wm. N. Tobin, 532 Columbus Ave., New York, $3,049.74; Kenrick Bros., Brookline, Mass., $3,238; Boston Furnace Co., 175 Hanover St., Boston, $3,311.50.

*Contract awarded.

New Bedford, Mass.—It is stated that plans are being prepared for a $25,000 addition to the court house.

Williamstown, Mass.—Weston & Butler, of Boston, are stated to have received the contract for erecting the Y. M. C. A. Building for the Williams College at $30,000.

Stevens Point, Wis.—Plans, specifications and bids are wanted Dec. 22 for ventilating, heating and plumbing the court house. W. W. Spraggon, Chmn. Com.

Peabody, Mass.—It is stated that $50,000 has been bequeathed to this town for a hospital.

Crookston, Minn.—See "Water."

Arkadelphia, Ark.—C. L. Thompson, Allis Bldg., Little Rock, is stated to have been selected to prepare plans for a $30,000 jail for Clark County.

Brooklyn, N. Y.—Bids are wanted Dec. 22 (readvertisement) for repairs and alterations to the Municipal Building. Henry S. Kearny, Commr. Pub. Bldgs., Lighting & Supplies, New York, N. Y.

New York, N. Y.—Bids are wanted Dec. 20 for a steam-heating apparatus in the Zbrowski mansion, Claremont Park, Bronx Boro. Henry S. Kearny, Commr. Pub. Bldgs., Lighting & Supplies.

Oshkosh, Wis.—Bids are wanted Dec. 19 for a heating plant in the Punhoqua school at West Algoma. Casper Fluor, Chmn. Bd. Pub. Wks.

Owatonna, Minn.—It is stated that bids will be received by the Library Board Jan. 4 for a library; probable cost, $18,000. B. E. Darby, Secy.

Cincinnati, O.—Bids are wanted Dec. 20 for a station house in the 6th police district. W. H. Harrison, Clk. Bd. Police Commrs.

Whitehall, N. Y.—Bids are wanted Dec. 23 for a State armory, work to include ventilating, heating, plumbing, drainage and electric wiring. Charles Whitney Tillinghast, 2d Adj. Gen., S. N. Y., Chmn. Armory Commrs.

Indianapolis, Ind.—The Northern Insane Hospital Board is stated to have recommended the erection of an $80,000 building, and $11,650 for water-works and additional boiler capacity. The Board of Control of the Central Hospital for Insane is stated to have decided to ask for an appropriation of $125,000 for a new hospital.

Kansas City, Mo.—Lilburn G. McNair, of St. Louis, is stated to have decided to erect a 7-story building on 8th St.

Hartford, Conn.—It is reported that about $30,000 will be expended on alteration to the Hartford Hospital. Dr. Harmon G. Hower.

Baltimore, Md.—The Council has passed the ordinance appropriating $40,000 for improvements to the city hall.

Norwich, N. Y.—Mr. Thomas, of Norwich, and Mr. Dalrymple, of Otselic, Supervisors, have been appointed to investigate the question of building a jail in Chenango County.

New Castle, Pa.—The Grand Jury, on Dec. 8, is stated to have recommended that the court house be enlarged or a new one built.

Balsam Lake, Wis.—It is stated that bids are wanted Jan. 3 for a court house, jail and residence. H. P. Burdick, Secy. Co. Commrs.

Marshall, Tex.—C. J. Randall, of Shreveport, La., will, it is reported, erect a $40,000 hotel at Ninson Springs, six miles west of here. An electric line will be operated from the city to the springs.

Cambridge, Pa.—R. M. Baird is reported to have accepted plans prepared by Franzheim, Giesey & Faris, of Wheeling, W. Va., for a $60,000 hotel.

St. Louis, Mo.—It is reported that the Second Presbyterian Society will soon let contracts for a $100,000 church.

Newark, N. J.—J. O'Rourke & Sons, 756 Broad St., Newark, are stated to be preparing plans for an 8-story building.

Springfield, O.—The Directors of the Y. M. C. A. are stated to have decided to erect a $65,000 building. T. J. Kirkpatrick, on East High St., is said to be interested.

Chicago, Ill.—It is stated that the owners of the Lincoln Theatre will erect a $75,000 building.

Cleveland, O.—Plans are stated to be on foot for the erection of a 10-story hotel on the site of the Lennox apartment house. Jas. H. Thompson, Mgr. of the Stillman Hotel, and W. C. Spaulding, Secy. of the Lennox Co., are reported to be interested.

Chicago, Ill.—Postle & Postle, 204 Dearborn St., are stated to have completed plans for reconstructing the building at 150 Michigan Ave.; estimated cost, $50,000.

Washington, D. C.—A bill providing for the erection of a municipal building and court house passed the Senate Dec. 13; estimated cost, $2,500,000.

Cleveland, O.—E. T. Hamilton, Pres. Co. Court House Commission, writes, in regard to proposed new court house, that the Co. Buildings Commission has just organized, and its first work will be to select a site. No architect or superintendent has yet been selected.

Atlantic City, N. J.—It is stated that John L. Young and Clarence Busch, of Philadelphia, have had plans drawn for a 6-story fireproof hotel, of steel and concrete construction, to be erected at Ocean Ave.; estimated cost, $225,000.

Chicago, Ill.—It is stated that the La Grange Club will erect a $25,000 clubhouse.

Shell Lake, Wis.—Bids are wanted Dec. 28 by the County Clerk for a jail.

Opelika, Ala.—The County Commissioners are stated to have decided to issue $25,000 bonds for a new court house.

Boone, Ia.—Plans and specifications are wanted Jan. 10 for a $10,000 jail. M. D. McGregor.

Henderson, Colo.—The following bids for a complete heating plant in the county poorhouse were opened Nov. 28 by J. W. Fleming, Chmn. County Commissioners, Denver: C. J. Reiley, *$9,200; Denver Boiler & Steam Heating Co., $9,342; Michael Heating Co., $11,050; C. Irving, $8,999. Bidders all of Denver.

*Contract awarded.

Boston, Mass.—The following bids were opened Nov. 23 for ventilating and heating the Ann White Vose Building: Ingalls & Kendricken, 80 Sudbury St., $7,985; Walworth Construction & Supply Co., 100 Pearl St., $7,437; Isaac Coffin & Co., 52 Sudburg St., $7,380; Huey Brothers, 4 Oliver St., $6,487; Lynch & W[illegible]ward, 28 Beach St., *$5,685.

*Contract awarded.

Brooklyn, N. Y.—The following bids were opened Dec. 13 by the Commissioners of Public Charities, New York City, for work at the Kings County Hospital: *a*, idiot pavilion; *b*, nurses' home; *c*, 2 wings; *d*, alterations to central top story: L. W. Seaman, Jr., & Son, *a*, $7,673; *b*, $29,998; *c*, $92,133; *d*, $11,164. P. J. Carlin & Co., 289 4th Ave, N. Y. City, *a*, $6,700; *b*, $27,743; *c*, $89,739; *d*, $9,449. Joseph Wagner, N. Y. City, *a*, $8,490; Ryan & McFerran, 106 E. 23d St., N. Y. City, *a*, $6,700; *c*, $83,600; *d*, $9,400. M. Gibbons & Sons, Brooklyn, N. Y., *b*, $27,899. John J. Cody, *a*, $9,687; *b*, $28,629. Newman & Co., 355 Adams St., Brooklyn, N. Y., *c*, $89,988. The lowest bid being above the appropriation, the Commissioners have recommended that the contract for erecting the two wings and the alterations be awarded to Ryan & McFerran, the lowest bidders.

Bridgeton, N. J.—The following bids are stated to have been received Dec. 12 by the Board of Chosen Freeholders for a county insane asylum:

Building: Burd P. Evans, *$57,393; Ph. Anns, $59,206; Jos. P. Best, Woodbury, $59,695.17; Bennett & Rothrock, Williamsport, Pa., $59,715; M P. Wells & Co., $59,907; R. C. Ballenger & Co., $60,400; Jos. Steelman, Bridgeton, $60,991; F. A. Souders, Atlantic City, $61,200; J. E. & A. L. Penick, $61,234; Macy, Henderson & Co., $63,495; Girard Construction Co., $64,300; Jas. W. Lanning, Trenton, $65,000; Wm. Severns, Camden, $65,447; J. S. Rogers & Co., Stanwick, N. J., $65,498; B. F. Sweeten & Son, Camden, $67,698.87; Chas. W. Kaffer, Trenton, $67,921; Harry T. Nichols & Co., $67,930; A. S. Reed & Bro., Wilmington, $67,990; Harry B. Shoemaker & Co., $69,990; Smith & Conover, Bridgeton, $72,300; Jas. Stewart & Co., Buffalo, $77,500:

Steam heating: E. Keeler Co., *$13,772; Rowell, Smith & Co., York, Pa., $14,497; Chas. F. West, $14,893; Harry A. Miller, Wilmington, $15,752; Evans, Almiral & Co., New York, $16,115; Roberts Machine Co., Collegeville, Pa., $16,450; Lewis W. Gould, Vineland, $17,042.16; John Brandriff, Millville, $17,678.77; D. R. Burns, $18,400; A. S. Reed & Bro., Wilmington, $18,798; Chas. W. Carll, Trenton, $19,989; E. Rutzler & Co., New York, $21,327; Francis Bros. & Gillette, $22,749.50.

Plumbing: Lewis W. Gould, Vineland, *$5,073.99; A. S. Reed & Bro., Wilmington, $5,262 (tank and power, $6,302); I. B. Thorn, $6,242; H. A. Miller, Wilmington, $6,56; Jos. Grim, Bridgeton, $6,690.49; Custer & Richards, Bridgeton, $6,748.27.

Address of bidders Philadelphia, unless otherwise stated.

*Contracts awarded.

FIRES.

Sacramento, Cal.—The Union Iron Works of Root, Beison & Co. are reported to have been burned; loss, $60,000.

Los Angeles, Cal.—The plant of the Standard Oil Co. is reported to have been destroyed by fire Dec. 7; loss, about $100,000.

NEW FACTORIES.

The Lobdell Car Wheel Company, Wilmington, Del., is erecting a steel foundry building 44x132x35 feet high, with lean-to 30x88x25 feet high. No additional power will be needed, but a 80-ton traveling crane will be installed.

The Pennsylvania Car Wheel Company, Pittsburg, Pa., is erecting a new boiler shop and machine shop and building an addition to its foundry.

MANUFACTURING NOTES.

The Berlin Iron Bridge Company, of East Berlin, Conn., has recently built for the town of Newport, Herkimer County, N. Y., a bridge having two spans of about 70 feet each. This bridge is of the parabolic type, with steel floor beams and stringers.

PROPOSALS OPEN.

Bids Close. — See Eng. Record.

WATER-WORKS.

Dec. 20. Pump, Dunkirk, N. Y. .... Dec. 10
Dec. 20. Orangeburg, S. C .... Dec. 10
Dec. 20. Castings, etc., Philadelphia, Pa .. Dec. 17
Dec. 24. Hunter's Point, Md .... Dec. 17
Dec. 27. Pipe, Jersey City, N. J. .... Dec. 17
Dec. 28. Pipe, etc , New York, N. Y. .... Dec. 17
Dec. 31. Brass castings, Chicago, Ill .... Dec. 10
Dec. 31. Bemidji, Minn .... Dec. 17
Jan. 1. Crisfield, Md .... Nov. 12
Jan. 3. Bonds, Gaffney, S. C .... Dec. 10
Jan. 5. Darlington, O. T .... Dec. 17
Jan. 5. Chicago, Junction, O .... Dec. 17
Jan. 6. Bonds, West Union, W. Va .... Dec. 17
Mar. 15. Belem, Para, Brazil .... Nov. 26
—— Pump, Austin, Tex .... Sept. 10
—— Tempe, A. T. .... Nov. 5
Adv., Eng. Record, Nov. 5, 12.

SEWERAGE AND SEWAGE DISPOSAL.

Dec. 19. Newburgh, N. Y .... Nov. 19
Dec. 19. Oneida, N. Y .... Dec. 17
Dec. 20. Buffalo, N. Y .... Dec. 17
Dec. 20. Orangeburg, S. C .... Dec. 10
Dec. 22. Fort Wayne, Ind .... Dec. 17
Dec. 26. South Bend, Ind .... Dec. 10
Dec. 27. Riverside, Cal .... Dec. 17
Dec. 28. New York, N. Y .... Dec. 17
Dec. 30. East Cleveland, O .... Dec. 3
Jan. 2. Bonds, Hamilton, O .... Dec. 10
Jan. 2. Hamilton, O .... Dec. 10
Jan. 3. Cincinnati, O .... Dec. 10
Jan. 3. Mount Vernon, N. Y. .... Dec. 17
Jan. 10. Bonds, Grass Valley, Cal .... Dec. 3
Jan. 15. New York City .... Dec. 3
Jan. 18. Aiken, S. C .... Dec. 17
—— Pittsburg, Pa .... Nov. 5

BRIDGES.

Dec. 20. Blair, Neb .... Dec. 10
Dec. 20. Fort Scott, Kan .... Dec. 17
Dec. 21. Bonds, Selma, Ala .... Dec. 17
Dec. 22. Lorain, O .... Nov. 5
Dec. 28. Chicago, Ill .... Nov. 5
Adv., Eng. Record, Dec. 3.
Dec. 28. Norfolk, Va .... Dec. 3
Adv., Eng. Record, Dec. 3 to 17.
Dec. 28. Plans, etc., Ogden, Utah .... Dec. 17
Dec. 28. Brooklyn, N. Y .... Dec. 17
Dec. 28. New York, N. Y .... Dec. 17
Dec. 29. Boston, Mass .... Dec. 17
Dec. 31. Plattsmouth, Neb .... Dec. 10
Jan. 1. Cathlamet, Wash .... Nov. 26
Jan. 2. Quebec, P. Q .... Oct. 1
Adv., Eng. Record, Oct. 1, 8.
Jan. 2. Aspen, Colo .... Dec. 17
Jan. 3. Brookhaven, Miss .... Nov. 19
Jan. 4. Denison, Ia .... Dec. 17
Jan. — Hastings, Neb .... Dec. 10
—— New Kensington, Pa .... Oct. 22
—— Plans, Lafayette, La .... Dec. 3

PAVING AND ROADMAKING.

Dec. 19. Hamilton, O .... Nov. 26
Dec. 19. Bonds, Lancaster, Ky .... Dec. 10
Dec. 19. Bonds, Lima, O .... Dec. 10
Dec. 19. Indianapolis, Ind .... Dec. 17
Dec. 19. Chicago, Ill .... Dec. 17
Dec. 19. Fargo, N. D .... Dec. 17
Dec. 20. Buffalo, N. Y .... Dec. 17
Dec. 20. Cincinnati, O .... Nov. 26
Dec. 21. Hoboken, N. J .... Dec. 3
Dec. 22. Jacksonville, Fla .... Dec. 10
Dec. 22. Philadelphia, Pa .... Dec. 17
Dec. 23. Zanesville, O .... Dec. 17
Dec. 23. St. Louis, Mo .... Dec. 17
Dec. 26 Atlantic City, N. J .... Dec. 10
Dec. 27. Atlantic City, N. J .... Dec. 17
Adv., Eng. Record, Dec. 17.
Dec. 28. Baltimore, Md .... Dec. 17
Dec. 28. New York, N. Y .... Dec. 17
Dec. 29 Bonds, Georgetown, Ky .... Dec. 3
Dec. 31. Keokuk, Ia .... Dec. 17
Jan. 2. Bonds, Tippecanoe City, O .... Dec. 10
Jan. 5. Decatur, Ind .... Dec. 3
Jan 7. Cincinnati, O .... Dec. 17
Jan. 9. Houston, Tex .... Dec. 17
Adv., Eng. Record, Dec. 17.
Feb. 27. Yonkers, N. Y .... Dec. 3

POWER, GAS AND ELECTRICITY

Dec. 19. Wiring, etc., New York, N. Y .... Dec. 10
Dec. 19. Colton, Cal .... Dec. 3
Dec. 20. Electric Light Plant, Mt. Pleasant, Mich .... Dec. 3
Dec. 20. Orangeburg, S. C .... Dec. 10
Dec. 20. Royal Oak, Mich .... Dec. 10
Dec. 20. Fountain City, Wis .... Dec. 17
Dec. 20. Gas fixtures, Newark, N. J .... Dec 17
Dec. 23. Boston, Mass .... Dec. 17
Dec. 23. Whitehall, N. Y .... Dec. 17
Dec. 26. Waterloo, N. Y .... Dec. 10
Dec 27. Woodsfield, O .... Dec. 3
Dec. 27. Gas fixtures, Washington, D. C .... Dec. 10
Dec. 27. Wiring, Paterson, N. J .... Dec. 17
Dec. 29. Power plant, etc , San Francisco, Cal .... Dec. 10
Dec. 28. Brooklyn, N Y .... Dec. 17
Dec. 31. Eau Claire, Wis .... Dec. 17
Jan. 1. Bonds, Lawton, Mich .... Nov. 26
Jan. 2. Vincennes Ind .... Oct. 22
Adv., Eng. Record, Oct. 22, Nov. 12, 26, Dec. 17
Jan. 6. Johannesburg, So. African Repub. Oct. 22
Jan. 12. Annapolis Md .... Dec. 17
Jan. 16. Duluth, Minn .... Dec. 10
Mar. 31. Telephone, Shanghai, China .... Nov. 19

GOVERNMENT WORK.

Dec. 20. Revetments, Duluth, Minn .... Nov. 26
Adv., Eng. Record, Nov. 26 to Dec. 17.
Dec. 21. Toms River, N. J .... Dec. 10
Dec. 23. Metal work, etc., Tompkinsville, N. Y .... Nov. 19
Dec. 23. Cement and gravel, Mobile, Ala. .... Nov. 26
Adv., Eng. Record, Nov. 26 to Dec. 17.
Dec. 23. Electric light plant, etc., Boston, Mass .... Dec. 17
Dec. 23. New York, N. Y .... Dec. 17
Dec. 27. Wiring, Paterson, N. J .... Dec. 17
Dec. 27. Gas fixtures, etc ,Washington, D.C. Dec. 10
Dec. 29. Boiler plant,etc ,San Francisco,Cal. Dec. 10
Jan. 10. Cement, Duluth, Minn .... Dec. 17
Adv., Eng. Record, Dec 17.
Jan. 12. Cement, St. Paul, Minn .... Dec. 17
Adv., Eng. Record, Dec. 17.

BUILDINGS.

Dec. 19. Lexington, Ky .... Dec. 10
Dec. 19. Heating, Oshkosh, Wis .... Dec. 17
Dec. 20. Steam heating, New York, N. Y.. Dec. 17
Dec. 20. School, Marshfield, Wis .... Dec. 17
Dec. 20 Cincinnati, O .... Dec. 17
Dec. 21. Atlanta, Ga .... Oct. 29
Dec. 21. School, Buffalo, N. Y .... Dec. 17
Dec. 22. Brooklyn, N. Y .... Dec. 17
Dec. 22. Plans, etc., Stevens Point, Wis .... Dec. 17
Dec. 23. New York, N. Y .... Dec. 17
Dec. 23. Whitehall, N. Y .... Dec. 17
Dec. 23. Liverpool, N. S .... Dec. 10
Dec. 23. Charleston, S. C .... Dec. 3
Adv., Eng. Record, Dec. 10.
Dec. 27. Ventilating, etc., Cleveland, O.. Dec. 3
Dec. 28. Shell Lake, Wis .... Dec. 17
Jan. 2 School, Luverne, Minn .... Dec. 10
Jan. 3. Plans, Albany, N. Y .... Dec. 3
Jan 3. Ashland, Ky .... Dec. 10
Jan. 3 Balsam Lake, Wis .... Dec. 17
Jan. 4. Library, Owatonna, Minn .... Dec. 17
Jan. 6. Albany, Ore .... Dec. 10
Jan. 9. School, Wilmington, Del .... Dec. 3
Jan. 10. Phoenix, Ariz .... Dec. 3
Jan. 10 Plans, etc., Boone, Ia .... Dec. 17
Jan. —. Superstructure, Newport, R. I .. Nov. 19
Feb. 1. School, Peoria, Ill .... Dec. 3
Feb. 10. Keyser, W. Va .... Nov. 5
—— Pittsburg, Pa .... Dec. 3
—— Machine shop, Birmingham, Ala.. Sept. 3

MISCELLANEOUS

Dec. 19. Engrs. supplies New York, N. Y.. Dec. 10
Dec. 19. Garbage disposal, Atlantic City, N. J .... Dec. 17
Dec. 20. Castings, etc., Philadelphia, Pa .. Dec. 17
Dec. 23. Dredging, New York, N. Y .... Dec. 17
Dec. 28. Dredging, Brooklyn, N. Y .... Dec. 17
Jan. 14. Philadelphia, Pa .... Nov. 19
Jan. 15. Street cleaning, Indianapolis, Ind. Dec. 17
Jan. 24. Tunnel, London, England .... Nov. 5
Feb. 1. Crane, Townsville, Australia .... Dec. 17
Mar. 15. El. Ry., Shanghai, China .... Nov. 19
—— Garbage crematory, Newport, Ky. July 31
Adv., Eng. Record, July 30.

NEW SCHOOLS.

West Hoboken, N. J.—The Council is stated to have appropriated $45,000 for a school.

Buffalo, N. Y.—Chas. Mosier is stated to have received the contract for No. 19 school at $82,686.21.

North Platte, Neb.—The question of building a high school is reported to be under consideration.

New York, N. Y.—The Board of Estimate and Apportionment on Dec. 9 authorized the issue of $605,903 bonds for the erection of schools and the purchase of sites.

Kansas City, Kan.—W. W. Rose, Archt. Bd. Educ., is stated to have prepared plans for a $75,000 high school. An election will probably be held Dec. 30 to vote on the question of erecting same.

Revere, Mass.—The matter of erecting a $45,000 school in the Revere Beach district is being considered.

Baltimore, Md.—Chas. E. Cassell, 405 Law Bldg., will prepare plans for a $20,000 high school for the Baltimore Society of Friends.

Ponca, Neb.—The citizens are stated to have voted to issue $12,000 bonds for a school.

El Paso, Tex.—The citizens have voted to issue $30,000 school bonds.

Marshfield, Wis.—Bids are wanted Dec. 20 for a high school. C. S. Vedder, Dist. Clk. of Schools.

Buffalo, N. Y.—It is stated that bids are wanted Dec. 21 for a brick addition to school No. 9. R. G. Parsons, Secy. Bd. Pub. Wks.

Sacramento, Cal.—The plans of J. M. Curtis, 126 Kearney St., San Francisco, for the proposed high school were adopted by the City Trustees Dec. 6; probable cost, $75,000.

STREET CLEANING AND GARBAGE DISPOSAL.

New York, N. Y.—The contract for the removal of snow and ice has been awarded to Bart Dunn for 30 cents a cu. yd.

San Francisco, Cal.—The Garbage Sanitary Cremation Co. has been organized, with a capital stock of $100,000. The directors are: Adolph Ramish, Martin C. Marsh, Charles L. Asher and others.

Covington, Ky.—The contract for removing garbage and ashes has been awarded to George Exterkamp at his bid of $361 per month.

Orange, N. J.—Local reports state that the six municipalities of Orange, East Orange, West Orange, Montclair, Glen Ridge and Bloomfield have under consideration a scheme to build a union garbage disposal crematory which will be centrally located for all.

Atlantic City, N. J.—Bids are wanted Dec. 19 for the collection and removal of garbage. Emery D. Irelan, City Clk.

GOVERNMENT WORK.

Duluth, Minn.—Bids are wanted Jan. 10 for 12,000 bbls. of Portland cement for the concrete superstructure for piers for Duluth ship canal, as advertised in "The Engineering Record."

Hunter's Point, Md.—Bids are wanted Dec. 24 for a water supply system. Address Quartermaster, Fort McHenry, Md.

St. Paul, Minn.—Bids are wanted Jan. 12 for American Portland cement, as advertised in "The Engineering Record."

Boston, Mass.—Bids are wanted Dec. 23 for enlarging the electric light and power plant and for extending the wiring system at the Navy Yard. Mordecai T. Endicott, Ch. Bureau Yards & Docks, Navy Dept., Washington, D. C.

New York, N. Y.—Bids are wanted Dec. 23 for a storehouse for ordnance materials at the Navy Yard. Mordecai T. Endicott, Ch. Bureau Yards & Docks, Navy Dept., Washington, D. C.

Paterson, N. J.—Bids are wanted Dec. 27 for installing a system of iron armored conduits or cold drawn steel tubing, with interior non-corrosive lining, or tubing equal thereto, wiring and distribution tablets, in the U. S. post office. O. L. Spaulding, Acting Secy., Treas. Dept., Washington, D. C.

Wilmington, N. C.—The following bids for constructing a torpedo storehouse at Fort Caswell, N. C., were opened Dec. 7 by Capt. W. E. Craighill, Corps of Engrs., U. S. A., as advertised in "The Engineering Record": Philadelphia Construction Co., Philadelphia, Pa., $6,300; Pullan & Weeks, Southport, N. C., $5,129.70; A. J. Robbins, Southport, N. C., *$4,740; Structural Iron Co., Baltimore, Md., $5,000.

*Recommended for award.

San Francisco, Cal.—It is stated that the California Bridge & Construction Co., of Oakland, was the lowest bidder in the Navy Department at Washington for the erection of a sawmill and a steel chimney at the Mare Island Navy Yard. The amount of the bid was $55,939.

Indianapolis, Ind.—It is stated that bids are wanted Jan. 15 for cleaning the streets for the year 1899.

Minneapolis, Minn.—Local reports state that an appropriation of $75,000 has been secured for an addition to the post office.

Yonkers, N. Y.—Crematory bonds to the amount of $3,600 have been sold.

Washington, D. C.—The Senate h[as] passed the bill authorizing the purcha[se] of a site east of the Capitol grounds [in] Washington for a building for t[he] United States Supreme Court.

CUBA.

Cold Storage Plants.—Chicago pac[k]ers propose to erect cold storage plan[ts] in Santiago, Havana and Porto Ric[o]. According to the Chicago "Record" those interested in the matter are P. Armour, G. F. Swift, Nelson Morris a[nd] Thomas J. Lipton.

Railroad and Wharf.—The New Yo[rk] "Herald" states that the United Stat[es] Government is about to construct [a] wharf 300 ft. in length and 7 miles [of] railway in Cuba, the former to be l[o]cated at Triscora.

MISCELLANEOUS.

Philadelphia, Pa.—Bids are want[ed] Dec. 20 for iron and malleable casting[s], brass castings, iron and steel, bol[ts], plumbers' supplies, conduits, etc. Fra[nk] M. Riter, Dir. Dept. Pub. Safety.

New York, N. Y.—Bids are want[ed] Dec. 23 for dredging in the vicinity [of] Catherine St. J. Sergeant Cram, Ch[m]. Commr. Docks.

New York, N. Y.—The Board of Es[ti]mate has authorized Essex St. pa[ving] bonds to the amount of $160,000.

Memphis, Tenn.—The advisory co[m]mittee of St. Francis levee board h[as] approved the contract awarded to B[o]kin Bros., of Little Rock, for the co[n]struction of 24 miles of new work [in] Crittenden County, Ark. Cost, abo[ut] $300,000. The committee also auth[or]ized the president of St. Francis lev[ee] board to accept the bid of George [A]nold for $50,000 for the construction [of] work authorized in Lee County, Ark.

Chicago, Ill.—Local press reports sta[te] that the Board of Local Improveme[nts] has decided to straighten the river fr[om] Belmont Ave. to Lawrence Ave., in co[n]nection with the completion of the int[er]cepting sewer system. Cost, $50,000.

THE ENGINEERING RECORD.
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TABLE OF LEADING ARTICLES.

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AN IMMEDIATE DUTY FOR ALL ENGINEERS.

At the present time every engineer has a duty to perform, not only for the good of his profession, but also for the furtherance of the navy, of which all Americans are so justly proud. It will be recalled that a year ago a board of line and engineer officers, with Theodore Roosevelt as chairman, reported to the Secretary of the Navy a bill for the consolidation of the line and engineer corps. On that board were Admiral William T. Sampson, Captain Robley D. Evans, Lieutenant Commander R. Wainwright and other line officers whose names are now household words wherever English is spoken; and the engineer corps was represented by Commodore George W. Melville, Chief Engineers Charles W. Rae and George H. Kearney, and Past Assistant Engineer Walter M. McFarland, men who need no introduction to the readers of "The Engineering Record." That bill went to the Committee on Naval Affairs of the House of Representatives, and was there amended, after a careful hearing of all arguments pro and con, so as to improve the condition of the marine corps as well.

Engineers do not need to be told that the men responsible for the driving of a war vessel have arduous duties. They do not direct the gun fire, it is true, but they do direct the firing of the boilers and the care of the engines which put the vessels where guns are useful. The keenest observer of the present time has lately had something to say about the engineer officer in his report to the London "Morning Post" on recent manœuvres of a British squadron, and what Rudyard Kipling says is worth quoting: "If anything goes wrong, if he overlooks a subordinate's error, he will not be wigged by the Admiral in God's open air. The bill will be presented to him down here, under the two-inch steel deck, by the power he has failed to control. He will be peeled, flayed, blinded or boiled. That is his hourly risk. * * * Behind him is his own honor and reputation—the honor of his ship and her imperious demands, for there is no excuse in the navy. If he fails in any one particular he severs just one nerve of the ship's life. If he fails in all, the ship dies—a prisoner to the set of the sea—a gift to the nearest enemy. And, as I have seen him, he is infinitely patient, resourceful and unhurried. However it may have been in the old days, when men clung obstinately to sticks and strings and cloths, the newer generation, bred to pole-masts, know that he is the king-pin of their system."

It is these men, whose record since the Roosevelt board met has attracted the attention of naval authorities in every country, and it is the officers of that other small corps in which all Americans have felt such pride since the anxious days when the first glance at a newspaper in the morning was to learn how the little band on the hill at Guantanamo Bay was faring, who will profit by the bill now before Congress. They have won the right to a better position, and their brother officers of the line unite with them in asking for it.

But it is hard to persuade Congress to act. It has much to do, and, moreover, where there are many men there are many minds. The bill may pass without urging, but if every engineer will make it his business to send to his Congressman a request to hasten the passage of the measure, and will see that all his friends do likewise, success will be assured. Copies of the bill and important information concerning it can be had for the asking from Mr. John Thomson, president of the Engineers' Club of New York, or Mr. Stephen W. Baldwin, chairman of the League of Associated Engineers, which has its office at the club house, 374 Fifth Avenue. This is a subject each engineer should feel under personal obligations to advance in every way in his power, and it is one which is bound to succeed, for all Americans acknowledge their indebtedness to the men who lived patiently, watchfully and tirelessly through the fearful heat of a tropical summer in the "young hell" of the engine rooms of our fleets.

THE ASHLAND WATER POLLUTION CASE.

It is hardly an exaggeration to say that the most important event of the year to managers of all water-works, public and private, was the recent decision of the Supreme Court of Wisconsin in the famous case of Julia L. Green, adm., v. Ashland Water Company. This action was brought by the plaintiff to recover from the water company for her husband's death, on the ground it had neglected to extend its intake into Chequamegon Bay from time to time to obtain unpolluted water. On account of this alleged negligence, the claim was made that the deceased, without fault on his part, took from the faucet at his home water containing the germs of typhoid fever, which caused his death.

The trial court held that the company's franchise did not require it to go outside of Chequamegon Bay for a water supply, and the Supreme Court upholds this opinion. The trial court then submitted these questions to the jury: Could the defendant company have procured wholesome water from Chequamegon Bay at and prior to the sickness of Green? Was the defendant company guilty of negligence which was the proximate cause of the death of Green? Did the defendant know, or ought it reasonably to have known, prior to the time when the deceased contracted the disease from which he died, that the water it furnished deceased was contaminated by typhoid germs? The jury answered each question in the affirmative and awarded the plaintiff $5,000 damages, from which the company appealed.

As the plaintiff's case was argued, the decision rested on whether the evidence warranted the finding that the defendant failed to procure a pure water supply from the bay. The opinion of the Supreme Court on this head reads: "We have searched the record from beginning to end, and read and reread it with the greatest care to find such evidence and have failed. The point was raised in appellant's brief that no such evidence exists, and no reply thereto appears in the brief of respondent. No evidence is pointed out by them upon which the finding can rest."

The only information on the subject was found in an unsworn report of a chemist, based in part on an unverified report of an examination, by another party, of several samples of water taken some time after the occurrence complained of. The only sample free from sewage contamination was taken two miles from the pumping station, and the chemist who made the report did not place sufficient reliance on this result to recommend drawing a supply from that place. He thought a supply might be found there with reasonable certainty, but expressed a preference for going outside of the bay entirely. All the sworn evidence in the case shows that pure water was found on one occasion at a particular place, that this condition might or might not continue, and that the bay water was so generally contaminated with sewage, especially in the spring, that a safe supply could not be found there with any reasonable certainty.

Nearly a year prior to the death of Green the officers of the city and water company were of one mind as to the necessity of going outside the bay to get water suitable for domestic use. In February, 1893, a report was adopted by the Common Council requesting the city attorney to draw a resolution formally directing the company to extend its intake so as to draw water from the lake, rather than the bay. In the following April such a resolution was drafted by the Board of Health and adopted by the Common Council, and an attempt was afterward made to condemn the water supply and annul the department's franchise because it did not go to the lake with its intake.

The Supreme Court considered it clearly established that all parties understood for nearly a year prior to Green's death the bay water was unsuitable for domestic use. During this time there was a contest between the municipality and the company as to whether the latter was obliged to extend its intake to the lake. This being the situation between the primary parties to the contract, the Supreme Court rules that the situation "could not be different as to private persons who became parties thereto, by claiming the benefit of the contract." The decision further reads: "The verdict of the jury on the point here considered appears to be contrary to the evidence, and if a recovery on the record depends on that question the verdict should have been directed for the defendant and the judgment appealed from cannot stand."

While the jury awarded damages to the plaintiff, yet it nevertheless said by another finding that prior to Green's death it was widely believed among the citizens of Ashland that the cause of the typhoid fever epidemics in the city was the impure drinking water furnished by the company. It requires only a passing acquaintance with the principles of the law to know that the doctrine of contributory fault can be resorted to in such a case to shield the defendant, and the importance of this principle in such a case of water pollution is evident from the following extract from the Supreme Court's opinion:

"In view of the facts, which we deem uncontroverted by the evidence, after the water was impure, and that such condition had existed for a long time and was widely and commonly known, the findings referred to are inconsistent, there being no evidence explaining why the deceased did not know that which was a matter of common knowledge in the community where he lived. Common knowledge of a fact raises a presumption that all persons of average intelligence have notice of it. That is elementary. Not only was there no proof to justify the jury in saying the deceased did not have reasonable ground to believe what they said was commonly known and believed, but there is much affirmative evidence to the contrary. He knew that the sewage of the city was drained into the bay, and that defendant's water supply was taken therefrom. He was an intelligent, read-

ing, working man; he took one of the city papers, wherein the dangers of taking water from the bay were discussed. He had typhoid fever in his family six months before he was stricken, his wife being the party. She was attended by Dr. Hosmer, one of the plaintiff's witnesses, who was thoroughly conversant with the condition of defendant's water supply, and who probably talked with the deceased on the subject, as he did with intelligent men generally, it being a matter of common talk.

"All these facts are in evidence; it is not deemed advisable to quote the evidence at length. Suffice to say that the proof is overwhelming to the point that the bay water was dangerously polluted at the time Green was stricken with the fever, and that it had been in that condition, especially in the spring, for several years. That the fact in that regard were understood in the city generally and had been the subject of discussion at public meetings and in the City Council and in newspapers, and among the people for a long time. There is no evidence in the record to abut the presumption that deceased had notice of what was so commonly known. So we cannot escape the conclusion that the verdict of the jury on subject of Green's contributory fault is without evidence to support it, and that the contrary is established by the evidence. For this and the other reasons mentioned the judgment appealed from must be reversed."

This portion of the decision is in a line with the arguments of counsel on the subject, but on account of the unique character of the action, the Supreme Court has discussed it under a different aspect of law, involving the so-called rule of implied warranty in the sale of provisions for immediate domestic use. What this rule means is stated as follows by the court: "The doctrine of Sir William Blackstone that there is a warranty of the wholesomeness of provisions sold for domestic use to the buyer and that the vender is bound to know their quality in that regard at his peril, is controverted by the weight of authority in this country and England. Liability for damages in the circumstances mentioned is supported, but on the ground of deceit, not contract."

No reason could be found by the court for saying that a mere distributer of water for a compensation should be held liable as a guarantor of its quality. "Water is not a commodity kept for sale, in the strict sense of the term." The immediate source is usually selected in advance and fixed by contract, as in this case, leaving simply the service of a carrier to be performed. To say that the person or corporation shall be burdened with an implied warranty of the quality of the thing carried and distributed would be treating the transaction as a sale, strictly so-called, "and then applying an exception of the doctrine of caveat emptor, not supported by good reason or any authority we are able to find, or any to which our attention has been called."

The decision of the Supreme Court dwells strongly on this point. To require such a guaranty, it says, in substance, would put a destructive burden on private water companies and render the operation of public works so fraught with danger as to discourage a service that has become a necessity in all communities. All that can be reasonably asked is to hold water companies strictly accountable for the exercise of ordinary care not to place before their customers an unwholesome article under circumstances liable to induce persons, with the exercise of ordinary care, to use it for domestic purposes. Reasoning on this line of argument, the court reached the following decision:

"From the foregoing it will be seen, that if a recovery can be sustained on the facts of this case at all, it must be on the ground of actionable fraud or negligence, without contributory fault on the part of the deceased. If defendant knew or from situation ought to have known that the water it was distributing in the city of Ashland was dangerous for domestic use from some cause not discoverable by the exercise of reasonable care, it owed the duty to its customers of disclosing that danger, and a failure to do so, knowing that such customers were liable to use the water through ignorance of its character, was a fraud, in law, rendering the defendant liable to legal damages to any person injured through such fraud without fault on his part, and it was also a failure of duty, amounting to actionable negligence as well, to which the same liability is incident.

"The mere fact, if it be a fact, that it had been rendered impracticable for defendants to procure a supply of wholesome water in Chequamegon Bay, as required by the contract with the city, from causes attributable to the municipality, though constituting a defense against any action on the part of the city, does not excuse knowingly pumping contaminated water from the bay and distributing the same to customers and deceiving them into belief that it was wholesome, but, as indicated, though the conduct of the defendant be held wrongful on the ground of either fraud or negligence, if the deceased knew, or under the circumstances ought to have known, the dangerous condition of the water, yet used it with the consequence complained of, no legal liability thereby attaches to the defendant. If the deceased knew, and he is charged with knowledge of what a man under the circumstances ought to have known, then he was not deceived, whatever may have been the conduct of the defendant, and for the same reason he is chargeable with contributing to the result complained of by his own want of care."

GENERAL FRANCIS V. GREENE.

Major General Francis V. Greene, U. S. Volunteers, left Havana this week to return to this country, where he will resign his commission and resume the conduct of his business affairs. General Greene, whose services have been so conspicuous and creditable in the late war, was born in Rhode Island and is a son of Major General George S. Greene, U. S. Volunteers, past president of the American Society of Civil Engineers, and a descendant of General Nathaniel Greene, of the Continental army. He was appointed to the United States Military Academy at West Point, and graduated at the head of his class in 1870. He was first assigned to duty with the artillery arm, there being at that time no vacancy in the Corps of Engineers. He was made Second Lieutenant in the Corps of Engineers June 10, 1872, and First Lieutenant January 13, 1874. His work at this time included service as Assistant Astronomer on the boundary survey of the forty-ninth parallel of latitude, and duty in the office of the Secretary of War. While a lieutenant of engineers he was sent on special duty for the State Department as military attaché to the United States Legation at St. Petersburg, Russia. Throughout the war with Turkey he occupied positions in the field particularly advantageous for observation and study of the operations. For nearly a year he was attached to the headquarters of the Russian army, serving on the staff of the Grand Duke as an aide. He crossed the Balkans with General Gourko in the depth of winter, and when Gourko no longer led he joined the brilliant Skobeleff in the advance and accompanied the Russian forces to the front of Constantinople. He was present at the battles of Shipka Pass, Plevna, Taskosen, Sophia and Philippopolis. For bravery in the battle of Shipka Pass he received the Order of St. Anne, and in the battle of Philippopolis the Order of St. Vladimir. Returning to this country, he was engaged until March, 1879, in preparing the report of the Russian campaign, and then served for five years as assistant to the Engineer Commissioner of the District of Columbia. He was commissioned a Captain in the Corps of Engineers February 20, 1883, and in August, 1885, was assigned to the United States Military Academy at West Point as assistant instructor of practical military engineering and in command of the engineer company stationed there. He resigned from the army December 31, 1886, and entered business as a civil engineer and vice-president, and later president, of the Barber Asphalt Paving Company. He was appointed Major of Engineers, N. G. S. N. Y., on the staff of Brigadier General Louis Fitzgerald, and later became Colonel of the Seventy-first Regiment of the National Guard of the State of New York. He brought this regiment to such a standard of efficiency that it was one of the three only regiments of volunteers which were brigaded with the regulars on the organization of field forces following the declaration of war with Spain. The other regiments were the Second Massachusetts and the First U. S. Volunteer Cavalry, popularly known as the Rough Riders. Gen. Greene became Colonel of the Seventy-first New York Volunteers and took the regiment as far as Tampa, Fla. He was awaiting orders to proceed to Cuba when, early in June last, he was commissioned Brigadier General and ordered to proceed with all despatch to Manila. He hurried across the continent, sailed from San Francisco and reached the Philippines in time to lead the landing party. He fought the first fight which took place and which resulted in the capture of Manila. Following this action, he was promoted to be Major General and was ordered home as soon as the peace protocol was signed. Arriving home, he was engaged in duty in Washington for a few weeks and was then assigned, in the latter part of October, to the command of the Second Division of the Seventh Army Corps. Later he was ordered to Havana on special duty, and it is this post from which he has now retired. True to the best traditions of the army, General Greene, when his country needed trained and experienced officers, promptly sacrificed important business interests and offered his services. Now that peace is declared, he very properly asks to be relieved, that his private interests need no longer suffer. The talk, then, of endeavoring to induce him to continue the sacrifice in order to accept the superintendency of Public Works of the State of New York is most unreasonable, as there is no lack of men available who can serve the state efficiently without loss to themselves.

NOTES.

The Effect of Subsidence due to coal workings upon bridges and other structures was discussed in a paper presented to the Institution of Civil Engineers on November 29 by Mr. S. R. Kay. He stated that he had taken a series of levels for five years over two separate colliery royalties under which coal was being worked at depths of 120 and 330 yards respectively. They proved in the former case that subsidence closely followed the extraction of the coal, and continued for three and a half years, amounting to seven-tenths of the thickness excavated. In the latter case it followed somewhat later, continued for four years, and amounted to 64 per cent. of the thickness excavated. The strata in each case were fairly level and of the average coal measure character; the movement was uniform, without breaking the surface. Before beginning buildings or other important structures over the site of extensive coal workings, Mr. Kay advised allowing two or three years to elapse after the coal was extracted in the case of shallow collieries and a longer period with deep mines. Arches should be avoided, and reservoirs should not be built unless the suitability of the site warrants unusual expense to protect the works.

THE CASTLEWOOD DAM.

[By A. M. Welles, Chief Engineer Denver Land & Water Co.]

The Castlewood dam is situated on the main Cherry Creek, about 35 miles south of the city of Denver. This stream flows directly through the city, separating East from West Denver, then has its confluence with the Platte River, which separates East and West Denver from North Denver. Cherry Creek has ever had the reputation of being one of the most treacherous and violent of waterways. Although but a trickling stream for most of the year after it leaves the divide between the waters of the South Platte and the Arkansas Rivers, where it heads, and enters the deep alluvial deposits of the plains, yet periodically it assumes enormous and destructive proportions from so-called "cloud bursts," sudden and intense precipitation which occurs during the summer months along the aforesaid divide, and as the drainage area intercepted by the Castlewood dam exceeds 175 square miles, the meteorological demonstrations impose their effect upon this drainage frequently, and at times to an alarming extent. These floods arising from sudden and violent rainfall upon the summit of the divide, from 35 to 50 miles distant, commonly make their appearance in the city under a cloudless sky, no previous evidence being given save the detection of a heavy dark cloud far away to the south. In the early history of the city, it then being located chiefly along the banks of this stream, a flood occurred which proved disastrous in the extreme. Among other losses was that of all of the records of the city, together with the vaults wherein they were contained, and of which to this day no trace has ever been detected. The bed of this creek passing through the city being a sand deposit of great depth, and in cases of violent floods being a moving mass even to bed rock, these vaults or safes are now far removed down stream from their point of first deposit, and will eventually find a resting place in the great delta of the Mississippi, possibly not in statu quo, but at least after decomposition and disintegration. This and repeated manifestations since of its dangerous and destructive nature naturally awakened residents and owners of property within its reach to a realization of its destroying power, which, coupled with its treacherous and unheralded approach, has provided a concatenation of causes for alarm of which they have never grown unmindful; consequently when the matter of attempting to bridle these forces and reserve them for more useful purposes than that of the destruction of life and property was suggested it was treated generally with a mixture of scepticism and ridicule, and later (when arrangements were made for the attempt) with disapproval and alarm. With such a feeling naturally the company labored under great disadvantages. The city had for some years previously atempted to devise some method for obtaining freedom from the constant menace of this stream, and to this end that of diverting it from its course at a point some 20 miles above Denver, and conveying it by artificial channel over a low divide, and discharging it into Coal Creek, a drain nearly parallel with Cherry Creek, but having its confluence with the Platte at a point below the city, was entertained. This was abandoned on account of the magnitude of the artificial channel necessary to carry the volume of water which in extreme floods reaches, and even exceeds, 10,000 cubic feet per second.

However, during the summer of 1889 the writer was authorized to investigate the conditions, obtain data, and prepare plans for a structure to intercept the drainage and impound the waters of Cherry Creek at a point in Sections 22 and 23, Township 8, South Range 66 West in Douglas County, Colorado. This being completed and approved, construction commenced in December of the same year, and was completed in November, 1890, with the exception that several of the provisions made were omitted, owing to inability to dispose of the bonds of the company at a price agreeable, which arose from continued conflict between the company and the authorities, city and state acting in behalf of plaintiffs, who were subjected to the dangers arising from a disaster

The company was first organized under the name of the Denver Land & Water Storage Company, but has since changed the name to the Denver Land & Water Company. The writer acted as chief engineer during construction, being ably advised by the company's consulting engineer, Mr. Alfred P. Boller, of New York, while Mr. H. A. Woods, formerly chief engineer and general manager of the Panama Railway, acted as first assistant, with Mr. Robert Waddell as second assistant. Two other engineers were also employed, as in addition to the dam there was at the same time under construction some 75 miles of waterways in connection with it. The summit of the divide is formed of a great depth of tertiary deposit, probably miocene, reaching a thickness of 1,500 feet and composed of great sheets of sandstone and conglomerates or pudding stone, with intercalary beds of clay.

The storage basin completed by the construction of the Castlewood dam was produced by the erosion of a great area and depth of this formation at this point, which was carried away through a narrow neck or cañon, the obstruction of which only remained to convert the described eroded area into a catchment basin. A cross-section of this cañon following along the line of the dam shows a surface sheet of sandstone and conglomerates, 100 feet or more in thickness; beneath this, reaching down to the bed of the creek and so much deeper as soundings were obtained, exists a bed of clay, the analysis of which is 64.60 per cent. silica, 18.83 alumina, 5.66 iron, with some lime carbonate. After determining that this sheet was practierally impenetrable for the purpose of securing a rock foundation, it was used for this purpose, excavations simply being made into it for depths ranging from 6 to 22 feet.

The dam is constructed entirely of the stone forming the upper sheet referred to, a section of which is exposed on each side of the cañon, forming cliffs, which, when broken, would deposit their material within easy reach. The dimensions of the structure are as follows: Length on top, 600 feet; extreme height above surface on inner or water face, 70 feet; height above foundations, 92 feet; width on top, 8 feet; length of spillway in center of dam, 100 feet; depth, 4 feet; width of by-pass at west end of dam, 40 feet, making a total of 140 feet of wasteway There being no possibility of discharging surplus water at any other point, this has been provided for to as great an extent as possible, and is ample, save in case a flood of great proportions should occur at a time when the reservoir was filled, which condition is guarded against most cautiously during flood season. In addition to the above described provisions for waste are the eight 12-inch pipes in the valve chamber.

TWO VIEWS OF THE CASTLEWOOD DAM.

The type of this dam is that of a combination of hydraulic cement mortar masonry and loose rock, with water tower and gates embodied in the structure itself, in place of being separated and connected by a bridge. Its construction is as follows: The inner or water face is a random rubble masonry wall of cyclopean blocks laid in mortar, and has a thickness of 4 feet and an inclination or batter of 1 foot horizontal to 10 feet vertical. The outer or downstream face has a slope of 1 foot horizontal to 1 foot vertical, and is faced with dimension stones 2 feet in thickness, not less than 2 feet in width, and having a length or reach back into the dam of not less than 3 feet. These are laid in belt courses and are stepped 2 feet horizontal at each layer, thus providing the slope. The space existing between these outer and inner walls is loose rock of all dimensions, closely deposited. The foundation for the inner wall was carried down to the greatest depth, from 6 to 22 feet, while that for outer in no place exceeded 10 feet. These walls preserve their batter to the elevation of the spillway, where they unite, when the whole, save the spillway, is surmounted by a rectangular coping 4 feet in height by 8 feet in width. This coping was laid of stones having a length of 4 feet, causing a joint along the center of the top of the dam longitudinally, it being impossible to obtain stones 8 feet in length. As will be observed, this coping rests one-half upon the solid masonry inner wall and one-half upon the loose rock interior; as a result, the last mentioned half in the first six months after completion settled a few inches, exposing the longitudinal fissure along the top of the dam from ¼ to 2 inches in width, proportionate to the height of dam or depth of filling. The portion resting on the inner wall and the wall itself have never shown the slightest settlement. When the settlement of this half had apparently ceased the bond of the top course was broken, each stone brought to its original position and spauled and bedded anew, since which time no movement has occurred or probably ever will again. The inner and outer walls rest upon footings of cement concrete from 1 to 2 feet in thickness, according to the height of wall they were to sustain. These footings are benched or stepped in ascending slopes. The inner wall being an anomaly in dam construction, having a uniform thickness and lean-

ing to an extent that for a greater part of the distance the center of gravity far overhangs the base, its stability was seriously questioned, and to conciliate protesting interests it was, along the highest portion from the shaft or water tower east for a distance of 120 feet, made vertical on the face next to the interior of the dam, thus rendering that portion of it self-supporting. After eight years of service, however, this section shows no superiority whatever in condition over the balance, there being not the slightest indication of any settlement, cracking or bulging in any portion of it. The water tower or shaft is rectangular in form, its water face rising vertically from the toe of the batter of the inner wall. It is supported by a solid block of masonry of the proper area and having a depth of 17 feet. The opening in this tower, or inside measurement, is 6x7½ feet. The walls have a thickness of 4 feet at all points save on the water face, where at about 40 feet from the summit, and on the inner face of the tower, it increases 2 feet by direct offset; the same occurs at 6 and at 12 feet, where it has now reached a thickness of 10 feet.

Outlet pipes, two in number, are laid upon the plane of each of these benches and upon that of the floor of the tower or receiving chamber therein, making a total of eight pipes. These benches and the floor provide seats for the gate valves attached to the pipes. To provide for the three offsets, which increase the thickness of wall 6 feet and would thereby block the interior space of the tower, the opposite wall is forced to recede through the use of two Roman arches, each having a span of 6 feet and ring stones 3 feet in height and 3½ feet in depth. The water is discharged through the eight gate valves into this chamber, from which it is discharged to the open air through a 36-inch conduit formed of 4 feet of concrete surrounding a former of cement pipe.

The interior mass existing between the outer and inner walls of the dam rests upon the natural surface, which is a slightly arenaceous clay with huge boulders embedded in it, all loose material being first removed. The floor and sides of the by-pass at the west end of the dam are laid in masonry to a safe point of discharge. The water discharged from the dam passes along the natural path of the stream down the cañon for a distance of about 1½ miles, where it is intercepted by a diverting dam 125 feet in length and of sufficient height to divert the waters through the head-gates and into the main canal. Through this it is conveyed for a distance of nearly 40 miles, being drawn from at various points by a system of laterals which distributes its water over some 16,000 acres of land, the property of the company, which extends to the very limits of the city of Denver. A storage basin on the line of the main canal, formed by a natural depression and protected by the low points in the rim being raised by earth embankments, furnishes a valuable auxiliary for storage; the excess waters of the main reservoir or Lake Castlewood, especially during flood season, being deposited herein, and that catchment basin being kept in a condition to impound and retain any ordinary flood waters which may appear.

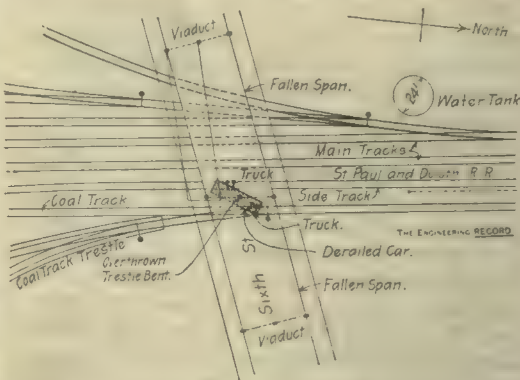
During the past summer the company has taken up and completed the original provisions in the construction of the Castlewood dam hereinbefore referred to. The earth slope at the toe of the inner face has been raised to within 30 feet of the top of the dam at the water tower, thence gradually rising toward each extremity. The entire surface of this apron has been riprapped closely and to an average depth of 1 foot with stone. A water cushion 25 feet in width and 200 feet in length has been placed at the toe of the outer slope, to receive the impact and destroy the erosive effect of the overflow. This cushion is formed of rock from 3 to 6 feet in depth, closely laid, the top grouted and finished with cement mortar. A dam attendant is constantly present, who at all times regulates the discharge of water, and in case of threatened overflow opens the eight gate valves, and to that extent augments the waste.

The surface area of the Castlewood reservoir when filled is nearly 200 acres, and its capacity is 4,000,000,000 U. S. gallons.

DESTRUCTION OF A CITY BRIDGE BY A TRAIN.

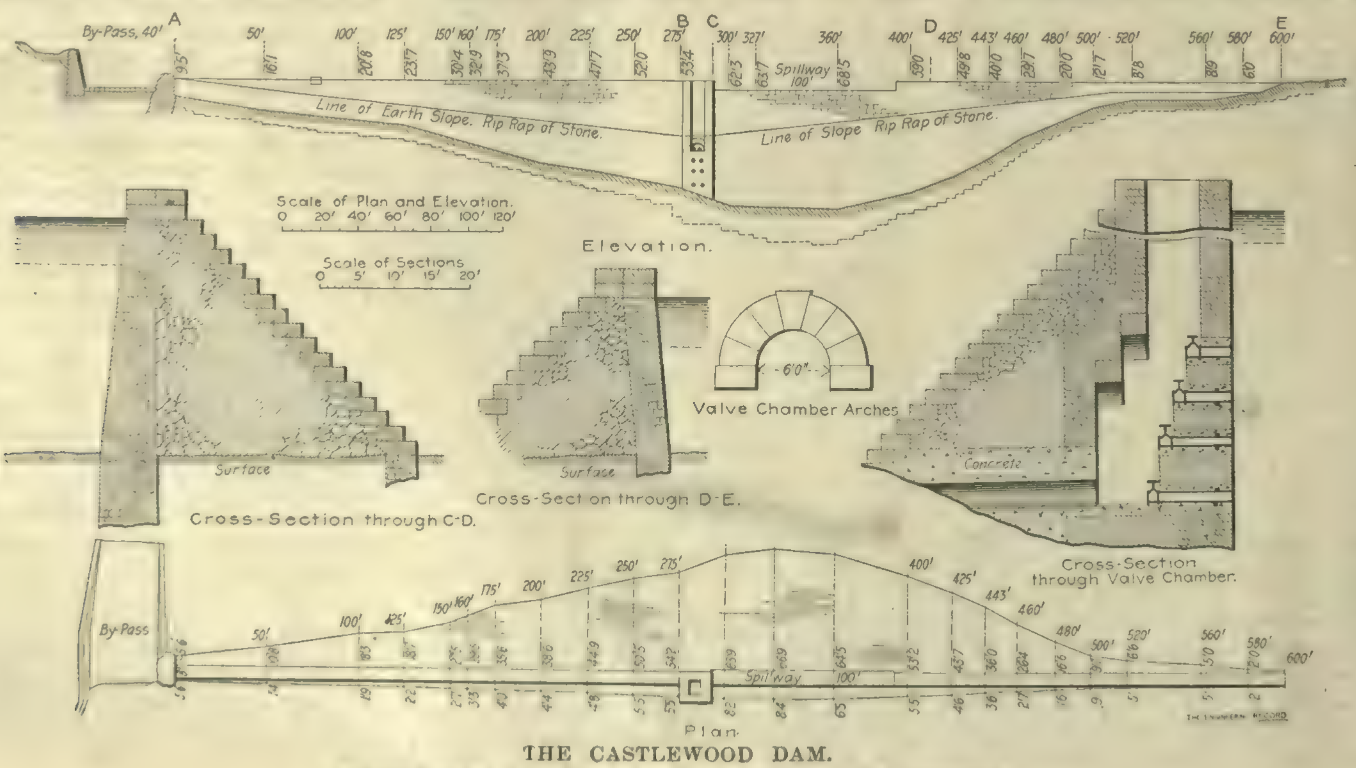
A serious bridge accident occurred about three weeks ago in St. Paul, Minn., through the splitting of a train on a switch, resulting in considerable direct and consequential damage, though fatalities were happily escaped. The adjacent ends of two highway spans forming part of a long viaduct rested on a steel trestle bent which stood in a narrow space between tracks of the St. Paul & Duluth Railroad. This part of the railway yard was on a heavy grade and there were several switches, diverging tracks and sidings in the vicinity of the highway crossing. The following description of the bridge and the circumstances of its destruction has been sent to "The Engineering Record" by Mr. L. W. Rundlett, M. Am. Soc. C. E., City Engineer of St. Paul, Minn.:

The Sixth Street bridge crosses the Trout Brook and Phalen Creek valleys, and is 1,152 feet long, with a roadway 40 feet wide and two sidewalks 10 feet wide. The roadway is planked with 4-inch pine planks and paved with 6-inch cedar block pavement. It is constructed as follows: Nine plate girder deck spans, 26 to 50 feet; one plate girder deck span, 82.2 feet; and six riveted triangular truss deck spans of the following lengths, 42.4, 80.2, 99.3, 100, 100, 134; also one riveted triangular truss through span, 134 feet long. The bridge was erected in 1891 at a cost of $148,000. For considerably more than half its length the bridge is over railroad tracks, as a large number of the railroads come into the city down the Trout Brook and Phalen Creek valleys. The right of way of the St. Paul & Duluth road is spanned



MAP OF SIXTH STREET VIADUCT CROSSING.

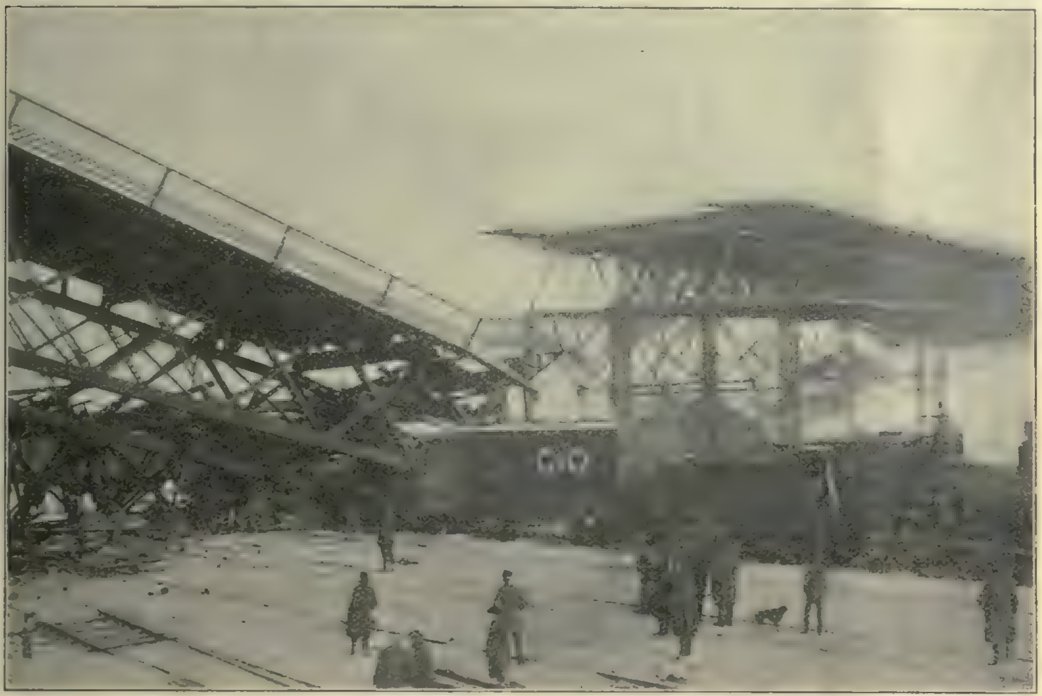
by two riveted triangular truss deck spans, one of 80.2 feet and the other 99.3 feet, the ends of which are supported by a trestle bent, which rests on the right of way of the St. Paul & Duluth Railroad, being the only bent on the right of way of that road. When the bridge was built the tracks were all west of this bent, but one track has since been laid on the east side of the bent, leading to some coal yards. Seventh Street also crosses the Duluth tracks and is carried over by a stone skew arch bridge, about 500 feet north of the Sixth Street bridge. Above Seventh Street and about 700 feet above the Sixth Street bridge is the switch which leads to the track on the outside of the bent, as shown on the accompanying plan. The tracks are on a heavy grade between the two bridges. On the morning of December 7 a freight train was coming down the track to the yards, which lie to the west of the bridge bent. The engine and one car safely passed over the switch, as did the front truck of the second car. The rear truck of the second car took the other track, followed



THE CASTLEWOOD DAM.

DENVER LAND & WATER COMPANY; A. M. WELLES, CHIEF ENGINEER.

by the rest of the train, numbering about 17 cars, part loaded and part empties. The second car, which was partially on one track and partially on the other, became derailed, but did not break the couplings, and the momentum of the train carried it against the bent of the bridge, destroying the bent and letting down the ends of the spans. One end of the trusses of the west span remained on the tower, but the other end fell upon the car and demolished it. The east span fell to the ground, a distance of over 50 feet from the bottom chord, into the ravine below, and was entirely demolished.



WRECK OF THE SIXTH STREET VIADUCT, ST. PAUL, MINN.

The bridge carries a large amount of traffic, but fortunately only one man was caught, and while he was severely injured, he will recover. The photograph is taken from the south side, looking up the tracks. Little salvage will be obtained from the wreck except the I-beams forming part of the floor system, and the floor beams. The estimated cost of renewing the spans, replacing the pavement, etc., is in the neighborhood of $15,000.

BROOKLYN CAISSONS, NEW EAST RIVER BRIDGE.

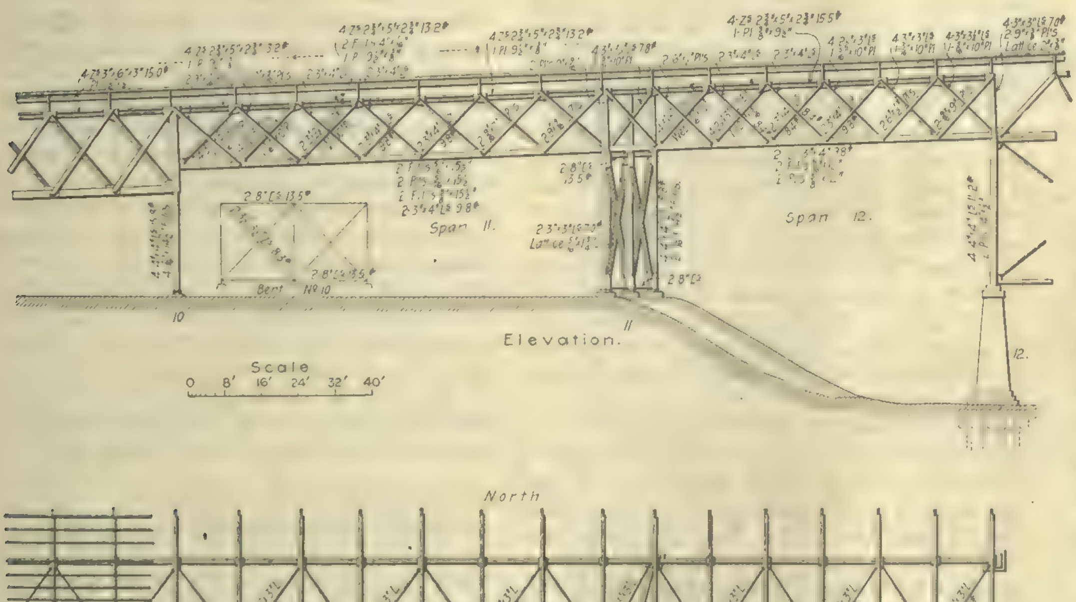
(Continued from Page 51.)

The excavation for the south caisson was carried in places to the solid rock at a depth of 11 feet below the cutting edge, when the latter was 82 feet below mean high water. It was interesting to see the change from the upper soft blue clay to the indurated stratified clay, scarcely distinguishable save by the presence of boulders from decomposed stone, and finally to the solid igneous rock. The hard stratified clay crumbles readily in the hand, and may be kneaded into plastic balls closely resembling puddle clay. Where the cutting edge rested in the clay material the inner wall of the caisson and the adjacent upper surface of the earth and rock were kept continually plastered or puddled with clay carefully applied in thick layers, to present the escape of air pressure under the edge. Before the pneumatic work was begun a contract was made with the "sand hogs," as the caisson excavators are called, many of whom were experienced in the deep foundation work of other bridge piers, in compliance with which the difficult work was executed continuously. Down to — 55 feet below datum (or mean high water level), the excavation was done by three gangs of about 16 men, each of whom received $2.50 for eight consecutive hours' work, inclusive of a half hour's intermission for lunch. From — 55 to — 70, four gangs each worked two alternate three-hour shifts and received $2.75 per man. From — 70 to — 80 six gangs each worked two two-hour shifts, with a four-hour interval of rest and received $3.00 a day. From — 80 to — 90, twelve gangs were employed, each working two one-hour shifts, with four-hour rest intervals, and the pay was $3.25 a day. From — 90 feet down there were sixteen gangs, each working two 45-minute shifts, with rest intervals of 3 hours or more. For the last stage of the excavation the men each received $3.50 for the one and one-half hours' labor that constituted a day's work, and when the excavation was completed at a maximum depth of — 107.5 feet (with the cutting edge at — 95), they each received $3.75 for the same hours of the more trying and disagreeable work of concreting the working chamber. Even at these prices it was impossible to secure enough men to fill up the desired number of gangs, so that sometimes all the sixteen shifts a day could not be worked.

No fatalities occurred, but several men suffered from the "bends." From the caisson they went immediately to the dressing room, which was steam heated to a high temperature and provided with ample lavatories. The men remained in the dressing room most of the time between their hours of labor and were served with an abundance of hot coffee. Several instances of temporary paralysis or serious collapse occurred soon after the men came out of the air locks, but they were immediately treated vigorously by their comrades, who restored respiration by rubbing, massage, etc., in the manner used to resuscitate half drowned people. When attacked severely with the "bends" the men refused to go to the hospital, and it was believed there is more chance of recovery from a serious attack when promptly and vigorously treated in the hot dressing room than if the patient is subjected to the delay, the chill, and the jolting involved in removal to a hospital.

In the north caisson there were fewer difficulties encountered, and the record of sinking shows the rapid progress by the following successive positions of the cutting edge: July 5, — 51.6; July 9, — 56.5; July 12, — 59.5; July 16, — 63; July 22, — 67; August 2, — 71.4; August 11, — 73.3; August 18, — 78.9; August 19, — 81.5; and September 1, — 85.8. At this point solid rock was encountered. As this caisson had a sectional area more than equivalent to 70 feet square, and each foot sunk involved the removal of at least 4,977 cubic feet of material, it is seen that a large amount of difficult work was rapidly accomplished.

All the caisson and cofferdam timbers were thoroughly calked and many of them recalked so that there was little leakage of water, although considerable air escaped. Two No. 7 pulsometers with 4-inch suctions, supplemented when necessary by two 4-inch compressed-air syphons, sufficed for emptying the cofferdams, which had been allowed to partly fill when concreting was suspended. The cofferdams were built in 17-foot vertical sections, each of which was anchored through the preceding ones to the caisson below by detachable vertical rods connected with sleeve nuts, and in order to provide a convenient fastening for the top of the rod before the sleeve nut of the succeeding section was added, a common square nut was screwed on to the end and made a permanent connection, above which the sleeve nut was added at convenience. The lowest section of the cofferdam was secured to the caisson by vertical flat iron bars bolted on the outside walls.



PLAN AND ELEVATION OF SIXTH STREET VIADUCT, ST. PAUL, MINN.

The bottoms were bent out 90 degrees perpendicular to the caisson sides, and were forked to receive similar reversed bent ends on the top of bars bolted to the sides of the caissons and extending a little above their decks. Between the overlapping ends of these bars wedges were driven against their parallel horizontal faces, so as to draw the caisson and cofferdam tightly together by a connection that could be easily and quickly released by a diver knocking out the wedges. The great pressure sustained by the walls of the caissons and cofferdams, as well as the limited transverse strength of pine timber, was illustrated by the fact that the 12x12-inch horizontal temporary cofferdam cross-struts were forced fully 1 inch deep into the sides of the vertical timbers in the exterior walls.

A power plant for handling and mixing concrete was provided for the south pier caisson, and after its completion was transferred to the north caisson, where it was located as shown in Figure 1. The equipment was simple, and consisted for the north caisson of a derrick, a tower, a steam mixing machine, four buckets and a car. The tower was about 20 feet high, and had an upper platform with a square hopper below it in the center. Into this hopper buckets containing the required proportions of broken stone, sand and cement were emptied by the adjacent derrick; then the chains which supported the downward opening pair of flap doors were tripped, and the contents were discharged into a cubical steel concrete mixer manufactured by Thomas Carlin's Sons, Allegheny, Pa. The mixer was closed, and revolved eight or ten times about its diagonal axis by means of the connected steam engine. Water was then admitted to the dry contents and the wet mass was revolved for one minute, or until sufficiently mixed. The mixer was turned with the orifice downward, and the door being opened, the contents were discharged into the bucket placed below on a small car. The car was then run a few feet away from the tower and delivered the bucket to a derrick that swung it to the required position over the caisson. Water was admitted to the mixer through backward pointing street elbows screwed into its hollow shaft, and the quantity was regulated in accordance with observations of a float and scale indicating the amount of water, which was drawn from a tank on top of the tower. The mixer had a capacity of 2 cubic yards, but was limited by the 1½-yard bucket used, and its output was restricted by the facilities for handling material. Two hundred yards of concrete have been mixed with it in 10 hours under these conditions.

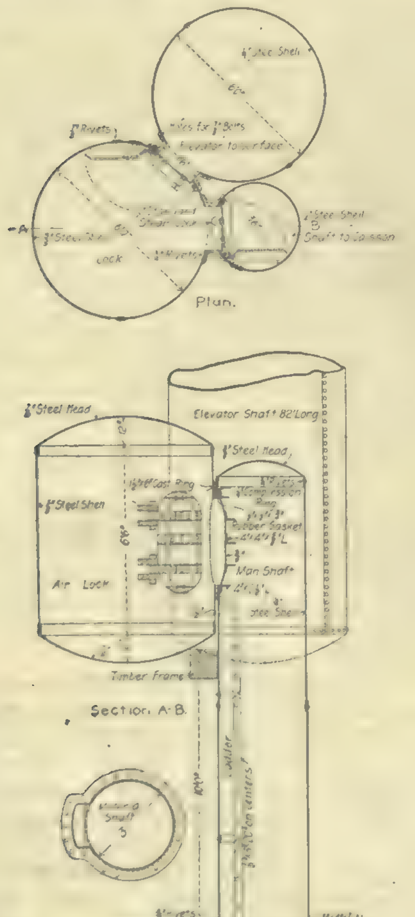


FIGURE 4.—PLAN AND ELEVATION OF SHAFT AND AIR LOCK.

Before the installation of a steam elevator in the man shaft of the caisson an ordinary ladder was used. The elevator was installed in the 6-foot open shaft, which extended from the top of the cofferdam nearly to the deck of the caisson, and connected there with a special air lock and small ladder shaft to the interior of the caisson, as shown in Figure 4. A circular cage 5½ feet in diameter, and protected by sides and top of heavy wire netting, was run in the 6-foot shaft, where it traveled about 50 feet, and was operated by an ordinary automatic Otis passenger elevator engine, fitted with the usual safety appliances. Twenty men could be locked in or out at once, and 18 carried in the cage, and the relief it afforded them from the severe effort of climbing the shaft was thought to be of importance, in consideration of the high pressure in which they worked. Two of the material shafts were made with a special cross-section, with an offset chamber to accommodate a ladder, and practically to increase the clearance inside so as to make them available for men to use.

The material lock is a special improved construction designed by Daniel E. Moran, M. Am. Soc. C. E., and Mr. A. A. Stuart, M. Am. Soc. C. E., and embracing the features covered by Mr. Moran's patent. In order to resist heavy pressures the top and bottom plates of the lock were domed, thus avoiding the use of heavy reinforcement. The circular top and bottom doors were made in halves, with a hole cut half way in each at the center to receive a stuffing box, through which the hoist rope can pass freely when the door is closed. The doors are operated by balanced levers, as shown in Figure 5. The bottom door was made in a single circular piece mounted on a double hinge, so that as the door opened it would swing outward from a vertical plane parallel to the axis of the shaft and cause less obstruction therein. Both doors close against rubber gaskets, and are made with loose bearings on their pivots, so that the air pressure will close them tight against the seat. Three-inch pressure and exhaust valves are provided for equalizing the pressure, and the lock can be opened or closed in about 30 seconds. Through one of these locks 225 cubic yards of concrete have been lowered in 20 working hours, and deposited at a depth of 108 feet below mean high water. On the concrete filling above the caisson roof a special cylindrical bottom dumping bucket of 20 cubic feet capacity was used, which was lifted by a hook attached to chains running

VIEW IN PNEUMATIC CAISSON, NEW EAST RIVER BRIDGE.
[The cutting edge is about at the middle of the picture and excavation has progressed below it as shown.]

down inside the bucket to the bottom flaps. This bucket was lowered to the bottom of the pocket in the caisson and then the weight was taken off the engine by a fixed rope attached to the bail. As the bucket descends the bottom flaps are released and opened, so as to deposit the contents in the required position. This bucket is essentially the same as that illustrated in "The Engineering Record" of April 23, 1898, and has extreme dimensions of 34 inches diameter and 42 inches height, exclusive of the bail. For removing the spoil from the material shafts, fixed bottoms were fitted to the concrete buckets. These had a ring attached to the bottom and a boom line was carried from it over a point of the boom and back to a cleat on the mast. This line was made fast at such a point that when the bucket was lowered to a given position it became taut, and tipped the bucket as the bail was lowered beyond this level. In the north caisson a square bucket of more than 40 cubic feet capacity, and fitted with similar dumping arrangements was used.

The daily consumption of coal for the caisson and anchorage work on the Brooklyn shore averaged about 50 tons, and from 300 to 700 tons were stored on the pier and at the anchorage. Steam was generated in three 100-horse power submerged tube vertical boilers and two 90 horse-power auxiliary locomotive boilers, and served for the operation of the entire mechanical plant. Feed water was heated in a Brooklyn heater, and the air is compressed by three duplex compressors, with 16x16-inch steam and 18x18-inch air cylinders, with a capacity of 3,600 cubic feet of free air per minute, made by the Laidlaw-Dunn-Gordon Company, of Cincinnati, O. One compressor sufficed, when necessary, to maintain the pressure in one caisson. There were seven hoisting engines of the Lidgerwood manufacture to operate the different derricks, and there was the usual provision of machinists', blacksmiths' and carpenters' shops and tools. The working force employed while both caissons were being sunk consisted of about 350 men, of whom 250 were employed under pressure, about 40 in the concreting, 25 on the masonry, 10 attending to the machinery, and the remainder as smiths, carpenters and general laborers.

Mr. Leffert L. Buck, M. Am. Soc. C. E., is chief engineer and designer of the new East River Bridge; Mr. O. F. Nichols, M. Am. Soc. C. E., is principal assistant engineer; Mr. Edwin Duryea, Jr., M. Am. Soc. C. E., is resident engineer in charge at the Brooklyn end, and Messrs.

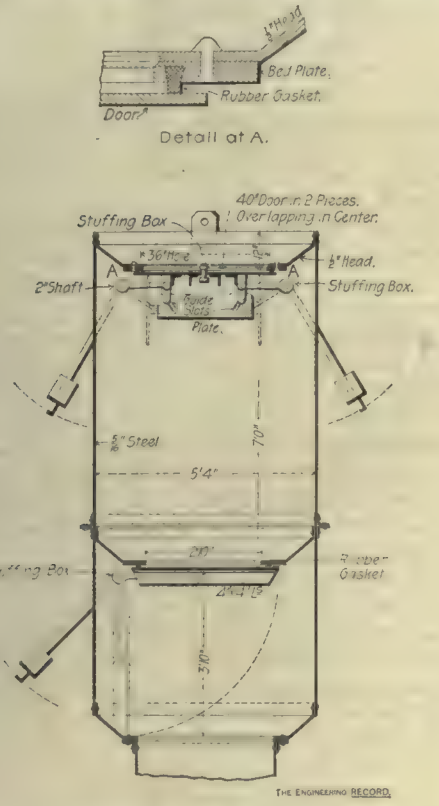


FIGURE 5.—MATERIAL LOCK.

F. L. Pruyn, C. E., and O. F. Kelly, C. E., are his assistants on the caissons. The contracts for the anchorage and foundation work are let to the Degnon-McLean Construction Co., of New York, Mr. A. A. Stuart, M. Am. Soc. C. E., chief engineer; Mr. W. O. Porter, general superintendent, and Mr. James E. Taber, superintendent of compressed air work.

THE COVINGTON AND CINCINNATI SUSPENSION BRIDGE.

Continuing from the issue of September 10 and November 26 the description of the Covington and Cincinnati suspension bridge, reference may be made to typical and special details characteristic of the connections throughout the stiffening trusses, and of their principal features, as shown in the accompanying Figures 16 and 17, and in Figure 8, page 315, Volume xxxviii. In Figures 16 and 17 the elevations are condensed and intermediate portions are omitted to save space, and in both cases the plans and transverse elevations are symmetrical about their center lines. The ends of the side elevation of the floor beam are omitted in the transverse elevations of both Figures 16 and 17, and the portions omitted are exactly the same as the corresponding elevations in Figure 8. A general view of the suspended structure of alternate panels is given in Figure 16. The adjacent panel points are similar except that the transverse top lateral strut and its four curved knee braces in the vertical and horizontal planes are omitted.

The slip joint in the center panel of the stiffening truss is shown in Figure 17. It was required to preserve the vertical and lateral continuity of the trusses and transmit all strains through them at this point, and yet provide for temperature variations in length at this point. This was accomplished by virtually making the two trusses four sides of a rectangular tube in this panel. The tube was practically in two sections, with a foot clearance between adjacent ends, and longitudinal members, A A, like sliding bolts, were fixed to one side, extended from it across the open space, and moved freely back and forth in rectangular cases, B B, etc., made in the other tube to receive them. Two transverse vertical and horizontal struts, S S, etc., were put in the center panel of each truss and in the horizontal plane of their top chords, and these, with the six intersecting longitudinal horizontal boxes B B, for the sliding connections, subdivided the three original panels into 27 sub-panels, each of which is braced with a pair of stiff riveted diagonal angles. The top and bottom chords themselves served as four of the boxes B, and the remaining six were made with similar cross-sections, except that their cover plates were very wide and extended beyond the flange angles. Channels and angles were riveted inside these boxes at one end of the tube, back to back with the web and flange plates, and extended inside the boxes of the adjacent tube, where they fitted closely and moved freely. The lower half of the main truss corresponds essentially to the upper half, and is therefore omitted in side elevation.

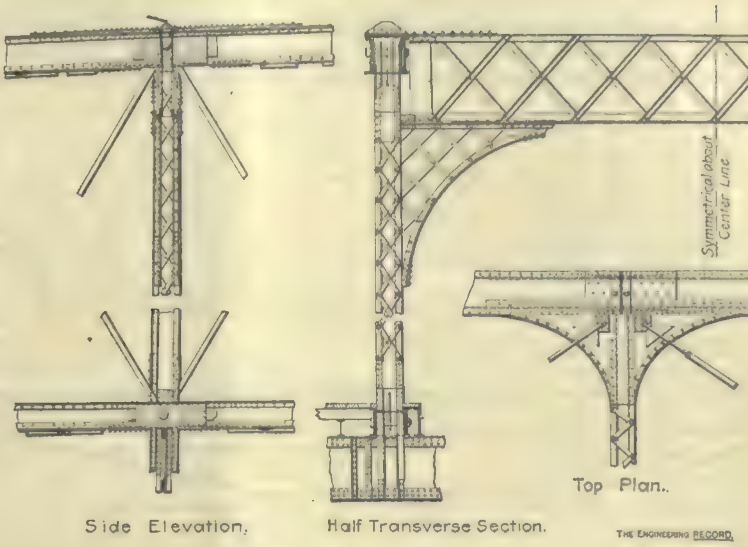


FIGURE 16.—CONNECTIONS OF THE STIFFENING TRUSS.

The work of erection of the bridge proper was begun by suspending from the cables the new floorbeams, which are 15 feet center to center. The permanent suspenders were used as far as possible for suspending these beams, but toward the center of the span temporary suspenders were provided. The attachment of the floorbeams in every case to the suspenders, however, was temporary, as it had to be shifted after the new stiffening trusses were erected. The floorbeams were lifted from a barge in the river below by balance beams projecting from and in front of the suspended traveler, Figure 18. As the floorbeams were put in place the 9-inch I-beams forming the sidewalk stringers were bolted on top of them at each end, thus making a track for the two trucks that carried the traveler and its platform underneath the old bridge and new floor. One sidewalk was abandoned, and the new stringers, etc., were run out on this abandoned walk, lowered upon the working platform, and put in place between the floorbeams panel by panel. As each panel of floor was in this way completed, the 7-inch I-beams forming the floorbeams of the old bridge were wedged up on the new longitudinal stringers, thus transferring the floor loads from the old suspenders to the new temporary suspenders which had been provided. The 7-inch floorbeams were left permanently in the new structure, and new 7-inch beams introduced between each of the old ones, thus making cross floorbeams on top of the longitudinal stringers 2½ feet from center to center, upon which was laid the floor-planking, girder rails, etc. After the floor system was hung from temporary suspenders and in place complete, as described above, the old suspenders were slacked off and the cables allowed to spread out to about their permanent position in the new structure, so that the new stiffening trusses, which are about 31 feet centers, could be erected in their final position between the cables.

During erection the stiffening trusses were supported on the floorbeams at each panel point

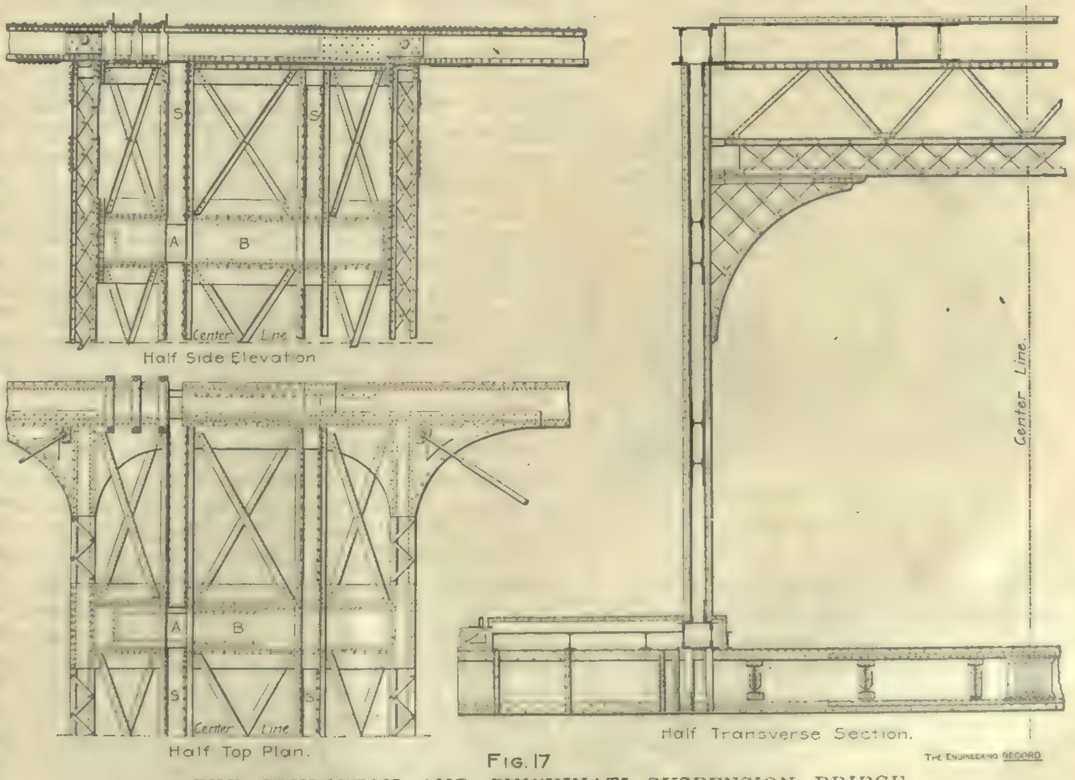


Fig. 17

THE COVINGTON AND CINCINNATI SUSPENSION BRIDGE.

WILLIAM HILDENBRAND, COVINGTON, KY., ENGINEER.

and the material put in place by two boom derricks, built about as shown by Figure 19, running on the top chord of the stiffening trusses and working out from both sides of the river simultaneously. When the new trusses were completed and the floorbeams pulled up to their proper position with relation to the stiffening trusses and the connections bolted, the old stiffening trusses were removed. After this the floorbeams were attached permanently to the suspenders, the new floor-planking laid, etc.

The same traveler was used for erecting the suspended superstructure and the viaduct approaches. It was proportioned for a live load of 30,000 pounds at the end of each boom, for a working strain of 45,000 pounds in each mast and of 47,800 pounds tension in each stiff leg. A four-spool hoisting engine, boiler, coal and water supply were carried on the platform at the rear of the traveler. Two travelers were used, one on each end of the bridge. In the plan, Figure 19, only one-half is drawn, as the figure is symmetrical about the center line.

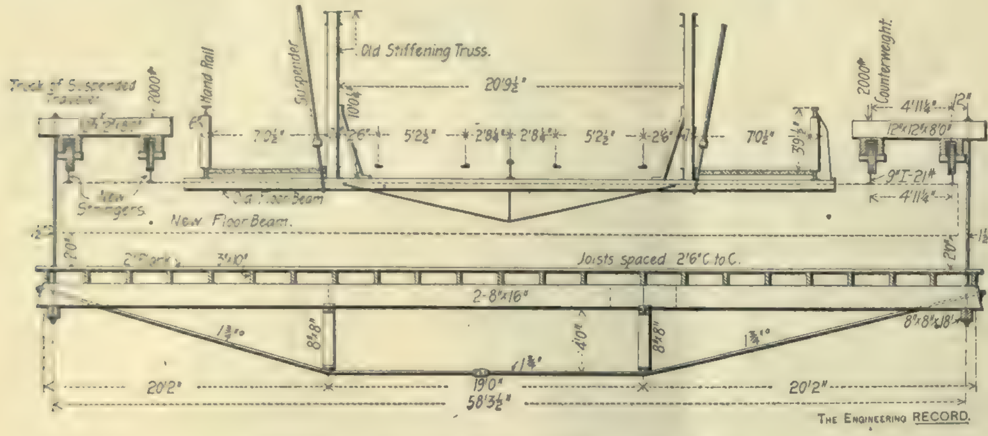


FIGURE 18.—METHOD OF ERECTING FLOOR BEAMS.

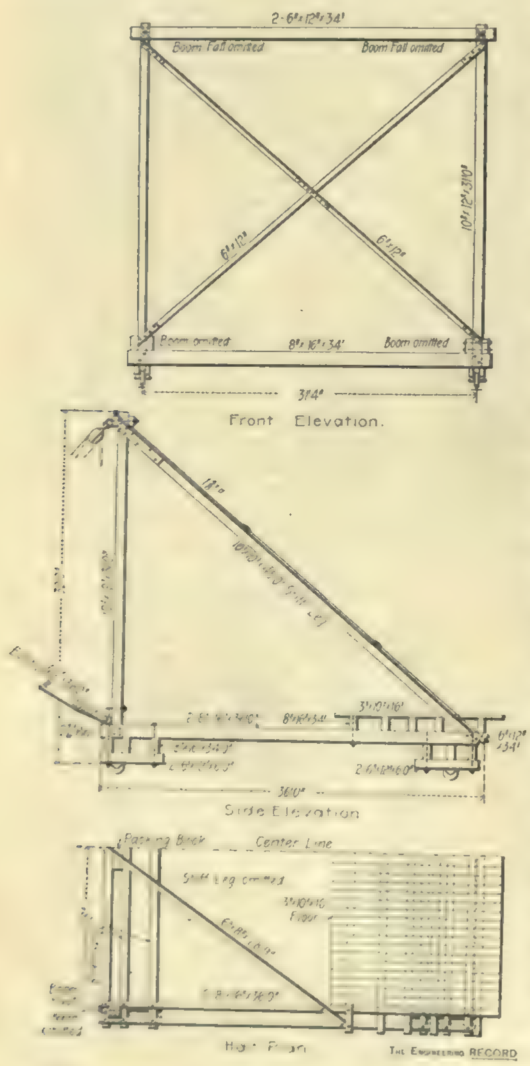


FIGURE 19.—TRAVELERS.

This bridge is crowded with street-cars, teams and pedestrians at almost all hours of the day, and the erection of the new floor system and stiffening trusses was done without interruption to traffic or without any one being hurt.

THE FLOW OF GROUND WATER.

The flow of ground water, or the underflow, as it is called west of the Mississippi, has been investigated for several years by Mr. H. V. Hinckley, M. Am. Soc. C. E., and at the twenty-fifth annual meeting of the Kansas State Board of Agriculture he described a number of the interesting results of his laboratory and field tests. The subject is an important one for both water-works and irrigation engineers, because the most reliable supply on the great plains, according to Mr. Hinckley, is afforded by the slow but reliable underflow, which can be drawn on when the Kansas, Arkansas, Rio Grande and other rivers of the country are apparently dry. The general conclusions drawn by this engineer from his studies are the following:

The only source of the underflow is the rainfall, though geological conditions may be such that rainfall in one drainage basin furnishes underflow in another. The bed of a mountain stream may have a continuous underflow from mountains to ocean; but the water that starts in the underflow at the mountains seldom traverses the entire distance to the ocean, generally reaching the surface of the stream by gravity, and then being evaporated, often at the rate of several inches per day when the river bed appears to be dry. Underflow of the same level as the stream water, or nearly so, is limited to the width of the valley proper usually, but not always, depending upon geological features. In general, the surface of the underflow tends to follow the ground surface, being higher, but at greater depths and more limited in volume under the divides, and sloping toward the rivers. If the water-bearing material in the valley bottom is not much coarser than that back from the river, the slope of the underflow may extend to the river. In Western Kansas, slopes in sand of 30 feet per mile (and possibly much more) extend to the river banks, while in valleys underlaid with coarse gravels the transverse sections of the valley proper usually show a level, or nearly level, water surface. The amount of water in saturated sands and gravels ranges from less than 20 to more than 40 per cent., the theoretical maximum percentage held between spherical grains being 48. The percentage volume of water depends mostly upon the uniformity of coarseness of material. Fine sand, if free from silt, contains the same percentage of water as coarse sand, or even coarse gravel, the general shape of the grains being the same. Very fine and silted sands and clays hold high percentages of water, but do not readily give it up or pass it along. A coarse gravel holding 40 per cent. of water may be so mixed with finer gravel and sands as to contain only 20 per cent. of water. The percentages of water that may be drawn off by gravity or by pumping from the sands or gravel are not proportional to the percentages held in them. The coarser the material the greater the percentage drainable, because fewer grains give less area of capillary surface; but a portion is invariably held back from the flow by capillarity. The greater the uniformity of sizes of grains or pebbles the greater the percentage drainable, and the coarser and more uniform the material the greater the drainage speed. In a given material the speeds of flow vary with the slopes in feet per mile, but not in arithmetical proportion therewith.

The flow in coarse gravel with a slope of 50 feet per mile, for example, is several hundred times the flow in a medium fine sand with a slope of five feet per mile.

Some streams, dry most of the year in the upper part of their course, become perennial further down from the constant underflow from the highlands; one stream, for example, in Western Kansas, flowing in sand and falling 13 feet per mile, was receiving last winter from the underflow, after a very dry year, 26 cubic feet per second in a distance of six miles. Sands and soils above the saturated water level are wet by capillarity, and when a well borer brings up wet sand he has not necessarily reached the water surface by several feet. The height of the capillary wetting depends upon the fineness and uniformity of the sand, but has no effect upon the flow of the water in the saturated sands and gravels below.

NOTES.

George Washington's Surveying Experiences were trying at times, as will be seen from the following quotation from one of his letters, reproduced by Mr. Ford in his "True George Washington." It describes his method of life during one trip while official surveyor of Culpepper County, an appointment he received in 1749, when 17 years old: "[Since] October Last I have not sleep'd above three Nights or four in a bed but after Walking a good deal all the Day lay down before the fire upon a little Hay Straw Fodder or bearskin whichever is to be had with Man Wife and Children like a Parcel of Dogs or Catts & happy's he that gets the Birth nearest the fire there's nothing would make it pass of tolerably but a good Reward a Dubbleloon is my constant gain every Day that the Weather will permit my going out and some time Six Pistoles the coldness of the Weather will not allow my making a long stay as the Lodging is rather too cold for the time of the Year I have never had my Cloths of but lay and sleep in them like a Negro except the few Nights I have lay'n in Frederick Town."

A Test of a Pumping Engine of 10,000,000 gallons capacity, built by the E. P. Allis Company for the city of St. Paul, Minn., was recently made by the Robert W. Hunt Company of Chicago, and a duty of over 144,000,000 foot pounds of work per 1,000 pounds of steam supplied to the engine was realized, thus earning a bonus for the builders of $6,000 for exceeding the duty guaranteed, which was 130,000,000 foot pounds. The cylinders of the engine are 21½, 38 and 56 inches in diameter, the three water plungers 24¾ inches in diameter, all with a stroke of 42 inches. The test was of 72 hours' duration, and from a report furnished by City Engineer L. W. Rundlett the following data have been taken:

Steam pressure, lbs.	128.
Average first receiver press. by gauge, lbs.	31.8
Average second receiver press. by gauge, lbs.	.28
Average vacuum by gauge, lbs. absolute	12.83
Total head on pumps, feet	146.586
Average rev. per minute	27.
Actual water pumped for 24 hours, gals. (by weir)	10,159,000.
Loss by slip and leakage, per cent.	.44
Total dry steam supplied to engine, lbs.	258,045.
Duty per 1,000 pounds steam	144,463,000.

THE EFFECT OF FROST ON PORTLAND CEMENT.

A number of experiments were made some time ago at the cold storage establishment of the corporation of Manchester, England, to determine the effect of frost on the strength of Portland cement. The results have just been published by the Institution of Civil Engineers in the form of a paper by Mr. Charles H. Godfrey, from which the following information has been compiled.

The cement used in the tests took its initial set in 30 minutes and its permanent set in 2 hours 10 minutes, in a room at 60 degrees Fahrenheit. Its mean tensile strength, after setting for six hours in air at the same temperature and afterward remaining in water for 6, 14 and 28 days, was 440, 504 and 513 pounds per square inch for these respective periods of immersion. The residue on a sieve having 75 meshes per linear inch averaged 5¼ per cent. by weight. Mixed with two parts by measure of sand, its average strength was 159 pounds at one month and 200 pounds at two months. After an exposure for one hour to moist air at 100 degrees Fahrenheit and then an immersion for 48 hours in water at 110 degrees, it showed no signs of blowing. Its weight was 97 pounds per cubic foot and its specific gravity 3.12. The chemical analysis was as follows: Silica, 23.20; sand, 0.55; lime, 58.91; magnesia, 0.68; iron oxide, 4.20; almuina, 8.90; sulphuric acid, 1.40; water and carbonic acid, 1.70; alkaline oxides, 0.46.

For the first set of experiments, rooms were available in which constant temperatures of 32, 29, 25, 18, 15 and 10 degrees Fahrenheit were maintained. In each room six briquettes were mixed, using 22½ per cent. by weight of water which had been brought to the temperature of the room and kept in motion to prevent freezing. The cement was agitated rapidly in an Adies mixer, subsequently turned over with a trowel on a slate slab, and placed in brass molds on a brass slab as quickly as possible. Little difficulty was experienced in working it except at temperatures below 18 degrees Fahrenheit, when the surplus cement from the mixing became stiff. In each case a small pat of the cement, about a quarter of an inch thick, was spread on a small glass plate.

After three hours the briquettes at temperatures of 10 and 15 degrees were quite hard, and "frost flowers" appeared on the surfaces, without any actual crystallization on the cement itself. At 18 degrees the briquettes had become fairly hard and could not be marked with the thumb nail. At 25 degrees the cement was stiff, and at 32 degrees it was perfectly plastic, with moisture in the molds.

After standing 24 hours, the samples in the 32-degree room were hard, and a chip broken from the pat became plastic, but not granular, when breathed on and kept in the warm hand. The samples at 29 degrees were hard; a chip crumbled when held in the hand, and became a moist powder which could easily be worked to a pasty consistency. The 25-degree samples were hard, and, when warmed in the hand and breathed on, became brittle, were easily pulverized by the fingers, and nearly dry. In the 18-degree room the samples had the same characteristics, except that more moisture appeared to be present. At 15 and 10 degrees the briquettes were very hard, and a chip from each pat seemed damp when pulverized.

After remaining three days at these various temperatures, three of each set of briquettes were tested in the cold rooms. The molds adhered tightly to the brass plates in all cases, and, at the lowest temperatures, could be detached only by sharp strokes on the plate with a mallet. The briquettes were perfect in form, with sharp and well-defined angles, but those made at the three higher temperatures were of indifferent character. The briquettes in the 32-degree room were somewhat stratified, and a skin about a sixteenth of an inch thick was formed over the surface of each, which was easily scaled off after the breaking tests were made. The average strength in pounds per square inch, determined by breaking three briquettes in each of the rooms by means of a Bailey compound-lever shot-filling machine, run so as to apply the load at the rate of 10 pounds a second, was as follows:

Temp.	32	29	25	18	15	10
Strength	190	189	108	140	203	280

The fractured surface at the three higher temperatures was fairly smooth and differed little from that of an ordinary test; the others were very granular.

The next set of experiments was made with the three three-day briquettes remaining in each room after the others were broken as just described. They were removed to a room at 60 degrees temperature, where they showed no other external change than a lighter color, due to the disappearance of the frozen mortar in the pores. After thawing thus for three days they were tested; the average of the three briquettes from each room was as follows:

Temp.	32	29	25	18	15	10
Strength	382	194	142	263	232	147

The fractures of the different briquettes varied widely in their appearance. Those having the smoothest fracture showed the highest tensile strength, and the strength decreased as the grain became coarser, so that Mr. Godfrey considers it improbable cement of a texture like that frozen at 25 degrees ever regains its full strength.

For the third set of experiments a number of briquettes were mixed at a temperature of 40 degrees. Three were placed immediately in a room at 19 degrees, three were placed there 5 minutes later, three 10 minutes later, and at various intervals up to an hour after mixing. They were kept for three days at this temperature and then allowed to thaw out for three days in a room at 60 degrees. The average strength of the briquettes of different times of setting before freezing was as follows:

Set, minutes	0	5	10	15	20	30	60
Strength, lbs.	90	118	138	157	168	195	249

The fractured surfaces showed the same characteristics as those of the briquettes employed in the second series of tests.

The fourth set of experiments was made to determine the truth or falsity of the common statement that Portland cement which has partially set and then been disturbed will not again set. Mr. Godfrey pulverized cement which had been mixed with water and placed in a room at 10 degrees Fahrenheit for three days, passed the powder through a sieve with 400 meshes per square inch, and again mixed it into a paste with the addition of warm water. The briquettes so made set quite hard, both under water and in air, at 60 degrees Fahrenheit, and after three days developed a tensile strength of 120 and 100 pounds respectively. A similar procedure was followed with cement which had been frozen under the same conditions and subsequently thawed for three days at 60 degrees, but though a slight cohesion was perceptible, the material crumbled to a powder and appeared to have lost all its cementing properties.

A batch of cement was mixed at the same time and under the same conditions as that for the third series of experiments, and, after setting for various periods, was kept at 19 degrees for three days, ground to pass a sieve with 400 meshes per square inch, remixed with warm water, and subsequently immersed for six days in water at 60 degrees. The results were as follows:

Set, minutes	0	5	10	15	20	30	60
Strength, lbs.	112	123	94	93	95	97	120

Three samples of cement, prepared by different methods, were examined to ascertain whether any chemical difference could be detected in them after six weeks. The first was allowed to set in air at 60 degrees; the second was mixed and set in air at 25 degrees for three days and then thawed in air at 60 degrees for the same time; the third was mixed and frozen at 10 degrees for three days and remixed at 60 degrees. On scraping portions from the samples for analysis, it was found that the first was hard, the second fairly hard, and the third soft. These portions were treated with an alcoholic solution of ammonium chloride, which showed that the least chemical change had taken place in the second case, although the differences were not very striking.

The conclusions drawn by Mr. Godfrey from these experiments read as follows:

"That frost has a deleterious effect on Portland cement.

"That though cement may, immediately after frost, appear to be seriously damaged, it will improve with time, though it is not probable that it will ever regain its original strength.

"That frost only partially suspends chemical action in the setting of cement.

"That the strength of cement may be expected to suffer most if frozen immediately or soon after mixing, but that the ill effects will be diminished with the amount of set previously attained.

"That liability to damage by frost decreases with the amount of water remaining in the cement.

"That a relation exists between the original tensile strength and the amount of suspended chemical action capable of producing tensile strength."

No experiments were made to determine the effect of frost on lime, but Mr. Godfrey states that in Norway unslaked lime is used for mortar, the quantity being increased as the thermometer falls; only a small quantity is prepared at one time. The theory is that the mortar sets before it cools, for the quicker the setting the less the risk of damage. The author refers to a case in Christiania, when five courses of a wall laid at a temperature of 2 degrees had to be pulled down two or three days later, owing to a mistake made by the contractor. When the wall was attacked with crowbars the mortar proved harder than the bricks.

NOTES.

The Budget for 1899 for Greater New York, as prepared by the Board of Estimate and Apportionment, amounts to $93,520,000; more than the United States spent in 1897 on its army, navy and Indian bureau.

Storage Tanks on the line of a trunk sewer for several townships in New Jersey are proposed in a report by Mr. Alexander Potter, Assoc. M. Am. Soc. C. E. Their purpose is to regulate the flow through the sewer and thus allow its size to be reduced to the minimum. The plan is stated to double the rated capacity of the outfall at about a quarter of the cost of duplicating it. Mr. Potter states that an examination of two years' gaugings of a trunk sewer in Boston showed, after allowing for ground and storm water, that the ratio in the rates of greatest and least flow was two to one. The report also contains an interesting review of various methods of assessing the cost of the sewer on the towns it is to drain, and advocates the following plan: "The apportionment recommended will be based upon the amount of sewerage contributed by the possible ultimate population of each district or municipality, determined by a detailed examination of the physical characteristics and environments of the various municipalities, and a study of the water supply of each. Further, that the absolute rights shall be granted each municipality or district to own, control and dispose of so much of the cubical capacity of the outlet sewer as is proportionate to the percentage of the total cost of the joint outlet which is borne by each municipality or district."

HIGHWAY BRIDGE BUILDING.

[By Albert W. Buel.]

The question of highway bridges having come up again, it may be profitable to inquire what it involves, to seek the cause of abuses that exist, and, if possible, a rational remedy. It is a complex problem of economics, morals and engineering, with economics the chief factor. Much has been said to discredit the highway bridge contractor and agent, but they are not inferior to men in any other line of business, and, like other men, they are conducting their business to meet the conditions which they find, but cannot change. Their business methods are only the "effect defective," and we must look further for the cause and remedy. If, at the same time, we note some of the faults in other lines of construction work, the highway bridge business will not have to bear all of the odious part of the comparison, and will not seem so black as it has been painted.

The complaints most generally heard are that the structures are too light, that competition is not free, and therefore the contractor's profits are extortionate; that improper influences are used with officials who have charge of awarding contracts; and that they are poorly designed by incompetent persons in the employ of the contractor, without proper engineering supervision or specifications on the part of the purchaser. That faults along these lines exist to some extent is true, but the same is true of any other business. Any fair-minded man who will look into it thoroughly will admit that they are not the general rule, but rather the exception, as they are in most other branches of industry.

Highway bridges are often built light, but usually as heavy as the community is able to pay for. They seldom fail under the loads which they were contracted to carry. I once heard an eminent engineer and builder of highway bridges describe how he had designed a very light bridge to bring it within the means of a certain poor community, and that, while the bridge bore the traffic for many years without accident, fatalities occurred annually for several years preceding the building of the bridge, to persons fording the river. If heavier loads are introduced into a section before the community can afford to replace the older and lighter bridges, a sign on the bridge stating its capacity, with a warning, should be a sufficient safeguard.

That bridges built 15 years ago were not proportioned for trolley lines and road rollers is not a fault. It would have been an economic fault in many cases if they had been, and in some cases financially impracticable. To state that many highway bridges are overloaded, due to the introduction of heavier loads, is only to state what is true on many railways. A few years ago the writer made an examination of some iron railway bridges and found stresses from actual loads occurring twelve to twenty times a day of from 18,000 to 22,500 pounds per square inch. About the same time an examination of some highway bridges in a certain county showed that they were subjected to about the same stresses, but the railway bridges were overloaded as often every day as the highway bridges would be in a year. Here it may be interesting to note that in one panel of one of these highway bridges were found three broken wooden joists. That they had not been discovered and renewed before is a question of maintenance, for which neither the designer nor builder was responsible. It is sufficient to suggest that these broken joists were inviting an accident, with possible fatalities, and the destruction of the entire bridge, from the wreck of which it might not have been easy to locate the cause. How many of the highway bridge accidents have been caused by broken or rotten joists? Since the reduction in the cost of steel beams, wooden joists have become almost obsolete, and the safety of highway bridges correspondingly increased. Nevertheless, for heavy concentrated loads the floor system is the vulnerable point in most bridges. Many railway bridges have had their floor systems reinforced for the increased loads and are now doing good service.

The trusses of most of the more recent highway bridges are sufficiently heavy to carry any highway loads, including electric cars. In some cases a few such members, as suspenders and counters, may require to be reinforced, but in the majority of cases it will be found sufficient to reinforce the floor system, which is usually a simple problem. From a list of over 300 bridges built during the past five years, which may be taken as a fair average of the current practice, I find that the live loads for which the structures were proportioned were as follows:

13 per cent., 2,000 pounds or over per lineal foot.
27 per cent., 1,600 pounds or over per lineal foot.
52 per cent., 1,400 pounds or over per lineal foot.
75 per cent., 1,200 pounds or over per lineal foot.
99 per cent., 1,000 pounds or over per lineal foot.
Only 1 per cent. for a load less than 1,000 pounds per lineal foot.

I also find from the same list that the live load proportioning may be stated as follows:

59 per cent., 100 pounds or over per square foot.
81 per cent., 80 pounds or over per square foot.
95 per cent., 70 pounds or over per square foot.

Only 5 per cent. were proportioned for a load of less than 70 pounds per square foot.

A live load of 1,000 pounds per foot of track is sufficient to provide for any electric line that is likely to be laid in a highway, and, on the basis of these 300 bridges, 75 per cent. are proportioned for 1,200 pounds per lineal foot, or about 85 pounds per square foot, with 14-foot roadway. Since a 14-foot roadway will not accommodate a double track. It is shown that the trusses of 75 per cent. of these bridges are safe to carry electric cars. If electric car lines run over these without reinforcing the floor systems when necessary, or run over the other 25 per cent. at all, it would seem to be the electric railway companies who are at fault, but certainly not the builders of the highway bridges.

The construction work done by electric railway companies is often much worse than anything in highway bridge work that has yet come to my notice. One of these companies had occasion to build a considerable bridge on their own right of way, and the engineer, who was a county surveyor who lived on the line of the road, drew up a specification of about 100 to 200 words, specifying a heavy loading, but giving no unit stresses or anything else. Both the president and general manager of the company declined the services of several experts and invited proposals. The general manager, who knew nothing about a bridge, asked one of the bidders to revise his plans and make it lighter and cheaper. He was informed that it was light enough as submitted, to which he replied that he did not care, that he was "building the road to sell," and "if you want this job cut it down." This bidder reduced his sections, got the contract and built the bridge with almost exactly one-half of the metal called for by the plans submitted with three other proposals, which were as light as any reputable party would want to build. The bridge fell down before it was a year old, leaving a list of killed and injured. No highway bridge accident yet reported is as unpardonable as this, yet no one was punished, because the prosecution was shifted upon a subordinate, who could not be held responsible.

Another electric road built a wooden trestle 30 to 40 feet high, bents 14 feet center to center, with one vertical and two battered posts 6 inches square; caps, one, 6 inches square; stringers, two, 3x12 inches, under each rail; ties, 4x6 inches, spaced about 30 inches center to center, and very little bracing, on which comment is unnecessary.

It is well known that many buildings have been built too light, and a number of them have collapsed. The earlier steel vessels built at the lake shipyards were built too light in some cases, and one of them broke in two in mid-lake during a storm. The same story runs through the accounts of all construction work, and the record of highway bridges is at least as good as that of any other class of structures.

Competition in highway bridge contracting is as free as it can be and leave a margin for the contractor to exist on. The average profits of the concerns in this line have been so small that only those with the best management have shown satisfactory results, while those with indifferent management have gone to the wall. Only a few have made comfortable fortunes and none has amassed great fortunes.

Competition has occasionally been subjected to a certain amount of control, but the total of the business would probably have shown a loss if it had been otherwise, since the productive capacity exceeds the demand. Competition is not strictly free all of the time in other lines, and in architectural and railway work it is often closely restricted. In railway bridge work a sort of territorial protection or reciprocity is very common, and the results show many good points to commend the practice. It may be profitable to inquire if there is any safe way to attain them in the highway bridge business. Railway officials often award contracts "for the good of the company," irrespective of the lowest responsible bid. This practice is conducive of much good and very little abuse when used by corporations and individuals, but its application to public works would be to invite corruption. It is generally prohibited by law, and should be so, but some of its advantages may be attained by very different means.

From the same list of 300 bridges I find that the spans were as follows:

80 per cent. between 30 and 100 feet.
90 per cent. under 100 feet.
65 per cent. under 60 feet.

The capital required to install and operate a shop for building highway spans of less than 100 feet is comparatively small, and there are plenty of men available who know the business. These conditions alone are sufficient to guarantee all the competition that the business will stand. But besides these there is the scalper, or highway bridge contractor, who buys his manufactured metal from any structural shop, sublets the erection and scalps a small profit. He does not require over $5,000 to $10,000 capital; he has no shop, often nothing but an office, and in dull times he has a positive advantage over the contractor who has a large manufacturing plant.

There are often as many as fifteen bidders at the letting of a $1,000 bridge, and sometimes twenty bidders attend a desirable letting. An average of ten at an advertised letting would probably be a fair estimate. Out of ten bridge shops represented, there are too often one or more that are short of work and have instructed the agent to take the work at cost, if necessary, to keep the shop running, or there is in view some more desirable contract coming up next year in the same county, and, to get an inside track on it, some one bids at cost, and generally some one else gets the more desirable job. In the long run, estimated cost is less than actual cost, so the profits must be made up on some other job. The result is an unequal distribution of very small average profits. This is not in any way peculiar to the highway bridge business. It is this "other job," which carries the profits for three or four contracts, to which all the improper and immoral influences brought to bear on officials is due. I once remarked to a very successful highway bridge contractor that it seems almost impossible to get contracts without resorting to immoral means. He replied: "No profitable ones can be secured in straight competition."

But the contractor is simply meeting conditions when the price is demanded by the officials, as it has been in a number of cases,

In one case the officials auctioned off a $50,000 job for the highest "insult," after the bids had been opened; and a much larger piece of work could not be let to the lowest responsible bidder because there was nothing in it for some of the commissioners. One county commissioner demanded and received something like $4,500 for the award of a contract amounting to $80,000, and on which the contractor afterwards cleared only $3,000. He soon after asked for re-election, stating in his speeches that he had "spurned the offers of the bridge men and had broken up their pool." His audacity is shown by the fact that the contractor who broke the pool with a low bid had to give him 60 per cent. of a very moderate profit under the threat of having all bids rejected and the letting readvertised. These few incidents out of many are sufficient to indicate where some of the money goes when the "county is soaked." The people continue to elect these men to office, and probably will until public morals reach a higher plane, by way of the slow educational process. But competition or overproduction is responsible for a large part of these evils, or at least the aggravation of them.

Instead of highway bridges being poorly designed by incompetent persons, no other class of structures exists in which economic and scientific principles and general adaptation of design have been brought to so high a standard, and the details of design and construction are as good as the public is able to pay for. Once in a while attention is called to a bad design, but there are also railway bridges, buildings and other structures just as bad, but which manage to keep out of print until an accident happens. The Ashtabula, Tay, Moenchenstein and Bussey railway bridges alone are sufficient to balance the account of fatalities against the highway bridges, to which might be added quite a formidable list of buildings, some even in New York City.

The most frequent sources of poor design of highway bridges are due to the fact that the designer cannot visit the bridge site and has to work from incomplete, misleading and unintelligible data, or an agent, not trained in engineering or construction, selects some stock design for the situation. The latter may be called ready-made designs. The contractor, to secure the work, often has to yield points of design to the notions of conceited and ignorant officials, which also happens in other lines of construction. This is called designing to sell. One or two concerns still advocate cast details, because they are cheaper, enabling them to undersell a competitor who offers wrought details. Notwithstanding all these influences, poor designs are in the minority, and these are largely due to excessive competition, because the competition is largely for the lightest and cheapest design.

Consideration of merit of design is often neglected by officials, and, when conscientiously considered, they lack the necessary technical knowledge to arrive at correct conclusions. Even when they have an engineer the result is often but little improved. I know of three cases where the enginer's opinion was, to say the least, contrary to all precedent; in two other cases the board ignored the engineer's opinion, and in several the engineer either was too inexperienced in bridge work to express any opinion or considered it good policy to keep it to himself. Happily these cases are in the minority.

There is no doubt that if all bridges were built under the supervision of bridge experts with proper authority, much good would result; but it is doubtful if this can be accomplished by legislation, even with civil service appointments, if civil engineers are substituted for bridge experts. Certainly not as long as there are professors of engineering in colleges who instruct students to "get the contractor to design the work for you when you have a job you do not understand." A student of civil engineering in a well-known institution informed me that he had been so instructed.

With specifications embodied in the law, as has been advocated, the evils would only be multiplied. Legislating specifications is exemplified in the New York building laws, than which a more crude, unscientific and obsolete set of rules for designing can hardly be found anywhere. Specifications, as far as they relate to design, when carefully drawn and interpreted with intelligence and justice, are most desirable; but the material and workmanship covered by about 30 words will be just as good as if furnished under specifications of 3,000 words. The other 2,970 words very generally have little if any effect on the quality of the work. This is true of a good deal of railway and other work, as well as of highway bridge work, and is very nicely illustrated by the following incident:

A large and prominent railway company, the chief engineer of which is a man of national reputation, invited proposals for several hundred thousand dollars' worth of work. The specifications were most carefully and elaborately drawn after months of study. The work was let at a very low figure, and constructed without any regard whatever to the specifications. One of the unsuccessful bidders remarked on this to the engineer, and said: "If I had known you would be satisfied with this kind of work instead of that specified, it would have made a great difference in my bid," to which the engineer replied: "You ought to have known me better; this work is plenty good enough to serve its purpose, and the company is getting it very cheap. The specifications are only a safeguard for special cases."

The chief engineer and manager of a large bridge company remarked not long ago, when reminded that a certain requirement was explicitly called for by the specifications: "American engineers do not mean anything by their specifications." The engineer who thinks that specifications are made to carry out and that the spirit of a written contract should be lived up to as expressed on its face, will find all the trouble he wants, and he may consider himself lucky if he only has one side to contend with. On the other hand, if he passes imperfections that impair the work, not only the structure, but his own reputation, is in danger of collapse. The safe road for the engineer is indeed a narrow path.

One of the worst evils of this practice is its injustice to the contractors who bid according to specifications. It may be asked why any of them do; because, unless they know just what will be required, to do otherwise would be like playing a lottery. A few years ago tenders were asked for building a highway bridge according to a well-known specification. One contractor bid at about cost and broke the combination. The officials got tangled up and called in an engineer to report on the plans submitted. The contract was given to the low bidder, but the engineer caused him a 10 per cent. loss, not so much by a rigid adherence to the letter of the law as by interpreting an ambiguous clause against the contractor. This engineer did not further fair competition, but encouraged pooling, although he probably did not appreciate the tendency of his course, for he is a very well-known member of the profession.

Modern engineering can accomplish many things, but it is not able, unaided, to reform the highway bridge business. The really expensive part of the present system of highway bridge lettings is the cost of agents attending lettings and the preparation of plans. Often several plans are submitted with each proposal, sometimes half a dozen, and they are frequently quite elaborate. There is the salary, railroad fares and expenses of the agent, a part of the general expenses of the business, and the cost of preparing plans. These items will cost on the average not less than $15 for a small bridge, up to as many hundred dollars on a large structure. If there are ten companies represented, the total expense at $15 each will be $150, and will amount to as high as 30 per cent. of the cost of the smaller spans down to 15 per cent. for a span of 100 feet, which limit includes 90 per cent. of the lettings. But this rate is so much lower on large and heavy work that the average, pro rated on the tonnage, is only 10 or 15 per cent. of the total cost. Still any plan that will save nine-tenths of this, or say 10 per cent. of the total average cost of bridges, and at the same time reduce or eliminate the other evils of the business, should deserve consideration. Proposals are occasionally sent by mail, but they have generally been so unsuccessful, and so many interests oppose the practice, that there is no hope for improvement by this means.

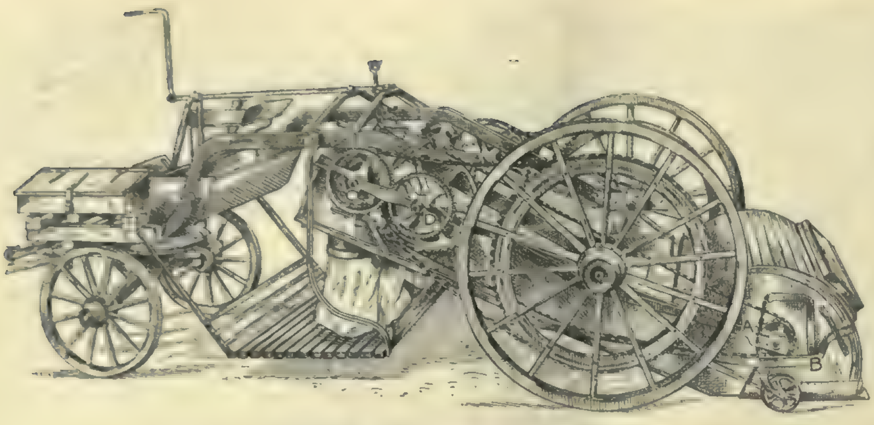
"To have each contractor submit a plan upon specifications furnished" cannot and does not make it "impossible for the agents to get together," but it does increase the cost of preparing plans, quite an amount when 20 or 30 plans are made for one structure, and which the county has to pay for in the end. Just the opposite method of asking a price per pound on detailed plans on file has given much more satisfactory results.

The well-meant and periodic efforts of numerous gentlemen and societies, intelligent and high minded, but not familiar with all the details of an intricate business, to apply legislation as a cure-all, is simply a Utopian scheme and sure to miscarry. These observations, and the failures of numerous agreements to restrict competition to materially benefit the contractors or ameliorate the existing evils, lead to the following conclusions:

Nothing but a combination or consolidation can reduce the expense of attending lettings and making a useless number of plans, as has already been indicated, effecting an average saving of 10 to 15 per cent. Since a bridge shop can turn its capital two or three times a year, this saving alone would amount to a profit of about 30 per cent. on the capital invested in the highway bridge business. By properly assigning to the several shops in the combination the territory naturally tributary to each, a further saving in the cost of charges for freight and erection could be effected. The railroad fare of the men sent to erect a small bridge is quite an item when they have to travel long distances on scattered work. These territorial divisions should not be inflexible, but the manager of the consolidation should assign work to the shops according to requirements and economy of execution. When to these items is added the saving in expense of management, it will be seen that there will be a profit in the business satisfactory to the most exacting, even if bridges are sold at present net cost figures.

In such a combination the smaller and weaker concerns would eventually be improved to the standard of the best, or else abandoned, according to demand and supply, by a purely economic process. Thus would be eliminated the chief source of poor design and workmanship. With the business in the hands of such a consolidated corporation, the influences encouraging corruption of officials would be almost entirely removed, for there would be no choice as to whom a contract should be awarded, and there would be no one who could underbid the combination and prevent it from naming a profitable price. At the same time the counties and municipalities would get their bridge work as cheap or cheaper than they do now, and also be sure of having a responsible contractor. An equitable distribution of the profits would result, each contract carrying its own profit and no others.

While the savings indicated above would no doubt yield profits enough to satisfy any corporation without any increase over present prices, extortion can be very easily guarded against. It is well known that, on equal terms, the American bridge builder can compete with



THE BROOKS STREET SWEEPER.

those of any other country. We have successfully competed in Mexico, South America, Australia and, I believe, in India, and in at least one case underbid all others on the continent of Europe. On the other hand, bridge work cannot be successfully imported in any appreciable amount, tariff or no tariff; for not only are our methods of manufacture cheaper, but the mass of detail involved is a handicap on the importer. Therefore, a reduction or even removal of the tariff on structural work would prevent extortion without injury to the domestic works. It should be noted that no combination short of an actual consolidation, with the structural mills a party to it if not the controlling factor, will have enough tenacity to hold together.

Finally, any law requiring the inspection of work during construction, or an annual examination of bridges, should require these duties to be performed by registered bridge experts, and the reports be published; it should prescribe the qualifications and methods of registration of said experts, somewhat similar to the law regulating pharmacists, and provide for the publication of the registration lists.

THE BROOKS STREET SWEEPER.

The Brooks street sweeper originated several years ago in a device patented by Mr. C. B. Brooks, Newark, N. J. He designed a machine having a revolving brush to sweep the dirt from the surface of a pavement against an endless carrier, by which it was lifted and discharged into three bags. Various additions were made to this early mechanism by another party, and it has recently developed into the form shown in the accompanying cut. The broom is placed in a case at the back of the sweeper. Its shaft is carried by the lever arm marked A in the cut. B is another lever pivoted under the body of the machine, and provided with an upright arm, from which a chain runs down to the lever A. Rollers are placed under the lever A, and by means of this combination the distance between the broom shaft and the pavement can be adjusted to take up any wear of the broom. The driving mechanism is evident from the cut. A sprocket wheel is attached to each main wheel of the sweeper, and drives the shaft C by means of link belts, and this in turn drives the shaft D by means of gear wheels. Shaft D carries a sprocket wheel, which is connected by a link belt to a small sprocket wheel on the shaft of the brush. At the right-hand end of shaft D there is a small sprocket wheel, which drives another shaft not shown in the cut, which projects inside the box that runs up from the brush casing at the rear of the sweeper. This small shaft drives three elevator chains within the box, which run from another shaft near the bottom of the casing. The sweepings are thrown by the brush on the chains, which carry them to the top of the box, where they fall into the bags shown in the illustration. The box containing the elevator chains is hung at its front end by links, so that it can be raised or lowered as may be desired. The shaft C has an ingenious friction clutch at each end, so arranged that in case the sweeper moves around a corner and one of the rear wheels moves more slowly than the other, the difference in the speed of the two link belts driving the shaft is rendered harmless by the slipping of the clutch at the end of the shaft corresponding to the inside wheel as the corner is turned. The sweeper is built by the Brooks Street Sweeper Manufacturing Company, Scranton, Pa.

THE SOUTH PARK CONSERVATORY, CHICAGO.

The South Park conservatory, Chicago, Ill., is a steel and glass structure about 417x58 feet in extreme dimensions and 31 feet in greatest height. It consists of a rectangular center pavilion about 81 by 28 feet and 31 feet high, and two rectangular end pavilions, each 62x52 feet, and connected by two structures 115 feet long and 39 feet wide on each side of the center pavilion, with their axes coincident. The connecting wings are architecturally considered as curtains, and their cross section resembles a pointed arch, the lower part of the walls being vertical, the rafters at the ridge being straight and the haunches curved. The pavilions are like groined domes, truncated, and the whole superstructure is of riveted steel, glazed on all its surfaces and supported on high foundation walls of dimension quarry stone. The conservatory is one of the largest in this country, and cost, complete, $40,000. It is heated by steam, and contains tropical trees and flowers, which are grown there or stored in the winter from the city parks.

The steel construction is simple and the principal numbers are as indicated by the plan diagram, Figure 1. The framework is essentially composed of rafters and purlins, the former made of riveted arch ribs and the latter of plain beams and channels. One of the curtain rafters, F, Figure 1, is shown in Figure 2. A pair of these rafters and their lower chord tie rod form an independent arch, symmetrical about the center line and spaced 7 feet 8 inches from the next one. The center pavilion hip rafters, D, Figure 1, are similar to the curtain rafters, except that they have no bottom chords and are made in three sections, having one splice shop-riveted and one splice field-riveted, as shown in Figure 3. The main rafters of the end pavilion, H H H, Figure 1, have two curved sections, like the ribs in Figures 2 and 3, connected by a horizontal top section field-riveted to them, as shown in Figure 4. All connections for purlins, etc., are made with bent plates riveted and bolted. The total weight of the steel structure was about 200,000 pounds, and an idea of its proportions and general appearance is given by Figure 5, which is made from a photograph taken before the glazing was begun. In erection, each arch rib or rafter was raised by a gin pole and hand windlass. The two ribs forming one arch were held by their gin poles until connected and braced to the assembled portion of the structure, and then the gin poles were moved one panel ahead to erect the next pair. Four pairs of ribs and corresponding members were erected in one day by a gang of 12 men. Each of the curtain ribs weighed about 1,000 pounds.

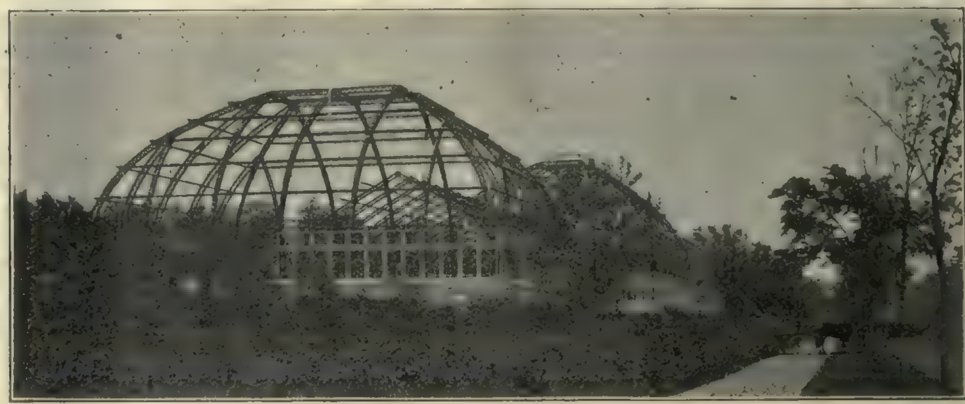
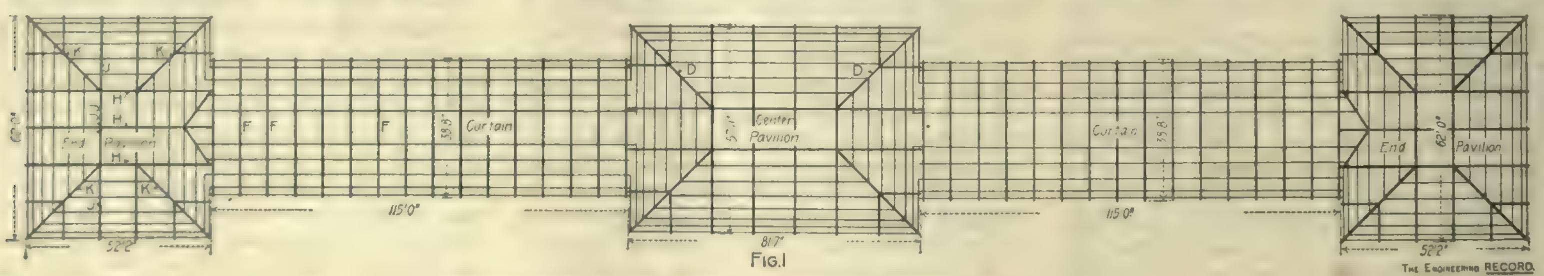


FIGURE 5.—SOUTH PARK CONSERVATORY, CHICAGO, ILL.



FRAMEWORK OF THE SOUTH PARK CONSERVATORY, CHICAGO, ILL.

The Lincoln Park conservatory was built in 1891, and inasmuch as the steel work is of a somewhat similar curved construction, it may be considered as a comparable design. It cost about three times as much per square foot of area covered as the work here described, which was built in 1897 for a contract price of $7,000. Mr. D. H. Burnham was the architect, and the steel work was designed and constructed by the Kenwood Bridge Company, Chicago, Mr. F. W. Barker, president, and Mr. Paul Willis, chief engineer. Mr. A. Motschman was the contractor for the masonry, and Messrs. Simmons & Co., all of Chicago, were the contractors for the heating apparatus.

LITTLE-KNOWN AMERICAN ORNAMENTAL STONES.

At the recent Washington convention of the American Institute of Architects, an interesting paper was presented by Mr. George P. Merrill, head curator of the department of geology at the United States National Museum, describing a number of little-known native ornamental stones useful for interior work which would doubtless be put on the market if architects called for them. The first was the so-called oriental alabaster, a carbonate of lime abundant throughout limestone caverns. The rock is usually removed from its bed by blasting, whereby it becomes more or less shattered, and is then cut into slabs and polished, in the expectation that it will be used for sheathing purposes and table tops. Walls thus sheathed are usually anything but beautiful, and the stone is of such a nature that surfaces of large size free from flaws are very rarely obtainable. The stone should be removed from its bed with the greatest care, to check the development of incipient fractures, and each block needs to be considered by itself with reference to its adaptability for a turned column, vase or slab. The so-called onyx marbles of the Western States and Mexico are of the same nature, and are so well known that Mr. Merrill mentioned them merely to call attention to their translucence when in thin sections, and to suggest the possibility of their use in place of highly colored glass.

Rosso antico, the antique porphyry which was such a favorite with the Romans, has a dense reddish base, studded thickly with small pinkish crystals of feldspar. A similar stone has been found in the West, although in a location which probably prohibits quarrying at present; but in the Franconia region of New Hampshire there is a deep, dull red porphyry breccia with spots of brighter hue and sometimes crystalline particles of feldspar. Hard and almost as indestructible as glass, Mr. Merrill considers it equally well adapted for exterior and interior work, and a beautiful stone for columns or pilasters. The old lava flows in Eastern Massachusetts yield a stone varying from brilliant red through brown and various shades of gray nearly to black, with occasional yellow mottling.

"In the Church of Our Saviour at Moscow," said Mr. Merrill, "the interior walls are sheathed to a height of perhaps 4 feet with a deep, dark gray, almost black, gabbro-like rock, variegated with most beautiful purplish iridescent spots. Above this, to the height of perhaps 6 feet, the walls are sheathed with a chocolate red quartzite. The rock is so dense and close that its exact mineral nature could be made out only with difficulty, but the effect, to my eye at least, was superb; and with this in mind I bring to your attention a block of quite similar quartzite from deposits near Courtland, in Nicollet County, Minn. It certainly merits a better use than that of the manufacture of paving stones, to which it is now exclusively applied."

Another Minnesota stone to which attention is drawn is the indurated mud or clay from Pipestone County. It is the catlinite, formerly used by the Sioux for the manufacture of ceremonial pipes, and now made into a variety of small objects. It is to be had in slabs of moderate size only, but its color is considered such as to render it worthy of more serious consideration than it has yet received.

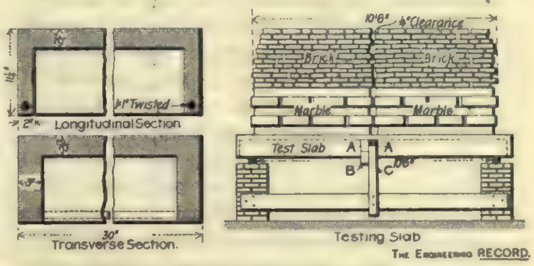
The so-called verd-antique marbles, so frequently used for interior decoration, are abundant in various parts of the United States, but the cost of working is such that the present supply is brought almost wholly from Italy. Many tons of this stone were wasted during the operation of the old chrome iron mines near the State line between Pennsylvania and Maryland, and no attempt has been made to put it to any practical use. When in thick masses it is not a stone of extraordinary beauty, but when cut sufficiently thin to allow the light to pass through it is more worthy of consideration.

Two unused granites were also mentioned as deserving attention from architects. The first is from Madison County, Va., and its colors, a light green ground spotted with light pink feldspar, make it of interest. The second is pegmatite, a graphitic granite, which works as readily and safely as ordinary granite, and was stated to be probably useful in many forms of interior decoration.

TEST OF A REINFORCED CONCRETE BEAM.

A test of a double webbed concrete beam with a twisted iron tension reinforcement was made October 29 and 30, 1897, at White's marble yard, Cincinnati, O., by Mr. E. L. Ransome, Assoc. Am. Soc. C. E., Chicago, to whom we are indebted for the data of conditions and results. The beam consisted, as shown by the accompanying details, of a slab of solid concrete 2½ inches thick by 30 inches wide, and about 11 or 12 feet long, with vertical webs around the four sides forming a bottomless box. A twisted iron rod 1 inch square was imbedded in the bottom of each side flange, and the beam was placed, flanges down, across two parallel supports 10½ feet apart. An index piece B was fastened to one side with a straight vertical edge exactly in the center, and adjacent to a gauge strip C, which was fixed to the abutment piers so as to settle with them, but not to be displaced by the bending of the floor. A horizontal line A A was then cut with a sharp knife across index and gauge blocks, so that as the beam deflected the relative displacement of the two sides of the cut would represent the deflection.

A load was then applied to the beam and was built up in two equal and symmetrical piles, each of which covered the full width of the beam and extended from just within the support at one end almost to the center line. The lower part of the piles was composed of marble slabs, each of which was weighed separately. Above these common brick were piled, and their weight determined by weighing some and counting the rest. The loads and corresponding deflections were carefully recorded as follows: 2,287 pounds load, 1/32 inch deflection; 3,562 pounds, ⅛ inch; 6,105 pounds, 3/16 inch; 3,203 pounds, ¼ inch; 10,470 pounds, ⅜ inch; 12,061 pounds, 7/16 inch; 14,033 pounds, ½ inch; 16,009 pounds, 9/16 inch; 17,930 pounds, ⅝ inch scant; 20,001 pounds, 11/16 inch. Here the test was stopped for the night, and when resumed the next morning the amounts were 20,001 pounds, ¾ inch scant; 22,001 pounds, ¾ inch full; 24,005 pounds, 13/16 inch; 26,000 pounds, 15/16 inch.

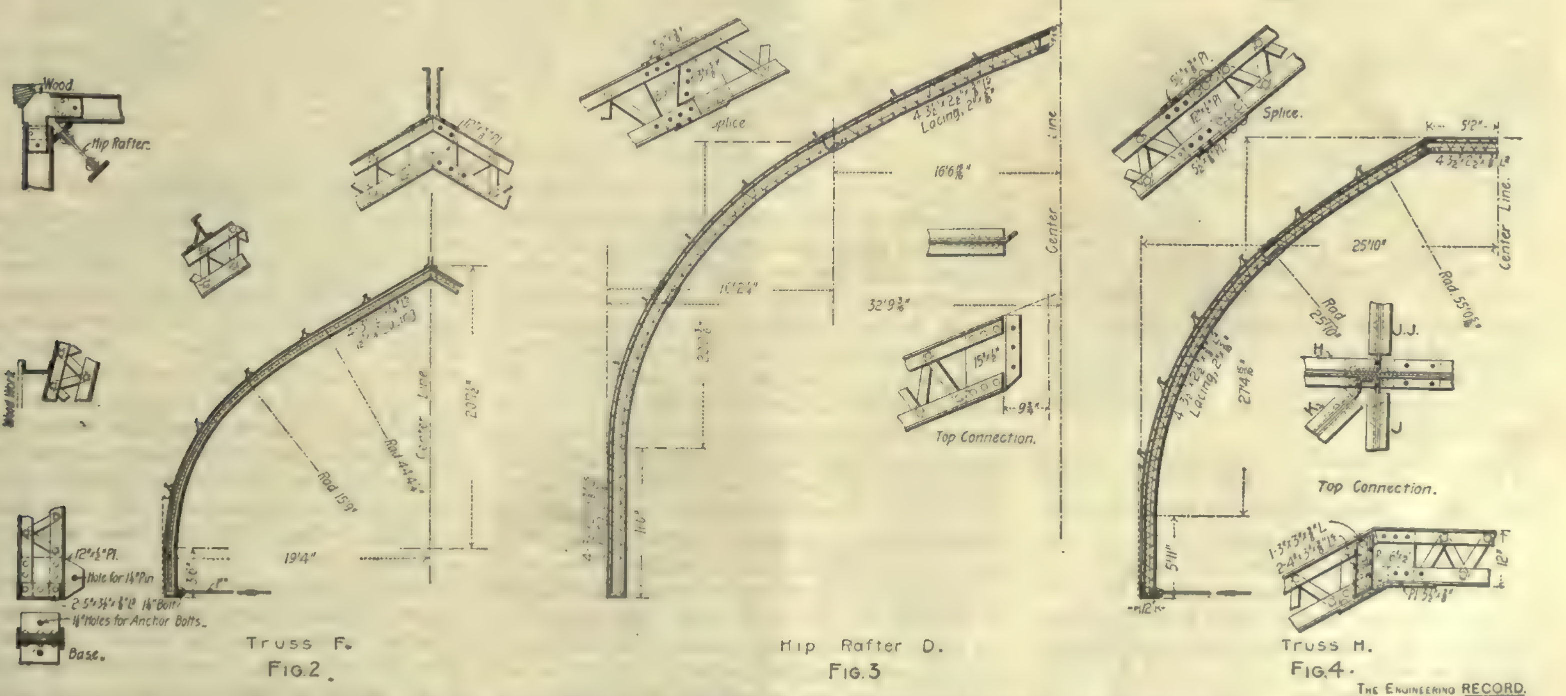


TEST OF REINFORCED CONCRETE BEAM.

At the conclusion of the test the beam was minutely and repeatedly examined without detecting any injury or signs of failure or any indication of even hair cracks. The load was removed quickly and the beam recovered more than half of its deflection, showing a permanent set of only ⅜ inch. The concrete had been made 11 months before the test, and was composed of one part Dyckerhoff Portland cement and 5 parts of selected gravel of sizes varying from sand to 1-inch pebbles. It was mixed by hand with a moderate quantity of water, and turned 12 times, making a plastic mass.

GASOLINE AND OIL ENGINES FOR PUMPS.

The application of gas, gasoline and oil engines to pumping machinery was the subject of a valuable paper presented recently to the New England Water-Works Association by



DETAILS OF CONSTRUCTION, SOUTH PARK CONSERVATORY, CHICAGO, ILL.
D. H. BURNHAM, ARCHITECT; KENWOOD BRIDGE COMPANY, CHICAGO, CONTRACTORS.

Mr. Freeman C. Coffin, M. Am. Soc. C. E., who has recently investigated the capabilities of these motors and made plans for several plants in which they are used. The paper and discussion will be printed in full in the association's "Journal," so only a review of a portion is presented here.

The first of the plants installed by Mr. Coffin was for the Cohasset, Mass., Water Company, to pump a small additional supply from driven wells. The conditions were such that the plant had to be put in with as little expense as possible. A Blake vertical triplex single-acting pump was selected, having plungers 6½ inches in diameter by 8 inches stroke, with a capacity of 150 gallons a minute at its normal rate of speed. The engine was a Hornsby-Akroyd oil engine, built by the De La Vergne Refrigerating Company, and was connected by a friction clutch with the pinion shaft of the pump.

The engine was guaranteed to develop at least 13 horse-power with a consumption of 1 pound of oil per horse-power per hour, the oil to be of 150 degrees test. The pump was guaranteed to give 70 per cent. efficiency. When the engine was tested alone with an absorption brake, it developed nearly 15 horse-power with 0.926 pounds of oil per horse-power per hour. The combined plant was then tested as nearly as possible under the same conditions, and it was found that 1.323 pounds of oil per horse-power per hour were required, these figures being based on the work actually done in raising the water.

This plant was started May 31, 1898, and stopped October 26. During this time it had been in operation 115 days, and had pumped 11,914,000 gallons. Deducting the amount of water used for cooling the cylinders of the engine, the effective pumpage was 11,741,000 gallons. The average lift was about 160 feet. The total amount of oil purchased was 1,745 gallons, and it was found that 6.5 pounds of oil measured 1 gallon. The attendance given this plant was limited to starting the engine in the morning, oiling at noon, as the oil cups were rather small, and shutting down at night; through the day the building was locked up. The cost of this plant erected, exclusive of building and foundations, was very nearly $1,500, including gauges, counters, etc.

The second plant was installed for the high pressure system of the Winchester, Mass., water-works. The pump if of the vertical triplex single-acting type, with 8½x12-inch plungers, and has a capacity of 350 gallons a minute. The engine is a 20-horse-power Hornsby-Akroyd oil engine. The results of the test of this plant was as follows:

Duration of test	5 hours.
Average head pumped against	142.6 feet.
Total number of revolutions	12,007
Revolutions per minute	40
Displacement per revolution	8.843 gallons.
Slip passed plungers, measured	20 gallons.
Net pumpage neglecting valve slip	106,163 gallons.
Total work	126,247,598 ft.-lbs.
Average power measured by water pumped	12.75 H.-P.
Total gallons, 150-degree test kerosene oil	10.876
Work done per gallon of oil	11,516,518 ft.-lbs.
Work done per pound of oil	1,771,772 ft.-lbs.

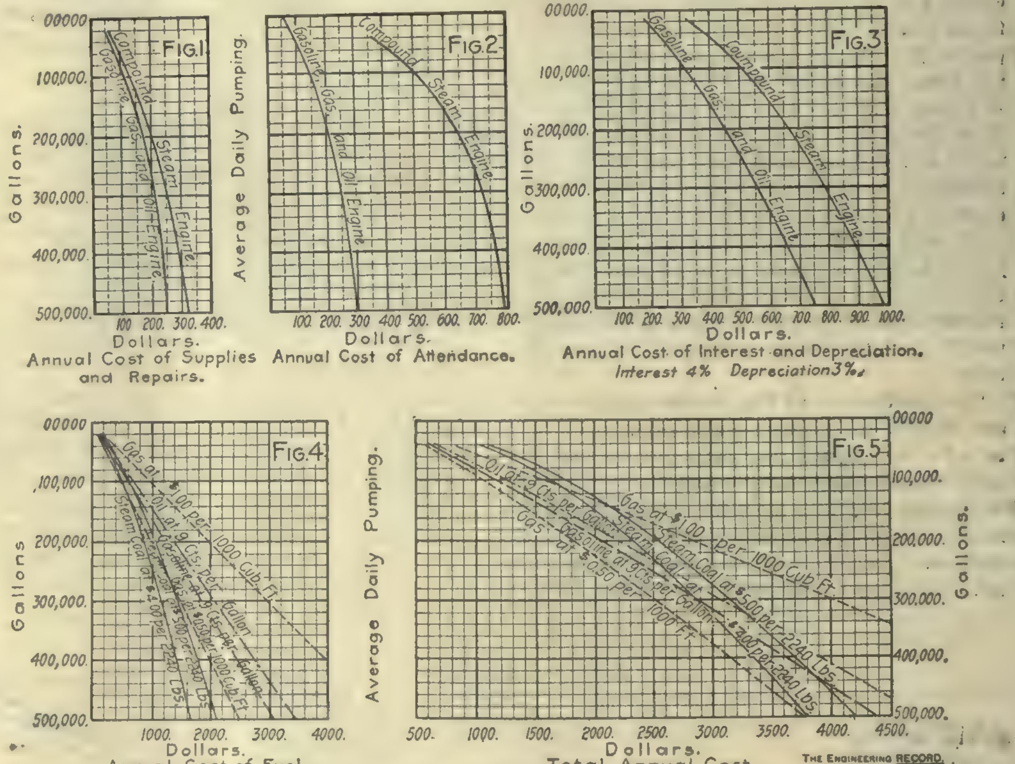
The amount of water used for cooling during the test was 8.2 gallons per horse-power of actual work done, or about 6.8 gallons per horse-power developed by the engine. The cost of this plant, including piping, erection, gauges, etc., but exclusive of buildings and foundations, was about $2,900.

A gas engine plant to drive sewage pumps has been designed by Mr. Coffin for Charlottetown, Prince Edward Island. It is the purpose of this plant to raise the sewage from two sections of the city, amounting to 250,000 gallons a day, from a small storage reservoir in each district. At each station there is to be a gas engine and two centrifugal pumps, one about equal to the engine in its capacity and the other half that size. With the smaller pump the operation of the station may go on nearly continuously, the reservoir being used as a margin for any excess or deficiency in the flow of sewage. The larger pump will be used if it is desired to discharge the sewage at certain stages of the tide, or if the flow is greater than the capacity of the small pump. The apparatus at each station will be stopped automatically, when the sewage in the pump well is drawn down, by the action of a float, which will cut off the fuel supply of the engine. The attendance will consist in starting the engine and keeping the oil cups filled.

Mr. Coffin states that his experience indicates a well designed oil engine plant will raise a million gallons one foot higher for each gallon of oil consumed. This allows the engine 1 pound of oil per horse-power per hour, and gives the pump an average efficiency of 65 per cent. From tests made by others, it is estimated that a first class gasoline engine plant will do the same amount of work with the consumption of 0.9 gallon of fuel. With regard to gas engines, there is so much difference in the quality of the gas that it is difficult to make an estimate as to the consumption of this fuel; Mr. Coffin states, however, that 130 cubic feet of good city gas will do the same work as a gallon of oil. Upon this basis the fuel cost of pumping water will be as follows:

	With oil at 9 cts. per gal.	Gasoline at 9 cts. per gal.	Gas at $1 per 1,000 ft.
1,000,000 gals. 1 foot high	9 cents.	8.1 cents.	13 cents.

An estimate has been made with an endeavor to be as exact as possible of the cost of installation of plants of different capacities with both steam and internal-combustion engines, and also of the cost of fuel attendance, repairs, supplies and such charges. The steam plants have compound condensing duplex direct-acting pumps, horizontal boilers, a brick chimney, and a small coal-shed. The duties allowed such plants were estimated from the reports of water-works of a similar capacity. The size of the plant of either type was such that the daily consumption could be pumped in 10 hours, and the cost used as a basis for the calculation of the fixed charges included the necessary building and foundations. From these estimates the accompanying diagrams have been prepared, showing the annual cost of each item of expense and the total cost. The diagrams are based on a dynamic head of 210 feet, this being an approximation to the average head at different places, as given in water-works statistics. The pumping is given as the amount pumped per day. The basis on which these comparative estimates were made was certainly not unduly favorable to the internal-combustion engine. It is important that there should be a margin of cost in this type of engine over the work to be done; if they are overloaded, they will gradually slow down and stop entirely.



COST OF PUMPING FOR SMALL WATER-WORKS.

PLUMBING IN THE LONG ISLAND STATE HOSPITAL.

In the issue of December 3 a general description was given of the construction of the Long Island State Hospital, at Kings Park, N. Y., with the water supply and distribution system, and the separate collection and combined outlet sewer system by which the group of buildings is served. The kitchen is equipped with hot and cold water and steam cooking apparatus, as shown in Figure 6, and in the basement adjoining the kitchen are serving rooms and pantries, with sinks and hot and cold water faucets. There are scullery sinks and dishwashers and a men's lavatory and toilet room, while in the second story an attendants' toilet room contains spray baths, wash basins, water closets and a urinal. The bath house is a one-story structure about 68x78 feet in extreme dimensions, with tiled floor, plastered walls, Alberene stone wainscot and partitions and a high ceiling. There is in it a large inclosed dressing room, with wall benches and lockers, a large room filled with lockers for clothing, and one open bathroom, with glazed brick walls, tiled floors and with spray and douche baths around its walls, and having its floor pitched from the edges and center to an open gutter set parallel with three walls and covered by sectional brass strainer plates. There are in this room 17 overhead douches supplied by six gegenstrom apparatus, as indicated in the general plan and elevation diagrams, Figure 7. The fire lines throughout the building have in every corridor two outlets, each valved and provided with 100 feet of 3-inch rubber lined hose wound on a swivel bracket pivoted to the standpipe itself, and so arranged that its pipe framework receives the water and admits it through hollow trunnions in the reel to the hose before it is unwound.

Water is heated by the introduction of live steam at the fixtures for the supply to the hospital bathtubs in the second story toilet room of each cottage, and in the large central bath apartment for the douches and sprays. For the ward sprays and for all other hot water

fixtures the supply is taken from hot water circulating lines, which are operated by independent steam heat at tanks located one in the basement of each cottage, one in the administration building, and two in the central building, one of the latter being for the kitchen and dishwashing fixtures and the other for the plumbing fixtures. There are in all 10 hot water heaters, all of them connected and ar-

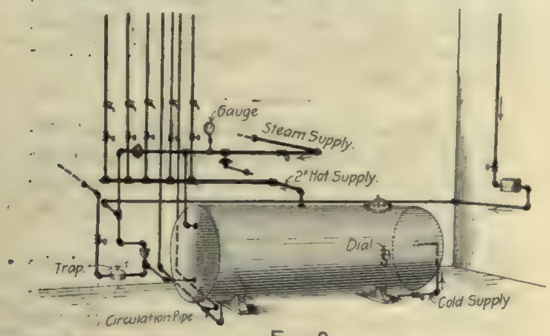


Fig. 8

ranged substantially alike, as shown in Figure 8, which is a sketch of one in a cottage basement. A Gleaner heater, manufactured by I. B. Davis & Sons, Hartford, is jacketed and provided with a thermostat and automatic pneumatic apparatus to control the steam supply and maintain the water at a constant temperature of 150 degrees Fahrenheit. The cold water pipe enters through the middle of one end of the heater and descends inside to the bottom, where it delivers the supply. Hot water rises through a 2-inch pipe in the top of the heater, and is distributed to the different rising lines through a short header placed on the wall and composed of tees and nipples. Each riser is valved at its base and has a drip cock above it, but no emptying pipe, as it was assumed that on the rare occasions when it might be used the water could be more economically carried to a floor drain through a flexible hose. The tops of the risers are connected to two ¾-inch return circulation pipes, run separately to the heater, and entering it through one inlet at the bottom, separate from the cold supply. The heater is provided with a hand hole, a steam pressure reducing valve, pneumatic operating service from a central compressor and accumulator, with a steam gauge, and with a dial and regulating device for adjusting the thermostat to control the temperature of the water.

The water closets and urinal cisterns in the wards are connected, as indicated in Figure 9, with two branches supplying the pull and automatic flushes separately. The former is controlled by the usual valves at each cistern, which are normally open, so that the pull flush is always operative, while the latter has only one valve, A, that controls the whole group and is expected always to be closed at night, and to be opened or closed by day according to the

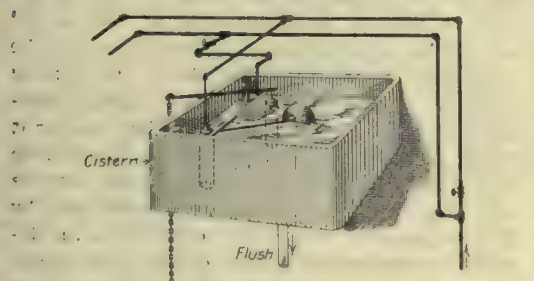


Fig. 9

class of patients in that particular ward. S traps with branch trap vent lines are only provided for the kitchen, pantry, scullery and slop sink fixtures, the horizontal branches of soil and waste pipes being generally extended to a vent line at the upper end, with a vertical pipe extending above the roof, as shown in Figure 10, which represents a diagram of the arrangement of pipes at one end of the row of basins in a first floor ward lavatory. The table is made of a single slab of handsome gray marble about 12 feet long, and contains five large oval basins, with extra large outlets, that discharge through brass 1½-inch wastes and non-syphoning traps connected by short pipes into Y's on the 2-inch waste line. This line terminates at the upper end in a Y, with a cleanout screw in the horizontal branch, and the foot of the 2-inch vent pipe screwed into the oblique branch with a short nipple and one-eighth bend.

Great care has been taken everywhere to construct and select the plumbing so that it would not be subject to injury from patients, so that it could be used by those who were trustworthy, and so that the helpless ones could be most readily cared for by the attendants, who can themselves control the apparatus or safely permit the patients to do so. The possibility of accidents by scalding is prevented by keeping the maximum temperature of the hot water below 150 degrees, by using key cocks on the hot water faucets of the ward basins, and by arranging all spray and gegenstrom bath apparatus so that the handles of the hot and cold water supplies interfere and the former cannot be opened until after the latter. The total contract prices of the work were about $27,500 for the interior plumbing and $11,000 for the exterior water pipe and hydrant system, and the drainage to main sewers, manholes, flush tanks, etc.

The hospital is built and equipped according to the designs of State Architect Isaac G. Perry, Albany, N. Y., and the engineering and sanitary work here described was designed, specified and executed under the supervision of Mr. William Paul Gerhard, C. E., of New York City.

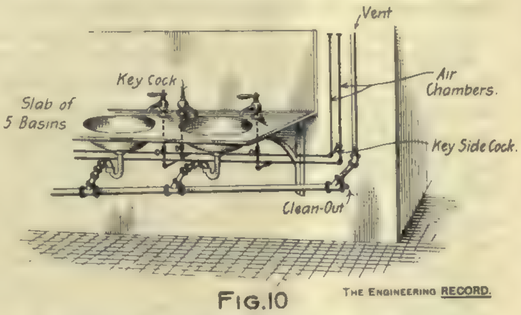


Fig. 10

Mr. A. T. Byrne was resident engineer and superintendent of building construction. The contracts for water mains, for exterior sewers, for interior plumbing and for steam pipes and hot water heaters were let to Messrs. James Harley, Brooklyn, N. Y., and George Fruh, respectively.

CORRESPONDENCE.

THE DOW ENGINE.

Philadelphia, December 6, 1898.

To the Editor of "The Engineering Record."

Sir: Permit me to call your attention to an error in your abstract of my paper on the steam engine in your issue of December 3, where my engine is designated as one "of the vertical compound type, arranged on the Woolf principle." The Woolfe of 1804 was, like its prototype, the Hornblower, a beam engine, one end of the beam carrying the connecting rods for both cylinders. Consequently the pistons had simultaneous movement, in time and direction, for both cylinders; the stroke of one being shorter than that of the other, and the necessarily long steam passages connected from the top of one cylinder to the bottom of the other, and vice versa. Consequently these passages caused too much "dead space" between the cylinders for economical continuous expansion.

Sometimes there is a confusion of statement between this, the English Woolfe engine, and the German Wolff, which appeared a number of years later, and, curiously enough, marked the next step in compounding, being a tandem compound, but also open to the great objection of long connecting passages.

I think you will readily see the difference between these engines and my own, with its close connections, alternating strokes and absence of the beam. My engine is really based on the Corliss system, not the Woolfe.

Josiah Dow.

[By stating that the Dow engine was arranged on the Woolf principle "The Engineering Record" meant to imply that the high pressure cylinder exhausted directly into the low pressure cylinder, that is, it was without a receiver.]

TRADE PUBLICATIONS.

The International Heater Company, Utica, N. Y., has issued to architects and others a large wall hanger, showing heating boilers.

Messrs. Charles E. Billin & Co., 1543 Marquette Building, Chicago, have issued No. 5 of the periodical, "Machinery and Supplies for Mines and Mills," containing illustrated descriptions of various supplies.

The Builders' Iron Foundry, Providence, R. I., has issued a little reminder card to those who are prone to trouble with their date-lines the first few days in January, and also a pocket calendar for 1899. A calendar has also been issued by the Youngstown Iron and Steel Roofing Company, Youngstown, O.

The Standard Steam Specialty Company, 83 Centre St., New York City, has issued a small folder describing the Boston boiler thermostat for controlling the temperature of hot water in tanks and for heating water economically. The operation of the device is explained and its application to a heating tank is illustrated.

Messrs. Warren Webster & Co., Camden, N. J., have issued several attractive folders calling attention to the Webster separators for live and exhaust steam, the Webster "vacuum" feed-water heater and purifier and the Webster system of steam heating, the latter including a characteristic story by the late "Bill" Nye.

The New Era Iron Works Company, Dayton, O., has issued a pamphlet, 6¾x8¾ inches, describing and illustrating the New Era gas and gasoline engines. The New Era is built on the four-cycle plan, with either electric or tube ignition, and has been built as large as 125 horse-power. Sufficient illustration of details is given, there are views of some installations and a number of testimonial letters from users.

"Fire Facts," a small pamphlet issued by the Central Fireproofing Company, New York City, is based upon the showing of fireproofing material in the Home Life Insurance Building during the recent fire. There is a brief general statement of the outcome, but the greater part of the pamphlet is made up of quotations from the daily press.

The Dunn Manufacturing Company, Pittsburg, Pa., has issued a pamphlet addressed especially to engineers and contractors, describing its extensible trench braces for supporting the sides of sewer, water, gas and conduit trenches. The photographic illustrations show the device as applied to work in Buffalo, Chicago, Pittsburg and Washington. Price lists and a few testimonial letters are appended.

The Q. & C. Company, Chicago and New York, has issued a 46-page 9x12-inch pamphlet on pneumatic tools for riveting, chipping, calking, heading flues, cutting stay-bolts, chipping iron and steel castings, stone-cutting, carving and lettering. These tools are shown in great variety, and applications to different classes of work are illustrated. A number of testimonial letters are appended, and several pages are devoted to other specialties made by the company.

The Chester B. Albree Iron Works, Allegheny, Pa., has issued catalogue No. 4 of bridge railing designs, portal ornaments, newels, crestings, lamp-posts, stairways, etc. This is a 130-page pamphlet of standard size, 6x9 inches, and it shows a variety of patterns and designs which should be of interest to bridge engineers

and builders. A number of half-tone views illustrate the appearance of some of the work after completion. The Pittsburg riveting machines for bridge and structural work, which are run by compressed air, are also illustrated and described.

The Sturtevant generating sets, that is, direct connected dynamos and engines made by the B. F. Sturtevant Company, of Boston, Mass., are described in Bulletin G, which has recently been brought out. The bulletin shows a number of half-tone illustrations, the engines being of the horizontal and vertical types, and the dynamos of the usual multipolar arrangement, such as are used in lightning and power plants. One enclosed generator is also illustrated. This company has also issued a second edition of its interesting pamphlet, entitled, "Draft Without a Chimney," which wil be mailed upon application.

The Buffalo Forge Company, Buffalo, N. Y., has issued a 7½x9-inch paper-covered book of 142 pages, entitled "American Schools of Mechanical Technology." The object of the book is to show the application of the company's equipment to the forge shops of such institutions, as well as a few typical industrial establishments. Exterior views are given of a large number of the mechanical buildings of polytechnic schools and manual training establishments, and these are generally accompanied by a facing view showing the forge shop interior. Illustrations of the company's engines of various types, mechanical draft apparatus, and fan system of heating and ventilating apparatus are also included.

The Westinghouse compound engine is described in a handsome catalogue that has recently been brought out by the Westinghouse Machine Company, of Pittsburg, Pa. The work contains about 100 pages, upon many of which are printed handsome half-tone cuts illustrating the engine and its parts. Some interesting information is contained in the body of the catalogue concerning the economy of compound engines in general and of the Westinghouse in particular, and the results of tests by several well known experts are printed. A table shows the economy of this engine when run non-condensing and condensing with various boiler pressures, the table of duties having been compiled from actual tests. The methods of testing engines in the shop before they are shipped and a view of the testing room are given.

ENGINEERING SOCIETIES.

The American Society of Civil Engineers held a special meeting December 14, at which a large number of members and ladies enjoyed an interesting description by Mr. Hiram S. Maxim, M. Am. Soc. C. E., of his aeroplane experiments and of his machine gun.

The Civil Engineers' Club of Cleveland met December 13. Messrs. W. M. Allen and Henry M. Lucas were elected active members. Mr. Edwin L. Thurston, associate member of the club, read an instructive paper on "The Nature and History of Patent Rights." An interesting discussion followed, after which the meeting adjourned for conversation and lunch.

The Montana Society of Engineers met in Helena, November 12. Mr. William Braden was elected to membership. The bill providing for the appointment of a state engineer and defining his duties was read and discussed, after which Mr. O. Jackson, recently from Alaska, addressed the society upon railway, tramway and other improvements now being made in that country.

The Brooklyn Engineers' Club held its annual meeting December 8 and elected officers as follows: President, Walter M. Meserole; Vice-President, Henry B. Seaman; Secretary, Andrew J. Provost, Jr., and Treasurer, Calvin W. Rice. Mr. N. P. Lewis, the retiring President, was made a member of the Board of Directors, which consists of the officers elected. After the meeting the members adjourned to the banquet hall, where the supper was served, after which a number of toasts were responded to.

The Scranton Engineers' Club held its monthly meeting December 7. Officers were nominated for the ensuing year as follows: President, William M. Marple; vice-president, C. C. Rose; secretary, H. W. Rowley; corresponding secretary, Morgan Davis; treasurer, A. C. Lamont; librarian, A. E. Lister; directors, James Archibald, Capt. W. A. May and Charles S. Farrer. Mr. Edmund A. Bartl, a member of the club, delivered an address, relating his recent experiences prospecting in the Peace River district, British Columbia.

The Civil Engineers' Society of St. Paul met December 5, with President Estabrook in the chair. Mr. Charles A. Forbes was elected to membership. Mr. Oliver Crosby read a paper on "The Manufacture of the United States 12-Inch Mortar Carriages." The American Hoist & Derrick Co., of St. Paul, has been turning out these carriages under his direction at the rate of two per month during the past year. He exhibited test pieces of gun-iron, the strength of which must be twice that of ordinary cast-iron. After much experimenting in the mixture of various grades of iron, he successfully melts, in a cupola furnace, the necessary 20 tons for one pouring, and molds the same to pass a most rigid inspection.

The Engineers' Club of St. Louis met December 7, with 34 members and 19 visitors present. Mr. Mark Bary was elected to membership. The annual reports from the officers and standing committees were presented, and the committee on standard gauges for thickness was honorably discharged. The committee on nominations reported a list of officers for 1899 as follows:

For President, B. H. Colby; for Vice-President, F. E. Nipher; for Secretary, E. R. Fish; for Treasurer, Thomas B. McMath; for Librarian, E. J. Jolley; for Directors, S. E. Freeman and J. H. Kinealy; for members of the Board of Managers of the Journal of the Association of Engineering Societies, J. B. Johnson and Richard McCulloch. Later these additional nominations were made: For Vice-President, M. L. Holman, Ed Flad and J. B. Johnson; for Secretary, Henry Branch; for Treasurer, E. H. Connor; for Directors, A. H. Zeller and John A. Laird.

The paper of the evening was by Mr. A. H. Zeller. The author was a delegate from the Engineers' Club of St. Louis to the celebration of the fiftieth anniversary of the Civil Engineers of France, and the paper described the manner in which the event was celebrated. After the reading of the paper a number of lantern slides were exhibited, showing views of engineering works in Paris, Berlin and other European cities.

The American Society of Heating and Ventilating Engineers has made the following nominations to the offices in the Society for the ensuing year:

For President—Henry Adams, Washington, D. C.; J. H. Kinealy, St. Louis, Mo. For First Vice-President—D. M. Quay, Chicago, Ill.; H. D. Crane, Cincinnati, O. For Second Vice-President—A. E. Kenrick, Brookline, Mass.; John A. Fish, Boston, Mass. For Third Vice-President—F. A. Williams, New York; A. C. Mott, Philadelphia, Pa. For Secretary—W. M. Mackay, New York; L. B. Sherman, New York. For Treasurer—Judson A. Goodrich, New York; J. J. Blackmore, New York. For Board of Managers—W. F. Wolfe, New York; S. A. Jellett, New York; Henry C. Meyer, Jr., New York; U. G. Scollay, Brooklyn, N. Y.; B. H. Carpenter, Wilkesbarre, Pa.; John D. Hibbard, Chicago, Ill.; A. A. Cary, New York; J. A. Connolly, New York; Thomas Barwick, New York; W. A. Russell, New York. For Council—R. C. Carpenter, Ithaca, N. Y.; W. McMannis, New York; W. S. Hadaway, Jr., New York; John Gormly, Philadelphia, Pa.; D. M. Nesbit, London, Eng.; W. H. Bryan, St. Louis, Mo.; B. F. Stangland, New York; T. J. Waters, Chicago, Ill.; George Mehring, Chicago, Ill.; F. W. Foster, Boston, Mass.

The Engineers' Club of Philadelphia met December 3, when nominations for officers for the ensuing year were presented. Several changes to the proposed amendments to the by-laws were presented and discussed.

Mr. R. W. Lesley presented the paper of the evening, on cement and cement-testing laboratories, and illustrated his remarks by diagrams and views of testing machinery reproduced by the electric lantern. He called attention to the fact that cement is the only material of construction that is tested in a different form on the work than at the mill. The paper showed some thirty or forty possible causes whereby the manufactured test-briquette may be injured during the process of its preparation or by its treatment thereafter and before it is tested. This was illustrated by a table prepared by Prof. J. Madison Porter, showing different treatments and results obtained upon a single sample of cement in nine different scientific laboratories. After drawing the clear distinction between the well-equipped, skilfully operated and technically perfect laboratories of the European governments, as well as some of the American public and private laboratories, and the ordinary testing laboratory in use on the field and on the work in most of the great American engineering constructions, where conditions do not admit of the same elaborate equipment and delicacy of manipulation as are found in the first-mentioned class of testing laboratories, the writer said that there was but one answer as to how cement shall be tested, and that is that there shall be distinct differences made between the specification for cement to be tested in the ordinary laboratory on public work, and cement to be tested in the perfectly equipped laboratory of the skilled expert.

The Work of the Volunteer Engineers in the Spanish-American war was well set forth by Col. Eugene Griffin, of the First Regiment of Volunteer Engineers, at a dinner given December 8 at Sherry's by the officers in honor of their colonel. Disclaiming for himself the credit which belonged to the regiment, Col. Griffin, in response to the address with which the officers presented him a silver loving-cup, said he felt on the declaration of war as did every West Point graduate in civil life—that he was again called to active duty. It appears that the regiment narrowly missed some exciting service. If it had sailed four days earlier it would have been sent around to the north side of Porto Rico to land at Arecibo and capture that city. The engineering work performed by the regiment in Porto Rico consisted of a detailed topographical survey of the main highway from the sea through Ponce to Aibonito; a survey of the Aibonito Pass, showing the locations of the Spanish batteries and intrenchments; a detailed hydrographical survey of the harbors of Ponce and Guanica; the rebuilding of the fine masonry bridges destroyed by the Spaniards on the military road which crosses the island; the building of a dock and commissary storehouses; the setting up of an ice plant and refrigerating plant for the general hospital at Ponce, and the construction of buildings for this purpose; the building of a concreted high-level reservoir for the hospital and the completion of the water-supply system, including set-

ting up the pumps, laying the pipes, etc.; the partial construction of Fort Capron on the heights overlooking the entrance to Guanica Harbor, and the building of a road up the side of the mountain leading to the fort; the laying out of the first National Cemetery in Porto Rico, and many other minor works. Col. Griffin considers that if the war had continued the introduction of modern engineering methods, especially of electrical development, would have changed in many respects the traditional methods of siege operations, the care of the wounded on the battlefield and the maintenance of field hospitals. He believed engineers, including tradesmen, will make better soldiers than any other class of men, and thought that in the proposed increase of the army to 100,000 men provision should be made for four engineer regiments, not two, as now contemplated.

PERSONAL.

Mr. Samuel E. Wilmer has been appointed assistant superintendent of the Woodbury, N. J., water department.

Second Lieutenant William P. Wooten, Corps of Engineers, U. S. A., has been ordered to Manila, Philippine Islands.

Mr. Julian Kendrick has been elected city engineer of Birmingham, Ala., and Mr. John McCartin has been elected street commissioner.

Mr. Louis B. Ohliger has been elected superintendent of water-works of Canton, O., and Mr. James D. Barry has been chosen secretary.

Mr. William B. Mundie, of the firm of Jenney & Mundie, architects, of Chicago, has been elected architect of the Board of Education of Chicago.

Mr. Albert Heller, of Wapakoneta, O., has been promoted from the position of assistant engineer to be chief engineer of the Youngstown Bridge Company, of Youngstown, O.

First Lieutenant Charles Keller, Corps of Engineers, U. S. A., has been ordered to Portland, Me., and First Lieutenant George P. Howell, Corps of Engineers, U. S. A., has been ordered to Willets Point, N. Y., for duty with the battalion of engineers.

Mr. M. J. Martinez, M. A. S. M. E., has received the appointment of resident agent at Havana, Cuba, for the Snow Steam Pump Works. The business will be conducted under the style of M. J. Martinez, consulting and contracting engineer.

Mr. N. P. Lewis, M. Am. Soc. C. E., Engineer of Streets of the Borough of Brooklyn, and a graduate of the class of 1879 of the Rensselaer Polytechnic Institute, delivered a lecture before the students of that institution Wednesday evening last on "Street Paving Materials and Their Use."

Mr. William W. Varney has been nominated and confirmed as city commissioner of Baltimore, Md., to succeed Mr. Lawrence F. Lewis, resigned. Mr. Varney is a son of Naval Constructor Varney, and has been engaged at the Columbian Iron Works, at Baltimore. He is both a civil engineer and a lawyer.

Mr. Charles E. Webster, chief engineer of the Lehigh Valley Railroad, has resigned that position, the resignation to take effect January 1, Mr. Webster is a graduate of Princeton University and entered railroad service as a rodman. He has been associated with a number of railroad systems in an engineering capacity, and was also an assistant engineer in the building of the Croton aqueduct, New York City. He has been connected with the Lehigh Valley Railroad for the past seven years.

Lieutenant Colonel William M. Black, Corps of Engineers, U. S. A., has been detached from duty in the office of the Chief of Engineers and ordered to Havana as engineer officer on the staff of Major General William Ludlow, whose appointment was noted in the preceding issue. Colonel Black is particularly well qualified for action on the numerous problems in municipal sanitation which will arise when the United States officers assume the direction of the affairs of the Cuban capital. He succeeded Major Charles F. Powell, Corps of Engineers, U. S. A., as Engineer Commissioner of the District of Columbia early in 1897, and held that place until assigned to duty on the staff of Major General Wade, commanding the Third Army Corps at Chickamauga, Ga., shortly after the declaration of war with Spain. His efforts as Engineer Commissioner, particularly in the matter of highway extensions, building operations and negotiations for the abolition of railway grade-crossings, earned for him the respect and admiration of the people of the District.

OBITUARY.

Mr. Alexander Nimick, an iron and steel manufacturer, of Pittsburg, Pa., died December 20.

Mr. William Dunkelberg, a contractor, of Lower Heidelberg, Berks County, Pa., died December 14.

Mr. Henry A. Chapin, who died at Niles, Mich., December 16, was an extensive owner of iron mines.

Mr. John Craig, member of the firm of Craig & Atkinson, contractors, of Salt Lake City, Utah, died December 17.

Mr. Charles Hughes, of the contracting firm of Hughes Brothers, Banges & Gaynor, which had been engaged on the Sault Ste. Marie locks and other Government work, died in Syracuse, N. Y., December 18.

Mr. Samuel McElroy, a veteran civil engineer of Brooklyn, N. Y., died in that borough December 9. He was a native of Albany and in early life served as engineer on the United States man-of-war "Fulton." In 1859 he was appointed civil engineer in the Department of City Works of Brooklyn, and laid out the system of water-works of the city. He was the engineer of the town survey commission and laid out the system of streets in the county towns. He was also the engineer of the Sea Beach Railroad and surveyed the route of that line, as also that of the Brighton Beach system. He planned the construction of the Brooklyn elevated system at its start. His was the plan of survey adopted by the county for Kings Park, known then as St. Johnland, and used as a farm for the insane, afterward sold to the State. For the past quarter century he had practised as expert and consulting engineer.

Sir William Anderson, K. C. B., M. Inst. C. E., died in England December 11. He was born in St. Petersburg, but was a British subject, and was educated in St. Petersburg and in King's College, London. In his early years of practice he lived in Dublin, and was engaged chiefly in the construction of bridges and other railway work. He devoted much attention to the theory of diagonally braced girders. In 1864 he removed to London and built the Erith Iron Works on the Thames. In 1889 he was appointed director general of the Royal Ordnance Factories, which comprise the laboratory, the carriage departments and the gun factory at the Royal Arsenal, Woolwich, and the royal gunpowder factory at Waltham Abbey and the small-arms factories at Enfield and Birmingham. He was a vice-president and member of the council of the Institution of Civil Engineers, a vice-president of the Institute of Mechanical Engineers and a vice-president of the Society of Arts. He contributed numerous papers to the publications of these societies. Some of his most important writings were his lectures on "Hydraulics," on "Hydro-pneumatic Gun Carriages" and on "The Conversion of Heat Into Work." He was knighted in 1897, and the University of Durham conferred on him the honorary degree of D. C. L.

CONTRACTING NEWS

OF SPECIAL INTEREST TO

CONTRACTORS, BUILDERS, ENGINEERS, AND MANUFACTURERS

OF ENGINEERING AND BUILDING SUPPLIES.

For Proposals see page ix.

WATER.

Winchester, Ind.—Bids are wanted Jan. 18 for a water plant, with sufficient building and power to add electric light. S. D. Fox, City Clk.

Millvale, Pa.—City Clerk C. W. Dankmyer writes that all bids opened Dec. 16, for a vertical pump, daily capacity 2,000,000 gallons, have been rejected. New bids will be received Jan. 3.

Binghamton, N. Y.—The Water Commissioners have decided to advertise for bids for the 6, 8 and 12-in. pipe required during the next year.

Minneapolis, Minn.—The City Council has decided to reject all bids received for two 10,000,000 gal. pumping engines. For list of bids received see our issue of Sept. 3.

Kenwood Park, Ia.—According to reports the Kenwood Park Water & Light Co. has been granted a franchise for a water system.

Hartford, Mich.—The question of issuing bonds for a system of water-works is stated as being under consideration.

Keithsburg, Ill.—The Council has appointed a committee to ascertain the cost of boilers and of putting in a plant and operating the same, and to report at the January meeting.

Prairie Depot, O.—According to reports the question of establishing water-works is under consideration.

Taunton, Mass.—An order has been adopted appropriating $15,000 for general construction work of the water-works.

Lansingburgh, N. Y.—The Water Board has purchased land for new reservoir site.

Necopeck, Pa.—It is stated that at the spring election a vote will be taken on the municipal ownership of the water plant.

Brandon, Vt.—Local reports state that the construction of the proposed water plant will cost about $75,000.

Bay City, Mich.—City Engineer Bloomshield has estimated the total cost of constructing a 4-ft. brick and cement inlet pipe, to the bay, at $55,000.

Brownstown, Ind.—The Town Council has under consideration the construction of water-works, according to reports.

Brazil, Ind.—The City Council has decided to take action at once to determine the cost of piping water to this city from Wabash River, a distance of 9 miles.

Phoenix, Ariz.—A special election will be held Jan. 12 to vote on the proposition to issue $265,000 bonds for water and sewerage systems.

Seattle, Wash.—Judge Moore, in the Superior Court, on Dec. 10, sustained the petition of Robert Moran for an injunction against letting the Cedar River water-works contract to Gahan & Byrne, of Chicago, and continued in force the order restraining the Board of Public Works from taking that step.

Somersworth, N. H.—Mayor Arthur J. Seavey writes that water-works bonds to the amount of $177,000 have been sold.

Hintonburgh, Ont.—Local reports state that a vote will be taken Jan. 2 on the proposition to issue $60,000 bonds for municipal water-works.

Hamilton, Ont.—City Engineer Barrow's report recommending that a large main be laid along Barton St. has been adopted.

Colton, Cal.—G. E. Slaughter, City Clk., writes that it has been voted to issue $20,000 bonds for improving the water system by adding pump and large mains.

Middletown, N. Y.—T. W. Davey, Supt. of Water-Wks., writes that the construction of a filtration plant is still under consideration.

Canton, O.—Superintendent Fife estimates the cost of 6,700 ft. of 30-in. main at $1.50 per ft.

San Pedro, Cal.—The question of issuing $40,000 bonds for a light and water plant is under consideration, according to reports.

Chattanooga, Tenn.—The City Engineer has been requested to furnish an estimate of the cost of building and operating a new water-works system.

Stanberry, Nev.—It is stated that bids are wanted Jan. 2 for $3,000 bonds for the proposed water-tower. W. A. Erwin, Mayor.

Reno, Nev.—It is stated that bids are wanted Feb 13 (change of date) for $130,000 water-works bonds. F. B. Porter, City Clk.

New York, N. Y.—See "Water."

Allegheny, Pa.—The contract for a 250-h. p. boiler and stoker for the Howard St. pumping station has been awarded to William F. Patterson, of Erie, at $5,298.

Orange, N. J.—Local reports state that the only complete bids received for a pumping station, dam, etc., at Campbell's Pond, were as follows: The Borough Construction Co., of New York, $50,000, and Col. Daniel F. Minihan of Orange, $66,666.66.

Baltimore, Md.—The Council committee on water has decided to report favorably an ordinance providing for the lease of filtration plants subject to purchase by the city after two or before 20 years after their construction.

Stayner, Ont.—It is stated that the by-law, providing for a gravity system of water-works, has been passed. Estimated cost, $24,000.

Detroit, Mich.—The Water Board has ordered estimates for an addition to the works large enough to accommodate three high pressure engines having a capacity of not less than 24,000,000 gals. each per day, together with a boiler plant of sufficient capacity for a sub-pumping station in the northern part of the city.

Oshawa, Ont.—A vote will be taken on Jan. 21 on the issue of $110,000 bonds for water-works and sewerage systems.

Louisville, Ky.—The Board of Public Safety has recommended the expenditure of $250,000 for fire hydrants.

Little Falls, Minn.—F. E. Hall, City Clk., writes that the sale of $60,000 water and light bonds has been postponed until January.

Northeast, Pa.—It is stated that $20,000 water bonds will be sold Jan. 3.

Albuquerque, N. M.—See "Government Work."

Goshen, Ind.—City Engineer Cooper reports that 14,161 ft. of 6 and 12-in. pipe will be required for proposed extension.

Dubuque, Ia.—The Dubuque Water Co. has given a trust deed for $800,000 to secure bonds issued for raising funds to improve its plant.

Sibley, Ia.—The proposition to construct water-works at a cost of $15,000 will probably be voted upon some time in February. T. O. Wilbern and H. Newell, Committee in Charge.

New York, N. Y.—The following sums are included in the 1899 budget: For new aqueduct, $2,000,000; for water supply, $750,000; for approaches to Willis Ave. bridges, $487,445; for south approach to Third Ave. bridge, $556,403; for new East River bridge, $2,500,000; for new bridges, $300,000; for repaving in all boroughs, $2,000,000.

Ute, Ia.—A new water-works engine will probably be purchased. Bonds voted to the amount of $1,800. D. E. Lathrop, City Clk.

Leadville, Colo.—The Leadville Water-Works Co. has filed articles of incorporation. Capital, $400,000. The directors are: H. B. Cleaves, D. B. Wesson, William E. Hawkes, C. N. Priddy and William Nason.

Southport, Conn.—A movement is on foot for the organization of a new company to supply Southport and Fairfield with water.

Philadelphia, Pa.—The Committee on plans and improvements of the Fairmount Park Commission has approved the revised plans for the auxiliary reservoir, at George's Hill, which will have a capacity of 84,000,000 gallons; estimated cost about $400,000.

Youngstown, O.—Local press reports state that the Water-Works Trustees are completing arrangements to have F. Herbert Snow, C. E., of Brockton, Mass., make a series of examinations of the city's available water supplies.

Los Angeles, Cal.—The Elizabeth Lake Water & Power Co. has been incorporated with a capital stock of $500,000. The directors are S. R. Thorpe, W. H. McCory and others.

Plymouth, N. H.—It was recently voted to appoint Jas. N. McCoy, Frank H. Rollins and Chas. J. Ayer a committee to confer with the Plymouth Aqueduct & Water Co., with power to purchase or to construct a new system, cost not to exceed $40,000.

Pittsburg, Pa.—It is stated that the Filtration Committee will recommend the use of sand filters. Probable cost, $2,000,000.

Chicago, Ill.—Bids are wanted Dec. 29 for repairs to the 68th St. pumping station. L. E. McGann, Commr. Pub. Wks.

Norfolk, Va.—Bids are wanted Jan. 5 by the Board of Water Commissioners for the construction at pumping station at Moore's Bridges of a building, flume, drains and foundations for a mechanical filter plant.

Phoenix, Ariz.—See "Government Work."

Oshawa, Ont.—Bids are wanted Jan. 4 for water-works and sewers, as advertised in "The Engineering Record."

New York, N. Y.—The Board of Aldermen on Dec. 20 approved the resolution for the extension of the Queens water system, about 3 miles, at an estimated cost of $50,000.

Vineland, N. J.—A petition is being circulated asking the Borough Council to bond to the amount of $140,000 for water-works, sewers and electric lights.

Lake Providence, La.—It was voted on Dec. 15 to issue bonds for the purchase or construction of water-works and light system.

Beaumont, Tex.—It is stated that the Beaumont Irrigation Co. has placed an order with John T. Wilkin, M. E., of Connersville, Ind., for pumping plants which will cost about $40,000.

York, Pa.—We are informed that 4,500 ft. of 20-in. pipe and 6 20-in. gates will be required about Jan. 20. Henry Birkinbine, Gen. Mgr. of Water-Works.

Ironton, O.—It is stated that Col. J. W. Hill of Cincinnati estimates the cost of purifying the river water as follows: For mechanical filtration, $24,000—annual expense, $8,000; for sand bed filtration, $46,000, or in combination with a reservoir, $56,000—annual expense, $5,900.

Florence, Colo.—It is stated that Judge M. S. Baily has granted an injunction restraining the city from constructing water-works, because of an informality in previous election. A vote will be taken again on Dec. 29 on the proposition to build works.

Jamaica, N. Y.—The City of New York has ratified all contracts between the Jamaica Water Supply Co. or its predecessor, the Jamaica Township Water Co., and the village of Jamaica. The contracts call for the maintenance for five years from December, 1897, of 22 street hydrants at $16 per year, 150 at $18 per year and 314 at $20 per year; also for the erection next year and the maintenance of 145 more hydrants in the Hollis and Queens districts at an annual rental of $20 per annum.

Mt. Vernon, N. Y.—The Aldermen have entered into a 10-year contract with the Suburban Water Co. Under this contract the city pays $30 a year for each hydrant. The aggregate rental will be about $12,000 per year.

Jersey City, N. J.—The Board of Finance on Dec. 21 concurred in the resolutions of the Street and Water Board, awarding the contract to Patrick Flynn, of Brooklyn, for supplying water from the Rockaway River by gravity. The price is to vary from $36 per 1,000,000 gals. to $20 as the daily consumption may increase from 25,000,000 to 50,000,000 gals. The resolutions will now go to Mayor Hoos for his action.

SEWERAGE AND SEWAGE DISPOSAL.

Columbus, Ga.—Bids are wanted Jan. 4 for terra cotta drain pipe, brick, gates or other castings, for the year 1899. M. M. Moore, Clk. of Council.

East Cleveland, O.—Bids are wanted Jan. 14 for sewers. H. B. Chapman, Village Clk.

Derby, Conn.—J. W. Larkin, City Clk., writes that the city has voted to issue $50,000 bonds for extending and constructing a system of sewers. Bonds will not be issued until authority is granted by the General Assembly.

Alliance, O.—O. W. Pfouts, City Engr., is preparing plans and specifications for the construction of sewers and for brick and asphalt pavements in Ward 6. Probable cost of work, $20,000.

Little Falls, N. Y.—Local reports state that plans are being prepared by Engineer Babcock for south side sewers.

Philadelphia, Pa.—We are informed that David Peoples, 25th and Callowhill Sts., has received the contract for a sewer at Van Kirk St. on line of P. R. R., for $6,934.

Montgomery, Ala.—A bill has passed the House authorizing the City Council to issue bonds for sanitary sewers.

East Hartford, Conn.—Jos. D. Goodwin, Town Clk., writes that the construction of proposed sewers has been postponed until spring. Wm. H. Olmsted, East Hartford, Engr. in charge.

Longbeach, Cal.—It is stated that general plans and estimates for the proposed trunk sewer system have been prepared by City Engr. C. I. Gouncher and Consulting Engr. T. H. James. Cost, about $24,000.

Portsmouth, O.—It is stated that the first section of the sanitary sewer system will soon be built, at an estimated cost of $6,000.

Jackson, Miss.—An election will be held Feb. 1 to vote on the issue of $100,000 bonds for a complete sewerage system.

Dunkirk, N. Y.—The following bids were opened Dec. 20 by the Board of Water Commissioners;

COMPARISON OF BIDS FOR HORIZONTAL ENGINES.

Bidder.	Type of engine.	Size cyl's and stroke, ins.	Size plunger and stroke, ins.	Rev. per min.	Feet per Min.	Capacity million gallons.	Duty ft. lbs. per 1,000 lbs. Steam.	Price.
Pioneer Iron Works	Cross-comp.	28x56 / 42	(2) 16x42	34	238	7	120,000,000	$17,160
Loretz & Son, Brooklyn, N. Y	Same engine	36" stroke.	....	....	....	....	....	15,660
Snow Steam Pump Works, Buffalo, N. Y	Cross-comp.	24x48 / 36	16x36	34 17	204 102	6 3	120,000,000 110,000,000	17,490
Holly Mfg. Co., Lockport, N. Y	Comp. condensing.	(2) 20x36 / 32	(2) 20x32	26	135	6	110,000,000	18,400
Nordberg Mfg. Co, Milwaukee, Wis	Comp. condensing.	22x40 / 36	13¼x36	50	300	6	110,000,000	16,250
Henry R. Worthington, New York City	Triple expansion.	(2) 13x21x34 / 24	(2) 19x24	37½ 25	150 100	6 4	105,000,000 80,000,000	12,270
	Comp. condensing.	(2) 18x36 / 24	(2) 19½x24	35 24	140 95	6 4	110,000,000 100,000,000	18,135
Barr Pumping Engine Co., Philadelphia, Pa	Cross-comp.	24x48 / 36	18x36	30	180	....	110,000,000	22,000

COMPARISON OF BIDS FOR VERTICAL ENGINES.

Bidder.	Type of engine.	Size cyl's and stroke, ins.	Size plunger and stroke, ins.	Rev. per min.	Feet per min.	Capacity million gallons.	Duty ft. lbs. per 1,000 lbs. Steam.	Price.
Pioneer Iron Works	Triplex comp.	26 x (2) 38 / 42	(3) 18 x 42	......	252	7	120,000,000	$23,000
	"	36 stroke	....	......	......	....	....	20,866
Loretz & Son, Brooklyn, N. Y	Triplex comp. tubular plunger.	26 x (2) 38 / 36	(3) 12½ x 18 / 36	42	252	7	125,000,000	21,966
	Cross-comp. differen.	30 x 48 / 36	(2) 16 x 22 / [illegible]	......	252	....	125,000,000	20,800
Snow Steam Pump W'ks, Buffalo, N. Y	Cross-comp.	24 x 48 / 36	16 x 36	34	204	6	120,000,000	23,996
	Same pump at half speed.		....	17	......	3	110,000,000	23,996
Holly Mfg. Co., Lockport, N. Y	Cross-comp.	24 x 46 / 36	17½ x 36	30	180	6	110,000,000	22,600
Barr Pumping Engine Co, Philadelphia, Pa	Cross-comp.	24 x 48 / 36	18 x 25½ / 36	30	180	6	110,000,000	25,500

REMARKS.—Loretz & Son—Deduct $1,500 from each bid if foundations are furnished by city. Barr Pumping Engine Co.—Deduct $1,500 from bid if time was extended to July 1, 1899.

Chester, Pa.—Ordinances have been passed for sewers in three streets.

Washington, D. C.—It is stated that T. B. Jones & Co. have secured the contract for Tiber Creek and New Jersey Ave. high-level sewer. See our issue of Dec. 17 for list of bids received.

Riverton, N. J.—It is stated that the construction of sewers was voted for at the recent special election.

Southbridge, Mass.—The Selectmen have purchased land to be used as filter beds for the proposed sewer system.

Philadelphia, Pa.—See "Miscellaneous."

Dunmore, Pa.—It is stated that at the spring election the construction of sewers will be voted upon.

Sleepy Eye, Minn.—The proposition to build a sewer will be voted upon at the election held Jan. 3. Geo. Glotzbach, Recorder.

Phoenix, Ariz.—See "Water."

Dubuque, Ia.—It is stated that J. K. Killmar, of Mason City, has secured the contract for the completion of Willow Creek sewer for $23,950.

Bryan, Tex.—The City Council has under consideration the proposition to build a sewerage system.

Delaware, O.—The City Council has authorized the construction of a storm water drain, to cost $5,000.

San Francisco, Cal.—The Street Committee recommends that surveys be made for a sewer system in the district bounded by Cortland Ave., Folsom St., Crescent Ave. and Bronte St.; also that provision be made in the next tax levy for a sewer system in the Sunset District.

Phoenix, Ariz.—See "Government Work."

Elizabeth, N. J.—It is stated that bids are wanted Jan. 16 for 800 ft. of 12-in. and 18-in. pipe sewers, etc.

Syracuse, N. Y.—Bids are wanted Dec. 27 for a 15-in. pipe sewer in McKinley Ave. M. Z. Haven, City Clk.

Vineland, N. J.—See "Water."

Hackensack, N. J.—Bids are wanted Dec. 28 for $56,000 sewer bonds. L. A. Campbell, Clk., Hackensack Improvement Commission.

Ponca, Neb.—Bids are wanted Jan. 2 for the construction of a drainage ditch. J. F. Ekeroth, Co. Clk.

Kingston, Pa.—Bids are wanted Jan. 2 for 9,462 lin. ft. of pipe sewers. P. B. Reynolds, Pres.; Wm. P. Somers, Secy.

Oshawa, Ont.—See "Water."

Bloomington, Ill.—An ordinance has been passed for the construction of a 36-in. and 33-in. brick sewer in Sugar Creek Valley in Bloomington and Normal. R. N. Evans, City Clk.

New London, Conn.—See "Gov. Work."

Zanesville, O.—An ordinance has been passed providing for brick and tile sewers in "The Licking Sewer District." C. N. Bainter, City Clk.

BRIDGES.

Chicago, Ill.—Bids are wanted Dec. 28 for erecting sub-structure and superstructure of an 8-track railroad bridge crossing the main drainage channel at Campbell Ave. William Boldenweck, Pres. Bd. Trustees, Sanitary Dist.

Geneva, Neb.—Bids are wanted Dec. 31 for constructing all bridges to be built in Fillmore County during 1899. A. M. Strickland, Co. Clk.

Columbus, Neb.—Bids are wanted Dec. 31 for a bridge across Shell Creek. G. W. Phillips, Co. Clk.

Newton, Ia.—Bids are wanted Jan. 2 for building and repairing county bridges during 1899. Frank Fisk, Co. Aud.

Toledo, O.—Local reports state that the United States Court has granted the petition of the receivers of the Lima Northern R. R. for authority to expend $6,500 in repairing a bridge over the Raisin River.

Yuma, Ariz.—It is stated that the citizens are considering the question of having an addition for wagons to the new Southern Pacific Ry. bridge, to cost from $10,000 to $15,000.

Le Roy, N. Y.—A bridge over the track of the Buffalo, Rochester & Pittsburg R. R. at Hastings' Crossing is to be built. Estimated cost, $8,000.

Spokane, Wash.—Local press reports state that the Great Northern Ry. will replace all wooden bridges west of Minot with steel structures.

Mekinock, N. D.—It is stated that the Bridge Committee recommends rebuilding the bridge over Turtle River.

Hatfield, Wis.—The Chicago Bridge & Iron Co., Chicago, Ill., are stated to have secured the contract for the 200-ft. iron bridge over Black River, at $2,000.

Binghamton, N. Y.—The Board of Trade has under consideration the construction of a viaduct on Chenango St., across the railroad tracks, to cost about $50,000.

Somerville, Mass.—We are informed that a steel or masonry bridge 50 to 60 ft. wide, span 60 to 70 ft., is proposed to replace wooden truss at the Boston Ave. crossing of the Mystic R. into Somerville.

Cincinnati, O.—The counties of Hamilton, O., and Dearborn, Ind., have under consideration the building or repair of bridge over Whitewater at Harrison.

Watertown, N. Y.—C. O. McComb, City Engr., is in charge of construction of the proposed bridge at Court St., to cost about $5,000.

Binghamton, N. Y.—Plans and approximate estimates are wanted Jan. 17 for a bridge across the Susquehanna River at Thompkins St. B. W. Mosher, City Clk.

St. Thomas, Ont.—Bids are wanted Jan. 24 for 2 iron bridges across Kettle Creek. James A. Bell, City Engr.

Hastings, Neb.—It is stated that bids are wanted Jan. 10 for bridge work for 1899. D. P. Bigelow, Co. Clk.

Trent, S. D.—Bids are wanted Jan. 4 for replacing the Trent bridge. H. W. B. Souther, Co., Aud., Flandreau, S. D.

Newburgh, N. Y.—The following bids for building First St. main sewer were opened Dec. 19, by the Board of Public Works:

Bidders.	Timber trunk sewer per ft.	42-in. C.-I. pipe sewer, per ft.	51-in. Brick Sewer: From C. I. pipe to sta. 24 per ft.	From sta. 24 to sta. 34 per ft.	From sta. 34 to Chambers st. per ft.	48-in. brick sewer, per ft.	36-in. brick sewer, per ft.	24-in. pipe sewer, per ft.	Rock excavation, per ft.	American cem. concrete, per cu. yd.	Brick manholes.	Manholes with special castings.	Special connection, per ft.	Timber grillage, per M. ft., B. M.	54-in. sewer in tunnel, per ft.: Firm rock.	Insecure rock.	Earth.
	$	$	$	$	$	$	$	$	$	$	$	$	$	$	$	$	$
Mack Paving Co., 35-37 Nassau St. N. Y. City	4.95	9.45	6.95	7.95	6.95	6.45	5.75	1.75	2.95	2.95	95.00	75.00	5.75	27.50	8.95	14.95	14.95
Michael J. Curley, 105 Hopkins Av., Jersey City, N. J.	7.00	8.50	9.00	9.00	9.00	8.00	6.00	2.00	3.00	4.00	60.00	60.00	3.00	40.00	22 00	22.00	22.00
John Sutcliffe, Po'keepsie, N. Y.	9.00	9.90	11.50	13.00	12.00	9.00	7.50	2.25	2.50	6.00	100.00	75.00	12.00	25.00	11.00	14.25	13.00
John A. Doolittle & Co., 179 Church St., New Haven, Conn.	7.00	9.00	7.75	9 40	7.90	6.00	5.00	2.30	2.25	1.00	55.00	60.00	3.00	50.00	23.50	26.00	30.00
Robt D. Maynard, Spr'field, Mass.	10.00	9.79	8.00	9.72	9.72	7.50	6.32	2.50	2.50	6.00	111.00	75.00	5.00	25.00	15.90	17.32	21.32
H. E Wieber & Co., Rondout, N. Y.	20.00	10.12	9.50	11.00	10.00	9.40	6.59	2.37	5.50	10.00	55.00	65.00	3.50	30.00	13.50	15.50	11.50
Ferrill & Hopper, 215 W. 105 St., N. Y. City	9.00	10.00	6.75	6.75	6.25	5.50	4.75	2.25	2.50	6.50	100.00	40.00	6.50	45.00	25.00	28.00	32.00
M. J. Dwyer & Wm. Sager, Newburgh	6.32	9.65	7.60	8.61	7.93	6 41	4.84	2.14	1.49	4.00	73.00	51.00	2.43	24.00	8.50	11 46	12.25
Troy Public Works Co., Utica, N. Y.	8.20	8.20	8 20	8.20	8.20	8.20	6.50	3.25	2.00	5.40	40.00	50.00	5.00	25.00	14.50	18.50	15.50
Wm. J. Flanagan, Yonkers, N. Y.	6.00	11.25	12.00	10.50	8.50	8.00	7.00	3.50	2.25	5.00	50.00	80.00	7.00	50.00	16.35	16.35	16.35
E. R. Patteson Const. Co., 141 B'way, N. Y. City.	4.00	8.25	8.50	9.00	8.75	7.35	5.55	2.00	1.95	5.00	40.00	60.00	3.00	35.00	17.00	20.00	20.00
T. Henry Dunnary, 1000 Madison Av., Albany, N. Y.	10.00	6.75	9.37	9.94	9.37	7.87	6.65	2.10	1.50	6.00	100.00	75.00	3.75	34.00	10 50	20.00	27.50
E. M. Haines & Co., Rhinebeck, N. Y.	8.00	7.54	12.00	14.25	11.99	9.59	8.40	1.99	3 50	6.00	89.00	65.00	3.55	25.00	17 91	17.91	17.92
Callery & Murphy, Weehawken, N. J.	11.50	9 00	9.20	9.20	9 20	6.55	5.45	2.50	1.45	5 00	100 00	60.00	2.50	30.00	13.50	17.00	14.75
E. Brown Baker, Gloversville, N. Y.	5.00	8.50	8 00	9.50	8.50	7.00	6.00	3.00	3.00	6 00	80.00	60.00	5.00	25.00	12.00	15.00	18 00
Frank Pidgeon, Saugerties, N. Y.	20.00	15.00	16.66	22.25	23.10	11.88	9 30	3.87	2.50	6.00	90.00	60.00	15.00	25.00	20 00	26.00	30.00
Jonathan D. Wilson, Newburgh.	9.50	10.50	12.00	18.00	14.50	11.00	9.50	3.25	2.30	4.75	98.00	68.00	3 00	35.00	15.00	16.50	17.00

Philadelphia, Pa.—According to local press reports the Phoenix Bridge Co., Phoenixville, Pa., has received the contract for the erection of the superstructure of the Gray's Ferry bridge. For list of bidders see our issue of Dec. 17.

Norwalk, O.—It is stated that the Linwood Ave. viaduct, recently condemned, will be replaced by a steel structure to cost about $15,000.

Denver, Colo.—The Board of Public Works directed its chief engineer to furnish an estimate of the probable cost of a viaduct to span the territory between 7th and So. 7th Sts. and Colfax Ave. at the eastern terminus and Highlands Boulevard.

Ft. Smith, Ark.—See "Electric Railways."

Cumberland, R. I.—The Massillon Bridge Co., Massillon, O., is stated to have secured the contract for the construction of the bridge at Ashton for $5,375.

Sacramento, Cal.—The Board of Supervisors authorized bids to be advertised for three bridges on the county road on Grand Island west and north of Beaver Lake.

Toronto, Ont.—See "Miscellaneous."

Jackson, Miss.—Bids are wanted Jan. 31 for $20,000 bonds for bridges and street work, and for building an extension to colored school. D. P. Porter, Jr., City Clk.

Newark, N. J.—The Edge Moor Bridge Works, Wilmington, Del., is stated to have received the contract for a steel drawbridge for the Pennsylvania R.R. Co. across the Passaic River.

PAVING AND ROADMAKING.

Beaumont, Tex.—Bids are wanted Jan. 4 (re-advertisement) for 12,000 sq. ft. of brick and asphalt paving. D. P. Wheat, Mayor.

New York, N. Y.—Bids are wanted Dec. 28 for paving several streets with granite block and asphalt. James P. Keating, Commr. of Highway.

Camden, N. J.—Bids will be received Dec. 27, according to local reports, for paving three streets with asphalt.

Fulton, N. Y.—The Village Engineer is preparing plans and specifications for paving 2d St. By agreement between the village and the New York, Ontario & Western R.R. Co. it is provided that the village shall receive from the company $7,500 toward the pavement.

Portsmouth, O.—It is proposed to pave Gallia St. at an estimated cost of $15,000.

Cortland, N. Y.—Engineer H. C. Allen estimates the total cost of paving Main St. at $75,000.

Baltimore, Md.—The Board of Public Improvement has passed favorably upon ordinances to pave Baltimore St. with asphalt and Light St. with Belgian blocks.

Norfolk, Va.—Resolutions have been adopted appropriating $7,425 for paving on Fenchurch St. and $17,250 for paving Chapel St.

Woodbury, Pa.—Plans and specifications for a macadam street through Woodbury have been approved by State Road Commissioner Budd, but work will not commence until spring.

Chester, Pa.—An ordinance has been passed for paving Edgmont Ave. with brick.

Lima, O.—C. E. Lynch, City Clk., writes that $40,000 street improvement bonds were sold Dec. 19.

Spokane, Wash.—It is stated that plans and specifications have been submitted for asphalt paving on the streets in the business district, but that definite action will not be taken until spring.

Toledo, O.—The Park Board is preparing plans for a boulevard 12 miles long and 200 ft. wide.

Indianapolis, Ind.—The contract for paving Miami St. with brick was awarded Dec. 19 by M. A. Downing, Chmn. Bd. of Pub. Wks., to W. H. Abbett, Indianapolis, at $1.93 per ft.

Louisville, Ky.—It is stated that bids are wanted Dec. 29 for paving several avenues with asphalt. Chas. F. Granger, Bd. Pub. Wks.

New York, N. Y.—See "Water."

New Orleans, La.—Bids will probably soon be asked for 34 blocks of brick or asphalt paving in Algiers. Probable cost, $75,000. A. C. Bell, City Engr.; Albert Tufts, City Clk.

Syracuse, N. Y.—Bids are wanted Dec. 27 for paving Townsend St. with asphalt or brick, and Laurel St. with asphalt or asphaltina. M. Z. Haven, City Clk.

Cincinnati, O.—Bids are wanted Jan. 17 for macadamizing Hopson St. A. B. Rattermann, Pres. Bd. City Affairs.

New York, N. Y.—Bids are wanted Dec. 31 for a steam roller, crushed trap rock and trap rock screenings. George C. Clausen, Chmn. Comm. Parks.

Hamilton, O.—The following bids for paving 2d St. were opened Dec. 19 by M. A. Burns, City Clk.: *a*, sheet asphalt; *b*, block asphalt; *c*, brick: David Folz Asphalt Co., Cincinnati, O., *a*, $1.67; *b*, $1.98. J. M. Quitt, *b*, $2.05; *c*, $1.29. Aug. Henkel, Cincinnati, *b*, $2.12; *c*, $1.28; Townsend Brick Co., Zanesville, O., *c*, $1.26. Irwin Bros., Hamilton, O., *b*, $2.05; *c*, $1.32. Warren Scharf Asphalt Co., Cincinnati, *a*, $1.73.

Dayton, O.—Local press reports state that the following bids were opened Dec. 12 for paving three streets: Warren Scharf Asphalt Paving Co., N. Y. City, $2.05 per sq. yd. for each street; Trinidad Asphalt Paving Co., Cincinnati, O., $2.10, $2.05 and $2; M. G. Cain, Dayton, O., with brick $1.44, and with asphalt $2.44; E. Brentlinger, with brick $1.50 for each street.

New Orleans, La.—Local reports state that the following bids were received for asphalt paving on Bertin and First Sts., respectively: Barber Asphalt Paving Co., N. Y. City, $2.07 and $1.89 per sq. yd.; Ayres Asphalt Paving Co., $2.05 and $1.90; Belden & Seeley, $2.09 and $2.12; Southwestern Alcatraz Co., $2.24 and $2.28.

Philadelphia, Pa.—We are informed that paving contracts for 1899 have been awarded as follows: To the Vulcan Paving Co., 1712 Market St., for resurfacing streets with sheet asphalt at $2.40 per sq. yd., 10 years' guarantee; David McMahon, P. O. Bldg., Germantown, Pa., for repaving and maintaining county roads for $94,800; 50,000 tons of broken stone will be required. See our issue of Dec. 17 for list of bids received.

POWER PLANTS, GAS AND ELECTRICITY

Camden, N. J.—Bids are wanted Dec. 29 for lighting the streets with incandescent and arc lights for a term of one, three and five years. Charles C. Southard, Chmn.

Columbus, Ga.—Bids are wanted Jan. 4 for 115 arc lights of 2,000 c. p. each. M. M. Moore, Clk. of Council.

Winchester, Ind.—See "Water."

Sumter, S. C.—C. M. Hurst, Jr., City Clk., writes that the Sumter Electric Lt. Co. has received the contract for 40 arc lights at $75 each per annum, for a term of ten years, contract to go into effect in November, 1899.

Newark, O.—There is said to be a movement on foot to generate the water power at Black Hand, 10 miles east of this place. Joseph M. Ickes and John C. White are said to be interested. The Creaghead Engineering Co., of Cincinnati, will be the engineers, according to the report.

Oquawka, Ill.—It is stated that it is proposed to issue $5,000 bonds for an electric light plant.

Milan, Ill.—George Tenges and Thomas Gannon are stated to have been appointed a committee to investigate the cost of an electric light plant.

New Holland, Pa.—It is stated that Eli Martin will soon put in an electric light plant.

Madelia, Minn.—The Village Board is said to be considering a proposition for a franchise for electric lights.

Grantsburg, Wis.—It is stated that there is a movement on foot to form a stock company to install an electric light plant.

New Iberia, La.—The Council is stated to have decided to purchase a dynamo.

Statesboro, Ga.—J. A. Scarboro is said to be investigating the cost of an electric light plant.

Muncie, Ind.—It is reported that the city electric light plant was damaged by an explosion; loss, $5,000. C. W. Warner, Supt.

Stockton, Cal.—The Standard Electric Co., of San Francisco, on Dec. 13 received a franchise for constructing, maintaining and operating an electric light, heat and power system. I. H. Robinson, City Clk.

Olivia, Minn.—F. McCormick, of Duluth, has received a franchise for an electric light plant.

San Pedro, Cal.—See "Water."

Waco, Texas.—The Waco Gas Co. is stated to have petitioned the City Council for permission to lay pipes through the streets.

Dayton, O.—The Board of City Affairs is stated to have instructed the City Engineer to report plans and specifications for furnishing and lighting 300 electric lights for 5 years; the present contract expires in November, 1899.

Keokuk, Ia.—The question of developing the water power of the Des Moines Rapids is said to be under consideration by local capitalists.

Britton, S. D.—The Britton Power & Electric Lt. Co. is stated to have been incorporated, with a capital of $3,500.

Provo City, Utah.—L. L. Nelson, City Recorder, writes: "It is proposed to purchase the pole line of the Reed Smoot plant, and an agreement is being made with the Telluride Power & Transmission Co. for power from its plant, which will mean some improvements and additions to present line. Walter Taylor, of Provo City, is the engineer in charge of the Reed Smoot plant."

Pittsfield, Mass.—Chas. E. Callender, of Stockbridge, is stated to have decided to utilize the water power at Glendale and furnish power and light in Pittsfield.

Jamestown, N. Y.—The Council is said to be considering the matter of purchasing the electric light plant of W. N. Gokey.

Green Bay, Wis.—The Green Bay Gas & Electric Light Co. is stated to have received the contract for lighting the city for seven years, from May 1.

Fort Plain, N. Y.—G. R. Beardsley, of Eastcreek, is stated to have applied for a franchise to extend the lighting system to this place.

Lonaconing, Md.—It is stated that the Lonaconing Electric Light & Power Co. will improve its plant, putting in new engines, boilers, two dynamos, etc.

Thief River Falls, Minn.—R. G. Willand, of Duluth, is reported to have made a proposition to furnish this place with an electric light plant.

Le Roy, Minn.—It is stated that H. E. Johnson contemplates putting in an electric light plant in connection with his mill.

Sidney, O.—A resolution is stated to have been presented to the Council providing for the issue of $15,000 bonds for the erection of an electric light plant.

Belding, Mich.—It is stated that the Council will grant a franchise for electric lighting.

Milton, Ia.—It is stated that the city will vote on a proposition to establish electric lights here.

Swedesboro, N. J.—The Swedesboro Light, Heat & Power Co. has been incorporated; capital, $25,000. Incorporators: Chas. D. Lippincott and Henry D. Mitchell.

Yorkville, S. C.—It is reported that T. B. McClain will receive bids for furnishing machinery and constructing an electric light plant of 25 2,000 c. p. arc and 600 16 c. p. incandescent lights.

Syracuse, N. Y.—Bids are wanted Dec. 30 for wiring, etc., for electric lighting in Washington Irving School. P. D. Cooney, Clk. Bd. Educ.

Pleasantville, O.—It is stated that bids are wanted for lighting the streets. Geo. L. Gebhart, Clk.

Little Falls, Minn.—See "Water."

Topeka, Kan.—Bids are wanted Dec. 29 for material and machinery for the improvement of the electric light plant. S. S. McFadden, City Clk.

Milford, Mass.—The Milford Electric Light & Power Co. will build at once an entire new system. M. J. Buckley, Engr., Milford.

Sault Ste. Marie, Mich.—Bids are wanted March 1 for the construction and installation of turbines of 45,200 aggregate H. P. on 16 ft. head. H. von Schon, Ch. Engr., Michigan Lake Superior Power Co.

Los Angeles, Cal.—See "Water."

Bad Axe, Mich.—We are informed that an electric light plant is to be built, at an estimated cost of $8,000. John G. Kundinger, Engr. in charge.

Lake Providence, La.—See "Water."

Vineland, N. J.—See "Water."

Germantown, O.—The contract for constructing the electric light plant is stated to have been awarded as follows: For the power house, C. C. Cochran, of Germantown, at $2,265; engines, boilers and steam plant, the Ridgway Engine & Dynamo Co., of Ridgway, Pa., at $3,975; dynamos, the General Electric Co., of Cincinnati, at $2,670.

Sumter, S. C.—The contract for lighting the city with electricity is stated to have been awarded to the Sumter Electric Light Co. at the following bid: For 40 arc lights, 2,000 c. p., $75 ea. per yr.; for additional lights in excess of 40 up to 50, $70 ea. per yr.; additional lights in excess of 50 up to 60, at $65 ea. per yr. For incandescent lights, used in and around the city hall, 50 cts. per mo.

ELECTRIC RAILWAYS.

Eastport, Me.—John H. M. Fane writes that the Eastport Street Railway Co. has a charter, but that work of construction will not be started before the spring.

Cleveland, O.—E. P. Bates, Gen. Mgr. of the United States Construction Co., writes that the company is in the market for a complete electric railroad equipment.

Cleveland, O.—The Cleveland & Chagrin Falls Electric Ry. Co. is reported to have bonded its line for $300,000, and will build an extension to Warren at once.

Fairfield, Me.—The Benton & Fairfield Ry. Co., of Fairfield, is stated to have petitioned the State Railroad Commission for permission to extend its line.

Englewood, N. J.—John Hull Browning, of Tenafly, N. J., is reported to be interested in the construction of a trolley line from this place to Nyack.

Durand, Mich.—It is stated that C. Crane will petition the Council for a franchise for an electric railway to be known as the Durand & Argentine Electric Ry. Co.

Cliffside, N. J.—We are informed that the Bergen County Traction Co., office address foot of West 130th St., New York City, is obtaining rights of way for a proposed electric line from Ft. Lee ferry at Undercliff to Hudson County, via Cliffside.

Hamilton, O.—The Hamilton & Eaton Electric Ry. Co. has been formed, and right of way has been secured, for a line between Hamilton and Eaton, a distance of about 125 miles; capital $10,000. Incorporators: J. E. Anderson, J. H. Shallenberger and others.

Erie, Pa.—The following ordinances were passed by the Council, Dec. 12: Granting a franchise to the Erie Rapid Transit Co. (the North East Line) and to the Erie Transit Co. (the Edinboro line), and also to the Erie Electric Motor Co. to extend its West 26th St. line.

Birmingham, Ala.—The Birmingham Railway & Electric Co. has received a franchise to extend its line.

Leavenworth, Kan.—The County Commissioners have granted Amos A. Fenn a franchise for an electric railway between this city and Kansas City; probable cost of work, $500,000.

Washington, D. C.—The District Commissioners are stated to have granted the Columbia Ry. Co. permission to change the motive power of its road from cable to electricity. Theo. J. King, Secy. and Supt.

Elmira, N. Y.—The American Engineering Co., of Bound Brook, N. J., is stated to have received the contract for constructing the Elmira & Seneca Lake Electric Ry., from Watkins to Horseheads.

Belleville, Ill.—The Belleville Electric Ry. Co. is stated to have petitioned the Council for permission to extend its line.

Newport, R. I.—The Newport St. Ry. Co. has applied for permission to extend its line.

Youngstown, O.—The Youngstown & New Castle Electric Ry. Co. is stated to have been formed to construct a line between this city and New Castle. Incorporators: D. S. Miller, Edward Gray and others.

Stonycreek Mills, Pa.—We are informed that preliminary surveys have been completed by the United Traction Co. for an electric railway, six miles long, between Stonycreek Mills and Friendensburg. N. S. Davis, Engr. in charge, 519 Court St., Reading, Pa.

Cincinnati, O.—It is stated that a company has been formed to build an electric road from the Norwood terminus of the Consolidated line to Lebanon. Chas. T. McRae, of College Hill, is said to be interested.

Fort Smith, Ark.—Harry E. Kelley, Secy., writes: "The Midland Co. has been organized, primarily for the purpose of improving a tract of land between Fort Smith and Van Buren, and incidentally to build an electric road between these two places in case other parties who have begun on such a road do not complete it within a reasonable time. The probable cost of the road is $60,000, aside from the cost of a bridge over the Arkansas River, which is about $125,000."

Riverside, Cal.—The Riverside & Arlington Ry. Co. has applied for a franchise.

Phœnixville, Pa.—Joseph MacCarroll, Pres. Fairmount Construction Co., Philadelphia, Pa., writes that his company has secured the contract for constructing 17 miles of electric railway. Work will be commenced in January, and it is hoped to have cars running between Spring City and Phœnixville by May 15.

Redlands, Cal.—J. H. Fisher, Secy. Redlands Street Railway Co., writes that bids will be received on 40-lb. rails, cars, wire, etc. Probable cost of work under consideration is $35,000.

Terre Haute, Ind.—Forbes Holton, a glass manufacturer; M. R. Williams, Mgr. of tne Strawboard Trust plants, and Crawford Fairbanks, are stated to have formed a company to build an electric railroad from Terre Haute via Mattoon, Ill., to Charleston.

Philadelphia, Pa.—The Inter-Urban Co. is reported to have decided to build a trolley road through Delaware, Chester and Lancaster Counties. W. T. Forsythe, of Avondale, Chf. Engr.; J. Preston Thomas, of Whitford; Dr. Geo. Morris Philips, of West Chester, and others are said to be interested.

Springfield, Ill.—Plans are stated to have been completed for an electric railroad between this city and Decatur. F. L. Sparrow, of Chicago, is said to be interested.

Bucyrus, O.—W. E. Haycox, of Mansfield, and F. C. Boyd, of New Haven, are stated to be interested in the construction of an electric railway between Galion and Bucyrus.

Noblesville, Ind.—Chas. L. Harry is stated to have petitioned the County Commissioners for a right of way for an electric railway through the county.

Wheeling, W. Va.—The Council is stated to have granted permission to the Wheeling & Elm Grove R.R. Co. to construct a line on 14th St.

Baltimore, Md.—The Baltimore & Northern Ry. Co. has applied for a franchise to extend its line on Woodbury Ave. Bids will be received for this franchise Jan. 9. Chas. D. Fenhagen, Controller.

RAILROADS.

Detroit, Mich.—H. D. Ludden, City Engr., writes that the Council has under consideration the proposition to construct an elevated railway connecting the railway depots on the east and west sides of the city.

New London, Conn.—Patrick H. Fitzgerald, of New London, is reported to have received the contract for building 2½ miles of railway for the New London & Northern R. R. Co.; contract said to be $100,000.

Pittsburg, Pa.—A charter has been granted to the Pittsburg & Allegheny River R. R. Co., with a capital of $30,000, to build a railroad 3 miles long. Incorporators: J. H. Park, of Pittsburg; D. E. Park, of Allegheny; W. G. Park, of New York, and others.

Truckee, Cal.—The Lake Tahoe Ry. Co. has been incorporated, with a capital of $100,000, to build a narrow-guage road from Truckee to Lake Tahoe. Directors: N. K. Masten, of San Francisco, and W. B. Tobey and D. L. Bliss, of Carson City, Nev.

Gloucester, Va.—The Board of Supervisors of Gloucester County are stated to have voted a subscription of $30,000 to the Richmond & Tidewater R.R. Co., if the road is built from Richmond to Gloucester Point.

Irondale, Mo.—It is stated that a corps of engineers have commenced the survey for the new standard gauge road for the Irondale & Farmington R.R.

Olympia, Wash.—The Clear Water Short Line Ry. Co. has filed with the Secretary of State certificates for a right of way for two branch lines in Washington and Idaho. Thos. Cooper, of Tacoma, Resident Agent for this State.

NEW DEPOTS.

Danville, Ill.—It is stated that a union depot will be erected here.

Pittsburg, Pa.—We are informed that the Pittsburg & Lake Erie R. R. Co. will call for bids in March, 1899, for a new depot to cost $250,000. J. A. Atwood, Ch. Engr.

PUBLIC BUILDINGS.

Hiltonhead, S. C.—Bids are wanted Dec. 27 for one set officers' quarters, two barracks, one hospital, one ordnance storehouse, etc. Chief Quartermaster John Simpson, Atlanta, Ga.

Osceola Mills, Wis.—Bids are wanted Jan. 3 for a jail and sheriff residence. H. P. Burdick, St. Croix Falls, Wis.

Princeton, Minn.—Bids are wanted Jan. 7 for church. D. A. Kalíher, Chmn. Bldg. Com.

New York, N. Y.—Bids are wanted Dec. 30 for alterations, general repairs and improvements to the station houses in the 6th, 11th and 18th precincts. William H. Kipp, Ch. Clk. Police Dept.

San Antonio, Texas.—Alfred Giles, San Antonio, is said to be preparing plans for a 5-story fireproof building for the San Antonio Loan & Trust Co. G. B. Taliaferro, Secy.

Easton, Pa.—The City Council has been asked to submit to the voters at the February election the question of issuing $100,000 bonds for a municipal building.

New York, N. Y.—It is stated that the General Theological Seminary of the Protestant Episcopal Church will shortly erect a $100,000 hall.

Lansing, Mich.—The plans of Pratt & Koeppe, of Bay City, are stated to have been accepted for a building for the Michigan Agricultural College; probable cost, $75,000.

Boston, Mass.—It is stated that Peabody & Stearns, 53 State St., will prepare plans for a hotel, to be erected on the site of the Bellevue Hotel.

Douglas, Ga.—The plans of Andrew J. Bryan & Co., of Atlanta, are stated to have been selected for a court house; probable cost, $15,000.

Chicago, Ill.—Holabird & Roche, 1618 Monadnock Bldg., are said to be preparing plans for a 10-story building for the Cable Piano Co.; probable cost, $100,000.

White Plains, N. Y.—The Board of Supervisors are stated to have decided to erect a new building on Court St., adjoining the present court house.

Lestershire, N. Y.—The plans of J. Lewis Weir, of Lestershire, are stated to have been accepted for the new city building; probable cost, $22,000.

Utica, N. Y.—Architect Lampert, of Rochester, is reported to be preparing plans for an opera house to be built here for Manager Jesse L. Oberdorfer, of Syracuse; probable cost, $50,000.

Pittsburg, Pa.—The St. Augustine R. C. Church will erect a new building, to cost about $100,000.

New York, N. Y.—Plans are being prepared for a 10-story addition to the store of H. O'Neill & Co., 6th Ave. and 20th St.

Des Moines, Ia.—It is stated that the Building Committee of the City Library Board of Trustees, will receive plans Jan. 10 for a city library; probable cost $110,000. A. P. Fleming, Chmn. Com.

Danville, Ill.—Bids are wanted Dec. 30 for laundry machinery, engine, etc., in the laundry building at the Danville branch of the National Home for D. V. Soldiers, as advertised in "The Engineering Record."

New York, N. Y.—The following appropriations are included in the budget for 1899: $7,673,640 for new schoolhouses and sites; $2,000,000 for new Hall of Records; $1,000,000 for public library, and $1,000,000 for new public buildings.

Washington, D. C.—Bids are wanted Jan. 21 for a building for the Evening Star Newspaper Co. Marsh & Peter, Archts., 1503 Pennsylvania Ave.

Mineola, N. Y.—The Supervisors are stated to have decided to receive plans Jan. 18 for a court house and jail for the new County of Nassau; probable cost, $100,000.

Brooklyn, N. Y.—The following bids were opened Dec. 22 for repairs and alterations to the Municipal Building: Leonard Bros., 963 Bergen St., Brooklyn, $32,690; Charles Hart, 4th Ave., corner Degraw St., Brooklyn, $33,400; Kelly & Kelley, 220 Bway., New York, $32,904; Newman & Co., 355 Allen St., Brooklyn, $31,750.

Waupaca, Wis.—The plans of Buemming & Dick, of Milwaukee, are stated to have been accepted for a hospital at the Wisconsin Veterans' Home; probable cost, $18,000.

New York, N. Y.—Bids are wanted Dec. 30 for installing bath and wash room in workhouse, and showers, plumbing and partitions in the bath house in penitentiary, Blackwell's Island. Francis J. Lantry, Commr. Dept. Correction.

Chicago, Ill.—Bids are wanted Dec. 28 for iron work in the Chicago Public Library. W. B. Wickersham, Secy. Bd. Directors, Chicago Public Library.

Phoenix, Ariz.—Bids are wanted Jan. 25 for a dormitory; also water and sewer system, at the U. S. Indian school. W. A. Jones, Commr. of Indian Affairs, Dept. of the Interior, Washington, D. C.

New York, N. Y.—The following bids were opened Dec. 20 for a steam heating apparatus in Zebrowski Mansion, Claremont Park, Bronx Borough: N. Y. Steam Fitting Co., $1,370; Phillips, Doup & Co., Brooklyn, $1,164; Jas. Curran Mfg. Co., 512 W. 36th, $1,421; Wm. W. Tobin, 532 Columbus Ave., *$1,140; E. Rutzler, 176 Centre, $1,222; the Wells & Newton Co., 235 Eldredge, $1,238; Francis A. Williams, 362 W. Broadway, $1,464; Frank Dobson, 576 W. 142d, $1,374; Jas. D. Duffy, 344½ E. 16th, $1,386.

*Contract awarded.

Cincinnati, O.—Bids are wanted Jan. 5 for the following improvements in the public library: Brick and cut stone work, galvanized, wrought and cast-iron work, plumbing, etc., for proposed alterations and additions; also for one hydraulic elevator, one pump, two tanks and necessary pipe connections. L. L. Sadler, Chmn. Bldg. Com.

NEW FACTORIES.

The Perkins Manufacturing Company, Augusta, Ga., intends to erect early in 1899 additions to its door, sash and blind factory of a 50x200-foot building, and a 40x200-foot building, each three stories.

The Brown Manufacturing Company, Greeneville, Tenn., will resume work in the spring on its two-story factory, 75x150 feet.

Brooks, Trammell & Co., Greenwood, S. C., are asking bids for an ice plant of five tons daily capacity to cool also two rooms.

MANUFACTURING NOTES.

The New York office of the Detroit Graphite Manufacturing Company in the Home Life Insurance Building having been destroyed by the fire in that building, the company has opened a new office in the St. James' Building, No. 1133 Broadway, corner of Twenty-sixth Street.

Some few days ago there was sent to the Thomson Meter Company, of Brooklyn, N. Y., from a large city, a 6-inch water meter, No. 44,368 for repairs. On examination it was found that this meter was sold on October 17, 1893, since which time it has registered 99,989,870 cubic feet, or 749,924,025 gallons of water, and it has never been repaired before. The cost of repairs on this meter to put it in as good shape as new was less than $28.

The Boston and Maine Railroad Company is erecting at Portsmouth, N. H., a building for its electric power station. The building is 118 feet wide, and 64 feet long, divided into two rooms, one for the boilers and the other for the engines and electric generators. The side walls are of brick, and the roof construction fireproof. The trusses are of steel, and they support steel beams for the purlins on which is to be placed a concrete roof. The contract for the steel work was given to the Berlin Iron Bridge Company, of East Berlin, Conn.

BUILDING INTELLIGENCE.

NEW YORK, N. Y.

26-28 Market st, br stores and flat; cost, $50,000; o, Jacob Fischel; a, Horenburger & Straub.

10th ave, s e cor 21st st, br refectory and gymnasium and living apartments; cost, $100,000; o, General Theological Seminary; a, C C Haight.

W s Madison ave, from 119th-120th st, 8 br flats; cost, $180,000 all; o, J & G J Fleischman; a, G F Pelham.

E s West End ave, 50 s 106th st, br stores and flat; cost, $110,000; o, Wm H Picken; a, Hy Andersen.

E s Riverside Drive, 76 s 95th st, br flat; cost, $140,000; o, Peter Talbot; a, Jno Wooley.

S s 80th st, 100 w West End ave, stone and br flat; cost, $95,000; o, Michl Tully; a, Janes & Leo.

S s 124th st, 275 w Columbus ave, br flat; cost, $23,000; o, John Fish; a, Schneider & Herter.

S s 124th st, 225 w Columbus ave, 2 br flats; cost, $46,000; o, H D A Rauhahn; a, Schneider & Herter.

S s 124th st, 300 w Columbus ave, br flat; cost, $23,000; o, E Schulz; a, Schneider & Herter.

N s 113th st, 100 e 8th ave, 4 br flats; cost, $120,000 all; o, John Acker; a, Chas Stegmayer.

N s Lawrence st, s s 127th st, 250 w Columbus ave, br stable, storage and office; cost, $20,000; o, Kertcher & Co; a, Henri Fouchaux.

W s Amsterdam ave, 24 s 142d st, 3 br tenements; cost, $57,000 all; o, Clarence A Lent; a, W O Tait.

St Nicholas ave, s w cor 153d st, 3 br and stone flats; cost, $325,000 all; o, Maurice Polk; a, Janes & Leo.

3d ave, n e cor Rose st, 2 br flats; cost, $40,000 all; o, Fred'k W Wane; a, W C Dickerson.

Melrose av, s e cor 158th st, br flat; cost, $19,000; o, James A Simpson; a, W C Dickerson.

3d ave, s w cor 138th st, br store and offices; cost, $25,000; o, Alonzo Carr; a, Harry T Howell.

Forest ave, n w cor 163d st, 3 br flats; cost, $40,000 all; o, Ellen Mulholland; a, Lawrence & Ringrose.

MISCELLANEOUS.

Fort Sill, Okla.—Stone and br school; cost, $15,000; o, U S Government.

New Haven, Conn.—Cor Columbus ave and Liberty st, br stores and tenement; cost, $10,300; o, Magnus Manson; a, L W Robinson.

Worcester, Mass.—Rear 262 Main st, br storage building; cost, $18,000; o, John E Day; a, Lewis Plack, Jr.

PROPOSALS OPEN.

Bids Close. — See Eng. Record.

WATER-WORKS.

Dec. 27. Pipe, Jersey City, N. J .... Dec. 17
Dec. 28. Pipe, etc., New York, N. Y .... Dec. 17
Dec. 28 Pump, etc., Albuquerque, N. M ..... Dec. 24
Dec. 29. Chicago, Ill. .... Dec. 24
Dec. 31. Brass castings, Chicago, Ill .... Dec. 10
Dec. 31. Bemidji, Minn .... Dec. 17
Jan. 1. Crisfield, Md .... Nov. 12
Jan. 2. Bonds, Stanberry, Nev .... Dec. 24
Jan. 3. Millvale, Pa .... Dec. 24
Jan. 3. Bonds, Northeast, Pa .... Dec. 24
Jan. 3. Bonds, Gaffney, S. C .... Dec. 10
Jan. 4. Oshawa, Ont .... Dec. 24
Adv., Eng. Record, Dec. 24.
Jan. 5. Darlington, O. T .... Dec. 17
Jan. 5. Chicago Junction, O .... Dec. 17
Jan. 5. Norfolk, Va .... Dec. 24
Jan. 6. Bonds, West Union, W. Va .... Dec. 17
Jan. 18. Winchester, Ind .... Dec. 24
Jan. 25. Phœnix, A. T .... Dec. 24
Jan. —. Bonds, Little Falls, Minn .... Dec 24
Feb. 13. Bonds, Reno, Nev .... Dec. 24
Mar. 15. Belem, Para, Brazil .... Nov. 26
—— Pump, Austin, Tex .... Sept. 10
—— Tempe, A. T .... Nov. 5
Adv, Eng. Record, Nov. 5, 12.

SEWERAGE AND SEWAGE DISPOSAL.

Dec. 26. South Bend, Ind .... Dec. 10
Dec. 27. Riverside, Cal .... Dec. 17
Dec. 27. Syracuse, N. Y .... Dec. 24
Dec. 28. Bonds, Hackensack, N. J .... Dec. 24
Dec. 28. New York, N. Y .... Dec. 17
Dec. 30. East Cleveland, O .... Dec. 3
Jan. 2. Bonds, Hamilton, O .... Dec. 10
Jan. 2. Hamilton, O .... Dec. 10
Jan. 2. Ditch, Ponca, Neb .... Dec. 24
Jan. 2. Kingston, Pa .... Dec. 24
Jan. 3. Cincinnati, O .... Dec. 10
Jan. 3. Mount Vernon, N. Y .... Dec. 17
Jan. 4. Pipe, etc., Columbus, Ga .... Dec. 24
Jan. 4. Oshawa, Ont .... Dec. 24
Adv., Eng. Record, Dec. 24.
Jan. 10. Bonds, Grass Valley, Cal .... Dec. 3
Jan. 14. East Cleveland, O .... Dec. 24
Jan. 15. New York City .... Dec. 3
Jan. 16. Elizabeth, N. J .... Dec. 24
Jan. 18. Aiken, S. C .... Dec. 17
Jan. 23. Sewer pipe, etc., New London, Conn. Dec. 24
Jan. 25. Phœnix, A. T .... Dec. 24
—— Pittsburg, Pa .... Nov. 5

BRIDGES.

Dec. 28. Chicago, Ill .... Nov. 5
Adv., Eng. Record, Dec. 3.
Dec. 28. Norfolk, Va .... Dec. 3
Adv., Eng. Record, Dec. 3 to 17.
Dec. 28. Plans, etc., Ogden, Utah .... Dec. 17
Dec. 28. Brooklyn, N. Y .... Dec. 17
Dec. 28. New York, N. Y .... Dec. 17
Dec. 29. Boston, Mass .... Dec. 17
Dec. 31. Plattsmouth, Neb .... Dec. 10
Dec. 31. Columbus, Neb .... Dec. 24
Dec. 31. Geneva, Neb .... Dec. 24
Jan. 1. Cathlamet, Wash .... Nov. 26
Jan. 2. Quebec, P. Q .... Oct. 1
Adv., Eng. Record, Oct. 1, 8.
Jan. 2. Aspen, Colo .... Dec. 17
Jan. 2. Newton, Ia .... Dec. 24
Jan. 3. Brookhaven, Miss .... Nov. 19
Jan. 4. Denison, Ia .... Dec 17
Jan. 4. Trent, S. Dak .... Dec. 24
Jan. 10. Hastings, Neb .... Dec 24
Jan. 17. Plans, Binghamton, N. Y .... ec. 24
Jan. 24. St Thomas, Ont .... Dec. 24
Jan. 31. Bonds, Jackson, Miss .... Dec. 24
Jan -- Hastings, Neb .... Dec. 10
—— New Kensington, Pa, ... Oct. 22
—— Plans, Lafayette, La .... Dec. 3

PAVING AND ROADMAKING.

Dec. 27. Atlantic City, N. J .... Dec. 17
Adv., Eng. Record, Dec. 17.
Dec. 27. Camden, N. J .... Dec. 24
Dec. 27. Syracuse, N. Y .... Dec. 24
Dec. 28. New York, N. Y .... Dec. 24
Dec. 28. Baltimore, Md .... Dec. 17
Dec. 28. New York, N. Y .... Dec. 17
Dec. 29. Bonds, Georgetown, Ky .... Dec. 3
Dec. 29. Louisville, Ky .... Dec. 24
Dec. 31. Steam roller, etc., New York, N. Y.. Dec. 24
Dec. 31. Keokuk, Ia .... Dec. 17
Jan. 2. Bonds, Tippecanoe City, O .... Dec. 10
Jan. 4. Beaumont, Tex .... Dec. 24
Jan. 5. Decatur, Ind .... Dec. 3
Jan. 7. Cincinnati, O .... Dec 17
Jan. 9. Houston, Tex .... Dec. 17
Adv., Eng. Record, Dec. 17, 24.
Jan. 17. Cincinnati, O .... Dec. 24
Feb. 27. Yonkers, N. Y .... Dec. 3

POWER, GAS AND ELECTRICITY

Dec. 26 Waterloo, N. Y .... Dec. 10
Dec. 27. Woodsfield, O .... Dec. 3
Dec. 27. Gas fixtures, Washington, D. C .... Dec. 10
Dec. 27. Wiring, Paterson, N. J .... Dec. 17
Dec. 28. Brooklyn, N. Y .... Dec. 17
Dec. 29. Power plant, etc., San Francisco, Cal .... Dec. 10
Dec. 29 Camden, N. J .... Dec. 24
Dec. 29 Topeka, Kan .... Dec. 24
Dec. 30. Wiring, etc., Syracuse, N. Y .... Dec. 24
Dec. 31. Eau Claire, Wis .... Dec. 17
Jan. 1. Bonds, Lawton, Mich .... Nov. 26
Jan. 2. Vincennes, Ind .... Oct. 22
Adv., Eng. Record, Oct. 22, Nov. 12, 26, Dec. 17
Jan. 4. Columbus, Ga .... Dec. 24
Jan. 6. Johannesburg, So. African Repub.. Oct. 22
Jan. 12. Annapolis, Md .... Dec. 17
Jan. 16. Duluth, Minn .... Dec. 10
Jan. 18. Winchester, Ind .... Dec. 24
Jan. —. Bonds, Little Falls, Minn .... Dec. 24
Mar. 1. Sault Ste. Marie, Mich .... Dec. 24
Mar. 31. Telephone, Shanghai, China .... Nov. 19
—— Pleasantville, O .... Dec. 24

GOVERNMENT WORK.

Dec. 27. Wiring, Paterson, N. J .... Dec. 17
Dec. 27. Gas fixtures, etc, Washington, D.C. Dec. 10
Dec. 28. Pump, etc., Albuquerque, N. M .... Dec. 24
Dec. 29. Boiler plant, etc., San Francisco, Cal. Dec. 10
Jan. 3. Cisterns, etc., Southport, N. C ...... Dec. 24
Jan. 3. Steel plates, Washington, D. C ...... Dec. 24
Jan. 5. New York, N. Y .... Dec. 24
Jan. 10. Cement, Duluth, Minn .... Dec. 17
Adv, Eng. Record, Dec. 17, 24.
Jan. 12. Cement, St. Paul, Minn .... Dec. 17
Adv., Eng. Record, Dec. 17, 24.
Jan. 12. Sea wall, Annapolis, Md .... Dec. 24
Jan. 14 St. Louis, Mo .... Dec. 24
Adv., Eng. Record, Dec. 24.
Jan. 19. Akron, O .... Dec. 24
Adv., Eng. Record, Dec. 24.
Jan. 19. Pottsville, Pa .... Dec. 24
Adv., Eng. Record, Dec. 24.
Jan. 20. Wharves, etc., Washington, D. C. . Dec. 24
Jan. 23. Stone, etc., New London, Conn .... Dec. 24
Jan. 24. Batteries, Fort Monroe, Va .... Dec. 24

BUILDINGS.

Dec. 27 Ventilating, etc., Cleveland, O ..... Dec. 3
Dec. 27. Hiltonhead, S. C .... Dec. 24
Dec. 28. Shell Lake, Wis .... Dec. 17
Dec. 28. Chicago, Ill .... Dec. 24
Dec. 29. School vent., etc., Brockton, Mass. Dec. 24
Dec. 30. Plumbing, etc., New York, N. Y.. Dec. 24
Dec. 30. Danville, Ill .... Dec. 24
Adv., Eng. Record, Dec. 24.
Jan. 2 School, Luverne, Minn .... Dec. 10
Jan. 3. Plans, Albany, N. Y .... Dec. 3
Jan 3. Ashland, Ky .... Dec. 10
Jan. 3 Balsam Lake, Wis .... Dec. 17
Jan. 3. Osceola Mills, Wis .... Dec. 24
Jan. 4. Library, Owatonna, Minn .... Dec. 17
Jan. 4. School, Wapakoneta, O .... Dec. 24
Jan. 5 Plumbing, etc., Cincinnati, O ...... Dec. 24
Jan. 6. Albany, Ore .... Dec. 10
Jan. 7. Princeton, Minn .... Dec. 24
Jan. 9. School, Wilmington, Del .... Dec. 3
Jan. 10. Plans, Des Moines, Ia .... Dec. 24
Jan. 18. Plans, Mineola, N. Y .... Dec. 24
Jan. 21. Washington, D. C .... Dec. 24
Jan. 25. Dormitory, etc., Phœnix, A. T ..... Dec. 24
Jan. 31. School bonds, Jackson, Miss ...... Dec. 24
Jan. 10. Phœnix, Ariz .... Dec. 3
Jan 10 Plans, etc., Boone, Ia .... Dec. 17
Jan. —. Superstructure, Newport, R. I .... Nov. 19
Feb. 1. School, Peoria, Ill .... Dec. 3
Feb. 10. Keyser, W. Va .... Nov. 5
—— Pittsburg, Pa .... Dec. 3
—— Machine shop, Birmingham, Ala... Sept. 3
—— School bonds, Franklin, Pa .... Dec. 24

MISCELLANEOUS.

Dec. 27. Scow, New York, N. Y .... Dec. 24
Dec. 28. Dredging, Brooklyn, N. Y .... Dec. 17
Dec. 28. Cement, Providence, R. I .... Dec. 24
Adv., Eng. Record, Dec. 24.
Dec. 30. Dumping cars, New York, N. Y .... Dec. 24
Jan. 9. Elec. Ry. franchise, Baltimore, Md.. Dec. 24
Jan. 14. Philadelphia, Pa .... Nov. 19
Jan. 15. Street cleaning, Indianapolis, Ind... Dec. 17
Jan. 19. Docks, etc., Cleveland, O .... Dec. 24
Jan. 24. Tunnel, London, England .... Nov. 5
Feb. 1. Crane, Townsville, Australia .... Dec. 17
Mar. 15. El. Ry., Shanghai, China .... Nov. 19
—— Garbage crematory, Newport, Ky.. July 30
Adv., Eng. Record, July 30.

NEW SCHOOLS.

McKeesport, Pa.—The plans of McCullum & Ely, Washington, Pa., are stated to have been accepted for an $80,000 high school.

Pawtucket, R. I.—The Council has appropriated $52,000 for two schools.

Kansas City, Kan.—Wm. W. Rose, Archt. Bd. Educ., is stated to have prepared plans for a $60,000 high school.

Pittsburg, Pa.—It is stated that a $40,000 school will be erected in the 18th Ward.

Wapakoneta, O.—Bids are wanted Jan. 4 for a school and auditorium. C. J. Heinl, Secy. Bldg. Com.

Boston, Mass.—Jas. Fagan has received the contract for the Quincy St. school, at $81,670.

New York, N. Y.—See "Public Buildings."

Franklin, Pa.—Bids will be received by the School Board for $15,000 bonds.

Jackson, Miss.—See "Bridges."

Brockton, Mass.—Bids are wanted Dec. 29 for ventilating and heating the Copeland School. Daniel D. Tilden, Chmn. Com.

STREET CLEANING AND GARBAGE DISPOSAL.

Wheeling, W. Va., — The Council Health Committee has under consideration various methods of garbage disposal.

Camden, N. J.—The following bids were opened Dec. 20 by the Street Committee: *a*, for repairing garbage crematory; *b*, for relining stack; B. F. Sweeton & Son, Camden, *a*, $974; *b*, $9.74 per ft. Burroughs & Madara, *a*, $1,733; *b*, $5.50 per ft. Burt & O'Hara, *a*, $990; *b*, $6.85.

New York, N. Y.—The sum of $100,000 for a new plant for the Street Cleaning Department is included in the budget for 1899.

Binghamton, N. Y.—The Health Commissioners have under consideration the construction of a garbage crematory.

New York, N. Y.—Bids are wanted Dec. 27 for a 200-ton scow and until Dec. 30 for furnishing 6 self-dumping cars for Riker's Island. Francis J. Lantry, Commr. Dept. of Correction.

Chicago, Ill.—The Finance Committee has ordered Commissioner McGann to advertise for the removal and disposal of city garbage.

GOVERNMENT WORK.

New York, N. Y.—The contract for mailing platform extension and shed for U. S. court house and post office has been awarded to W. G. Triest, C. E., 39 Cortlandt St., at $11,437, galvanized iron being used instead of copper.

New York, N. Y.—Bids are wanted Jan. 5 for renewing about 200 lin. ft. of sheet piling shore protection at Ft. Hancock, N. J., as advertised in "The Engineering Record."

Albuquerque, N. M.—E. A. Allen, Supt. U. S. Indian Service, writes that bids will be received Dec. 28 for a pump, tower, building, etc. Cost, $2,400.

Southport, N. C.—Bids are wanted Jan. 3 to furnish men's quarters, cisterns and hoisting apparatus for use in the marine hospital service at Cape Fear quarantine station. B. W. Brown, Passed Asst. Surgeon, Marine Hospital Service, Treas. Dept.

Fort Monroe, Va.—Bids are wanted Jan. 24 for 4 storage batteries. Maj. Thos. L. Casey, Corps Engrs., 166 Granby St., Norfolk, Va.

Annapolis, Md.—Bids are wanted Jan. 12 for constructing a sea wall at the Naval Academy. Ernest Flagg, Archt., 35 Wall St., New York, N. Y.

St. Louis, Mo.—Bids are wanted Jan. 14 at the U. S. Engineers' Office for three steel hulled steam tenders, as advertised in "The Engineering Record."

Washington, D. C.—Bids are wanted Jan. 20 for the construction of wharves and the excavation of slips in the harbor of Honolulu, Hawaiian Islands. R. B. Bradford, Ch. Bureau of Equipment, Navy Dept.

Pottsville, Pa.—Bids are wanted Jan. 19 by the Superv. Archt., Treas. Dept., Washington, D. C., for low pressure, return circulation steam heating and ventilating apparatus for the U. S. Post Office, as advertised in "The Engineering Record."

Toms River, N. J.—The following bids were opened Dec. 21 at Washington for a life-saving station on Berkeley Beach, N. J.: Leonidas J. Stone, Haddonfield, N. J., $7,100; Bernard Johnson, West Hoboken, N. J., $8,966; Henry A. Tolbert, Barnegat, N. J., $6,650; W. H. Glover Co., Rockland, Me., $6,700; Wm. L. Butler, Beach Haven, N. J., $6,499; Charles W. Kafer, Trenton, N. J., $7,468.

Akron, O.—Bids are wanted Jan. 19 by the Superv. Archt., Treas. Dept., Washington, D. C., for the low pressure return circulation steam heating and ventilating apparatus for the U. S. Post Office Building, as advertised in "The Engineering Record."

New London, Conn.—Bids are wanted Jan. 23 for broken stone, sewer pipe, manhole covers, etc. Maj. Smith S. Leach, Corps of Engrs., U. S. A.

Washington, D. C.—Bids are wanted Jan. 3 for furnishing steel plates at the navy yard, Mare Island, Cal. Edwin Stewart, Paymaster Gen., U. S. Navy, Bureau Supplies and Accounts, Navy Dept.

New York, N. Y.—It is stated that the lowest bid received for erecting a storehouse at the Brooklyn Navy Yard was from M. Gibbons & Son, of Brooklyn, for $62,975.

CUBA.

Army Buildings.—Press reports state that bids were opened Dec. 15 at the Quartermaster's Department, Washington, D. C., for constructing warehouses and other buildings at Casa Blanca, opposite Havana, for the use of the United States troops. The lowest bidder was D. Vanaken, of New York, at $39,900.

Sewerage and Paving.—The New York Herald states that the Municipal Council, at Havana, has approved the $12,000,000 sewerage and paving project of M. J. Dady, of Brooklyn. Later reports state that the U. S. authorities at Havana have protested against this action of the Council.

MISCELLANEOUS.

Buffalo, N. Y.—Local reports state that bids will soon be asked for widening and deepening a portion of Buffalo River and Cazenovia Creek. City Engineer Bardol estimates the cost at $570,000.

THE ENGINEERING RECORD.
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TABLE OF LEADING ARTICLES.

The Engineering Record, conducted by Henry C. Meyer, is published every Saturday at 100 William Street, New York. Its opinions on technical subjects are either prepared or revised by specialists.
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GRADING ENGINEERS BY EXAMINATION.

The examinations which were recently begun by the Institution of Civil Engineers to determine the eligibility of candidates for admission to certain grades of membership have had the expected result of producing a wave of protest in the British technical papers. The various communications on this interesting subject which have appeared from time to time are counterparts of the statements made in the United States concerning civil service examinations for engineering positions under national, state and municipal governments. In the case of the British examinations, it was found, according to friends of the welfare of the Institution of Civil Engineers, that men were crowding into that organization whose qualifications for membership were based rather on the kindness of their friends than on any special competence they had manifested. A correspondent of "The Engineer" pointed out that under the new regulations the examination affords a means of extending an empty but unavoidable courtesy to an engineering friend, for, under the rules, no matter how well recommended a candidate may be, if he cannot pass an examination he cannot enter that body. In this way the examinations, of course, are a good thing, when viewed from the standpoint of the individual member who is asked to act as a referee for a candidate, but from the standpoint of the association this condition may work harm, for, when all is said and done, what is said of an engineer by his associates in the profession has much weight with the public at large.

According to a review of the subject by the journal just mentioned, the objections to the Institution's examinations proceed from men who have attained a considerable reputation and even some eminence in particular branches of the profession, and from young men or middle-aged men who cannot, or at all events think they cannot, pass the examination. The former class considers it an indignity to be asked to answer question papers before it is admitted to a professional organization, and the second class, which may not have had the advantages of technical schools, holds that the experience which it has gained should be considered more than an offset to the theoretical information obtained in the schools; question papers, however, do not bring out this practical knowledge as they do the more theoretical information of the candidate. What "The Engineer" has to say on this subject deserves careful attention.

"It is urged that the examination gives no clue and can give no clue to the merits or demerits of the candidate as an engineer practicing his profession. This is, on the whole, quite true. But the examination is not in any way intended to settle the point. One of the most curious mistakes about the whole matter is the understanding that the examination is a pass examination. That is to say, if the examiners are satisfied, then the candidate at once becomes an Associate of the Institute. Nothing can be further from the truth. While he cannot at all become an Associate if he does not pass, the passing in no way secures his election. In a word, the candidate has just the same ordeal to go through as before, and he has the examination thrown in as an extra. The objection to the entrance examination for the Institution is based on the peculiar conditions under which the profession has been practiced. In all other cases, almost without exception, an entrance examination is passed by young men fresh from school or college. They have at once plenty of time in which to grind, and that special facility for absorbing book learning which is peculiar to youth. If all the candidates for membership of the Institution were under 20 years of age we should have heard very few complaints; and we believe that it is the desire of the Council that in process of time this entrance examination shall be passed by very young men—students of the Institution, in short. Once through, their names can be subsequently brought forward as candidates for associateship or membership as time passes. But at the present moment there is no doubt a large number of men still young, but no longer youthful, who are quite eligible for election as Associate, but who are entirely unable to get through the examinations. It is no disparagement to any one to say that very few engineers in practice could pass without cramming. We do not believe there are five men now on the Council who could get through without preparation. But for this preparation busy men have no time, and the result is that they find themselves excluded from the Institution, to which they are very well entitled to belong. There is more than one way to get over the difficulty; in the first place the Council can, if they see fit, dispense with the examination. Another plan suggested is an alteration in the examination papers, which will enable the candidate to utilize the knowledge which he really possesses and by which he earns his bread. Unfortunately it is impossible to do this. The candidate for a diploma in medicine or surgery is tested in the practice of the profession by the examiner. He is shown patients. He has to say what is the matter with them and how he would treat them. The Institution of Civil Engineers cannot take a candidate to a broken bridge and ask him why it has broken. They cannot set him down in the fields with a level or a theodolite, and tell him to trace a line of railway; nor can they give him charge of a machine shop and see how he manages men or deals with piece-work prices. The practical examination is, to a certain extent, out of the question. There remains, then, the examination in theory, and that can, we think, be so conducted that many objectors will be silenced. There are not, we are sure, any engineers in the present day who would attempt to maintain that theory is useless. The examinations of the Institution may very well be directed to ascertaining whether the candidate does or does not understand the inwardness of any given practical problem—the reason why a particular way of doing a given bit of work is better or worse than any other way."

Engineers who have talked with their associates in this country who have passed civil service examinations or have employed assistants obtained in this manner will find these criticisms have a familiar ring. It is quite important, however, to notice a distinction between the results of failure to pass an examination for the Institution of Civil Engineers and failure to pass a civil service examination in the United States. In the former case the result is simply to keep the candidate out of a professional body; in the latter case it keeps him out of employment. In the former case it affects his pride; in the latter case his pocket. If, therefore, the examining board of the Institution of Civil Engineers is criticised for setting questions which no sane engineer should be expected to answer without a preliminary grind, it is worth considering whether the many complaints against the questions set in this country may not be still better founded. The examination papers are supposed to be set by engineers, but "The Engineering Record" can say of its own knowledge that many questions set in three recent examinations were ridiculous. Not long ago the head of one of the most important engineering bureaus of a leading city needed an expert assistant. The civil service commission would not think of allowing this gentleman to draw up a list of questions which would in some manner tend to bring out the fitness of the candidate for the position. On the contrary, they turned the preparation of the questions over to one of their own examiners, who drafted a paper which he considered to bring out the fitness of the various candidates for this particular responsible specialized office. The head of the department happened to see a copy of this paper. There were ten questions set. Three of these he was pretty sure he could answer correctly, a fourth he had some doubts about, and the remaining six he knew he could not answer. In another instance "The Engineering Record" knows that a large undertaking involving the expenditure of several million dollars by a state government was seriously delayed and hampered throughout its whole progress by the impossibility of obtaining suitable engineering assistants through the state civil service examination. The papers set on these examinations were notoriously inadequate to bring out the fitness of the candidate for the particular work in question, and the men who were wanted would not even attempt to pass the examination, for the inducements were not great enough for reviewing all the subjects covered by the questions they had to expect.

It seems time, therefore, that something was done to harmonize the present strained relations obtaining in most places in this country where engineers are selected by examinations. The obvious remedy would be to have an engineer, when he applies to a civil service board for assistants, send at the same time some twenty questions covering the nature of the work for which the assistants are desired, and bringing out as far as practicable their theoretical information and practical experience. The great objection which would be met by advocates of such a system is, of course, that the civil service examination might become a farce by collusion between the engineer and some of the candidates. The claim would undoubtedly be made at times that the engineer sent his questions to his favorite candidates, so they could become acquainted with the subject before they went into the examination room. In answering this objection, but one thing can be said. In every undertaking involving more than one man, trust has to be placed somewhere. Under the present system of examination, implicit trust seems to be placed in the examiners of the civil service commissions; under the proposed system it would be placed in the heads of departments. The present system has been very strongly condemned a number of times recently by engineers in responsible places who have been debarred from getting

suitable assistants on account of its faulty work. The proposed system might therefore be very well introduced and given a trial, for it is certain that the objections to the other now raised in this country, if true, indicate that many engineers are being kept out of good positions and many cities are losing the services of good men through the poor work of the commissions. If this subject is so important in England, where a man is only indirectly affected financially, it is still more important in this country, and it would be an excellent idea, in the opinion of this journal, if it could be discussed by some of the leading associations, the weight of whose influence one way or the other would do much to quiet the present discontent.

THE NEW WATER RATES IN MILWAUKEE.

For several months the municipal authorities of Milwaukee, Wis., have been discussing the subject of water rates, which was precipitated by a request by the mayor of that city for a uniform schedule for large and small consumers alike. It was pointed out in these columns at the time that an absolute rate of so much per thousand gallons, or the equivalent, would be hardly just, for a number of reasons which it is unnecessary to refer to in this place. The Board of Public Works of Milwaukee has apparently taken this view of the matter. In the new schedule, which has just been received from City Engineer Benzenberg, president of the board, an unusually thorough attempt has been made to place fixture and meter rates on a par and to provide means for keeping them so. This schedule is now in the hands of the council's committees of water-works and finance, but it is understood that it will be made a law as it stands.

According to the new regulations, wherever water is supplied to a consumer, public or private, through a pipe 2 inches in diameter or larger, it must be measured by a meter and paid for by meter rates. Moreover, all supplies to consumers like saloons, livery stables, malthouses, laundries, breweries, hydraulic elevators, hydraulic motors, distilleries, beer bottling establishments, tanneries, dye houses and railways must be metered. A charge of $1 a year is made for reading each meter, and all metered water must be paid for at the rate of 4½ cents per hundred cubic feet or 6 cents per thousand gallons, no deductions to be made on account of any leakage, wastage, or large consumption. It will be noticed that the schedule provides for no minimum meter rate, except the dollar a year for reading; such a minimum rate could not be passed in the present state of public opinion in Milwaukee. Water used for any purposes beyond the city limits must be metered, and 25 per cent. is to be added to the regular charge. Any property fronting the city limits shall pay, in addition to this 25 per cent., the regular water pipe assessment for mains laid on the roadway bounding the city. Any person connected with the city water supply can have a meter attached to his service pipe at his expense, and is then privileged to pay for his supply by meter rates. He must pay for the maintenance of the meter.

While this meter schedule is distinctly novel, it by no means furnishes so much food for reflection as the schedule of annual water rates. For dwelling houses for one family, the rates range from $4 a year for a house of one or two rooms to $18 for one of 17 or 18 rooms. Houses occupied by more than one family pay these rates and $4 for each additional family beyond the first. Boarding houses accommodating not more than four boarders are rated as dwelling houses. Those accommodating more than four are rated as hotels and must pay $1.50 a year for each room. These rates, which include one free sink or faucet, are for the general uses of water in and about the premises, while the rates for special uses are classified under three divisions. The first division includes lavatory fixtures; the second, street and lawn sprinklers, fountains and private stables, and the third comprises various business establishments. Under these regulations a theater, which is specially designated as in class 3, pays from $10 to $15 for the general use of water, and must also pay for each of the fixtures which are specially assessed in the first division.

The rates in these various classes are based upon a carefully estimated consumption and entitle the consumer to 45.66 gallons of water per day for every dollar he pays in annual rates. Mr. Benzenberg stated at the various hearings on the new schedules that the city engineer's office was in possession of information enabling it to estimate closely the amount of water used legitimately from fixtures of various classes, and it is natural to assume that the new rates embody his views as to these figures. In order to be sure, however, that a consumer who pays by the fixture rates is not getting more for his money than the consumer who pays by the meter rate, which, it will be noted, are really identical, the Commissioners of Public Works have included in their rules and regulations for the use of water a clause which reads as follows:

"Whenever the Water Department has reason to believe that any consumer is using more water than the amount set opposite the rate he or she is paying in this table, the Board of Public Works will place a meter on the water service pipe supplying such consumer, for the purpose of measuring the water consumed, and charge for the amount consumed according to meter rates; provided the amount charged shall not be less than the regular rate charged in the foregoing classes."

Precisely the same idea has been followed out for the public uses of water, and the new regulations provide schedule rates for fire and drinking hydrants, flushing sewers of various sizes, settling trenches, and similar purposes. Moreover, many classes of work which require a small amount of water for a short time, particularly mason work, have a particular charge made against them in accordance with the usual practice in such matters.

This schedule is probably the first attempt of the sort made in this country, and its operation will be followed with interest by all water purveyors. It will be noticed that it aims to distribute the cost of supplying water equitably over all consumers and the city as a whole, and provides an unusual safeguard for equalizing the meter and fixture rates, inasmuch as no consumer of water by a fixture rate has any right under the rules to use more than a certain amount of water per day for each dollar he pays as an annual rate. Under the usual causes there is no such actual statement of quantities made, and it is simply provided that the authorities may attach meters where it is believed there is an unwarranted use or waste of water.

There seems to be just one criticism to be made on the rates as now laid down, and this is a criticism on popular feeling rather than on the Board of Public Works. It is that while the lowest rate for houses has been fixed at $4, the lowest rate for a metered service is simply $1. That charge of $1 has apparently been made to cover the expense of reading the meter. The charge of $4 not only covers the equivalent expense of the visit of the assessors who examine the fixtures of every house once a year, as well as all new plumbing work, but it also helps to pay the clerical work in the accountant's office. It is doubtful if one dollar covers the expense to the city of keeping track of a service provided with a meter, even if that service has been out of use throughout a year. The meter reader must visit it just as often as if it ran at its full capacity all the time. The same amount of bookkeeping is necessary as if the meter were in use, and the only saving is the fact that no bill must be rendered against the owner or consumer, as the case may be.

NOTES.

The Philadelphia Water Question is fast becoming a mere matter of dirty politics, with a private franchise somewhere in the background. This was well shown by the action of the Water Committee of Councils on December 19 in demanding a plan for a system of filtration without allowing the Bureau of Water time or money to investigate the subject. One committeeman said he was opposed to all schemes for private control of the water-works, but if the Department of Public Works was incompetent to produce a plan for their improvement, the sooner that fact became known the better. Then he tried to show that the department was incompetent, but very unsuccessfully. It is evident that no stone is being left unturned to spread abroad the idea that the Bureau of Water is so badly managed that the water-works should be turned over to a private company.

The Litigation between the two large canal interests in Illinois is finally ended by a decree of the courts and an agreement between the Trustees of the Sanitary District of Chicago and the State Commissioners of the Illinois and Michigan Canal. The principal question involved was that of water power, and the Canal Commissioners retain all of this and any new power which may be developed by the increased volume of water from the drainage channel. This litigation possesses unusual interest from an engineering point of view because of the many hydraulic questions involved, including the navigation of canals and locks, the flow of large volumes of water over broad crested dams, water power, tests of water wheels, measurement of stream flow, velocity in regular channels and the hydraulics of canals. The Sanitary District's engineering corps was assisted by Messrs. John T. Fanning, George W. Rafter, George Y. Wisner, A. V. Powell, W. H. S. McHarg and others, while the Canal Commissioners called on their side Messrs. John Bogart, Albert Porter, Samuel G. Artingstall, William Sooy Smith, John W. Alvord, George H. Benzenberg, Daniel Mead and others.

An Interesting Piece of Bridge Moving was accomplished at Milwaukee, Wis., a few days ago, when a 200-ton single-track drawbridge on the Chicago & Northwestern Railroad over the Kinnickinnic River was moved about 300 feet and set in the new position ready for train service in about three hours. Two 70-foot scows were partly sunk by water ballast and run under the span, one on each side of the pivot pier. Then they were pumped out and rose till the blocking on their decks took bearing on the under side of the bridge and raised it clear of its sub-structure. The scows were hauled by steam tackle attached to adjacent piers, the bridge located in the new position and lowered to its permanent bearing by pumping water into the scows with two fire tugs and two fire engines. A similar method has been employed for shifting old draw spans in Chicago, and for the erection of various important new bridges, though most, if not all, of the latter have been moved by tug boats. Important examples are the Hawkesbury bridge, Australia; the Coteau bridge, Canada; the Ohio River connecting bridge, Brunot's Island; the Belle Isle bridge, Detroit, and the Harvard bridge, Boston. Descriptions of this work may be found in "The Engineering Record" of June 29, 1889; September 13, 1890; June 6, 1891, and November 7, 1896.

THE NEW SOUTHERN TERMINAL STATION, BOSTON.

According to the census of 1895, the population of New York, Boston, Philadelphia and Chicago was respectively in round numbers 4,700,000, 2,400,000, 2,300,000 and 1,200,000, considering in each case a circle 50 miles in radius concentric with the city proper. The population contained within Boston's 10-mile circle was 890,000, and within its 20-mile circle 1,217,000. These figures indicate the density of the suburbs from which the city's passenger traffic is largely drawn. At present over 50,000,000 people are estimated to be carried in and out of Boston annually on the steam railway cars alone. In order to suitably accommodate and develop this traffic, operations have for some time been in progress for the construction of improved union terminals to concentrate the railway tracks at two convenient points, and provide not only for the long distance passengers of the steam roads, but also for the immense and increasing volume of local suburban passengers or commuters who will be transported by electric or other systems.

There were eight separate railway terminal stations in simultaneous use in Boston, when it was determined to replace them by two great union terminals in the north and south sides of the city. One of them now accommodates all the roads entering from the North and East, is called the Union Station, and has been built at Causeway Street. According to a legislative act of 1896, the new Southern Terminal Station at Summer Street was authorized to receive the roads from the South and West, and will be the terminus for the New York, New Haven & Hartford and for the Boston & Albany railroads, their leased lines and branches, whose officers constitute the Boston Terminal Company, which has designed and constructed the depot and yards. About 40 acres of land is to be occupied by tracks, yards and buildings, and about $9,000,000 will be expended for real estate and $4,000,000 for construction. Mr. George B. Francis, M. Am. Soc. C. E., is resident engineer of the Terminal Company. The new station is now practically completed and ready for train service.

A general description of the conditions and design and the principal diagrams were published in "The Engineering Record" of January 2, 1897, and should be read in connection with the description of the structure in this article. The location and arrangement of tracks and the outlines of yards and main buildings were shown in Figures 2 and 3 of that article. The construction of the terminal required the removal of about two hundred old buildings from the site, many of them valuable and well built. The site is largely on made ground, and required difficult foundation and drainage work. The principal engineering problems involved were the construction of sea wall and cofferdam, the foundations, water-proofing, the arrangement of tracks and train service, the switch and signal system, the mechanical and power installation, the train shed construction and the head house.

The extreme dimensions of the station, including train shed, head house and attached awning shelters, is 725x850 feet, and it will suffice for the operation of 2,000 trains in 18 hours, although the present requirements are for only 270 long distance and 450 suburban trains in 24 hours. In general, the steam car trains will occupy the main level of the train shed, where there are 28 stub tracks, each with a total capacity of 344 cars, and the electric or suburban trains will be operated on two loop lines in subways directly underneath the stub tracks. The stub tracks will be controlled by interlocking switches, and the loops will be operated by a continuous circuit system. Separate loading and unloading platforms will be provided, with a capacity of 25,000 people. The capacity, as well as dimensions of this depot, will be greater than any other depot yet constructed, and its arrangement and equipment with hydraulic, pnuematic, electric and mechanical service and complete provision for public and official requirements are intended to be of the most complete and advanced character.

The terminal property on the water front side is bounded by Dorchester Avenue and Fort Point Channel. The front of about 2,400 feet on Fort Point Channel has been protected by a masonry sea wall, supported on piles and riprapped both sides, as shown in section Figure 1. This is a section taken about northeast and southwest through Dorchester avenue and the east wing of the head house. The wall was built partly by the city of Boston, which also built the street sewers and partly by the Boston Terminal Company. All mud and silt beneath the sea wall was dredged out, measured into scows, and deposited in deep water. Foundation piles of straight spruce or yellow pine from 30 to 75 feet long, 12 inches in diameter at the butt and 6 inches in diameter at the tip, were driven and surrounded with clean bank gravel ballast, brought to the work on scows, and riprapped with granite chips, stone and spalls of varying sizes. The platform under the sea wall, built by the Boston Terminal Company, resting on the piles, was sunk to place in open water, and consists of three courses of hemlock timber 8 inches thick, well spiked together with 16x¾ inch drift bolts. The lower course forms caps, bolted to the piles with ⅞x20 inch drift bolts. Timber bulkheads to hold the filling were built at right angles to the sea wall at the Dorchester Avenue and Broadway ends. They were made of hard pine timber sheeting, splined, 6 inches thick and 36 feet long, driven and bolted between 8x12 inch clamps for guides. The sea wall proper is a dry wall throughout, with cut stone coping and bridge seats, excepting where it formed an abutment for the tracks, where it is laid in Portland cement mortar.

Between the sea wall and the station, and under the structure, the soil was originally of a very poor and unstable artificial character, consisting of an upper layer of ashes, refuse, etc., from 10 to 25 feet deep, then a layer of soft black silt 5 to 10 feet deep, then one or two feet of sand or gravel, and near the river a bed of stiff blue clay 6 feet thick, then one or two feet of sand or clay, and finally about 18 feet of stiff blue clay extending down to a solid thick stratum of sand, gravel and clay, at about 44 feet below mean low tide level. The general position and dimensions of the strata are indicated in section in Figure 1, as plotted from excavations and borings. The strata above the clay are all saturated up to a permanent ground water level a little below average high tide, or about 4 feet above the bottom of the lowest floors in the station, and in order to keep the floors dry, all the floors and walls and sides of piers were waterproofed.

It is, however, possible that in extreme high tides the water in the channel may for a short time have a head of 7 feet above the floor level, and in order to prevent the possibility of so great an upward hydrostatic pressure as this might produce, as well as primarily to protect the excavation as much as possible during construction, the entire site was surrounded on three sides by a permanent cofferdam, shown also in cross section in Figure 1. This encloses all the building and foundation masonry from the water during construction, and is believed to sufficiently keep the head of ground water down to approximately its average level. The cofferdam consists generally of two parallel rows of 6-inch splined sheet piles, about 35 feet long, driven into blue clay 6 feet apart, filled in between with clay and bolted together with 1-inch rods 6 feet apart through the pair of ledger guide pieces. Between the cofferdam and the channel the old made soil was excavated and filled in solid with clay up to about 18 feet above datum (mean low tide). The surface was graded and paved, tracks laid for street cars and a sewer run outside the cofferdam to receive the surface water and rain flow from the roofs of the station. Inside the cofferdam the made soil was everywhere excavated and removed to below the required level of the masonry footings. All the walls and piers in the depot, train shed, subway and principal buildings have stone and

THE BOSTON SOUTHERN TERMINAL.
SHEPLEY, RUTAN & COOLIDGE, ARCHITECTS; GEORGE B. FRANCIS, M. AM. SOC. C. E., CHIEF ENGINEER, BOSTON TERMINAL COMPANY.

concrete footings, supported on piles about 45 feet long, driven into the lower clay and gravel stratum. Different sections through the subways and foundations are shown in Figures 2, 3 and 4, and are typical of the general constructions. Figure 2 is a section through the front of the headhouse at right angles to that of Figure 1. Figure 3 is a section parallel to Figure 1 and south of the station building, and Figure 4 is a section through the subway for the suburban loop. After the foundations were built a system of open drains leading to a pumping sump was laid over the excavation, and the pit was filled in with good sand, grading it up to the bottom of the concrete, which was laid in a continuous bed over the whole depot are to distribute the pressure over the soil, as well as to form a solid floor in all places.

becomes one homogeneous sheet, flexible and watertight. The utmost care was exacted to perfect this feature of the building and protect it from injury during the progress of the work, and no material or workmanship in the slightest degree inferior was allowed. The top surface of the concrete base for waterproofing was trowelled with Portland cement, so as not to tear the tarred paper. The first coat of concrete upon the top of the waterproofing is about 4 inches in depth, placed without tearing or disturbing the paper, the edges of which were left extended to make a splice with the next section whenever the work was discontinued during construction.

Coursed granite face masonry, laid in mortar, is built in courses varying in height from 15 to 26 inches, generally 18 inches in height, alternating header and stretcher work, with headers always over stretchers, and not narrower than their rise. The beds of stretchers are equal in width to the height of the course, and without slack spots deeper than 1 inch. The headers are 5 feet long when the walls will admit of that length, and the stretchers not more than 8 feet in length. All joints are not more than 1¼ inches wide for a distance of 12 inches back from the face, and beyond that are approximately horizontal or vertical. The stones are laid in Rosendale cement mortar, two of sand to one of cement. Coursed granite face masonry, laid dry, is similar in appearance to the above described masonry, laid in mortar, excepting that the stone is rough point dressed, so that the joints are close for 16 inches back from the face. Rubble masonry, whether laid dry, as in the sea wall, or in mortar, is of large stone, well bonded and laid compact, so as to make strong work. The coping is neat point dressed work, with stone lines up front and back. The bridge seats are point dressed face and pene hammered tops. All are cut for half-inch joints, and all are laid in Portland cement mortar. All granite is sound stone, free from flaws and bad discolorations and without noticeable stratification. As far as possible, the granite from various quarries and of radically different colors is kept in clusters, and not laid promiscuously.

Mortar is made of one part of cement to two parts of sand, and used when newly mixed by measure in a box prepared for the purpose. In freezing weather the sand and water were thoroughly heated. Quartz sand, clean and sharp, of light color and fairly coarse, was used throughout for mortar. The masonry joints were raked out 2 inches deep and pointed with a mortar made of one part sand to one part Portland cement, applied when the temperature was above freezing. Rubble backing is sound granite rubble, carefully laid and completely embedded in spalls and mortar. Second class Portland cement concrete consists of one part cement, three or four parts clean sand, and six or seven parts screened gravel. All concrete is rammed in 6-inch layers. The screened gravel is of varying sizes, up to what will pass through a 3½-inch ring. Briquettes of neat Portland cement of 1 square inch section were required to develop a tensile strength of 200 pounds or upward in 24 hours, having stood until set in air and then being submerged for the remainder of the time.

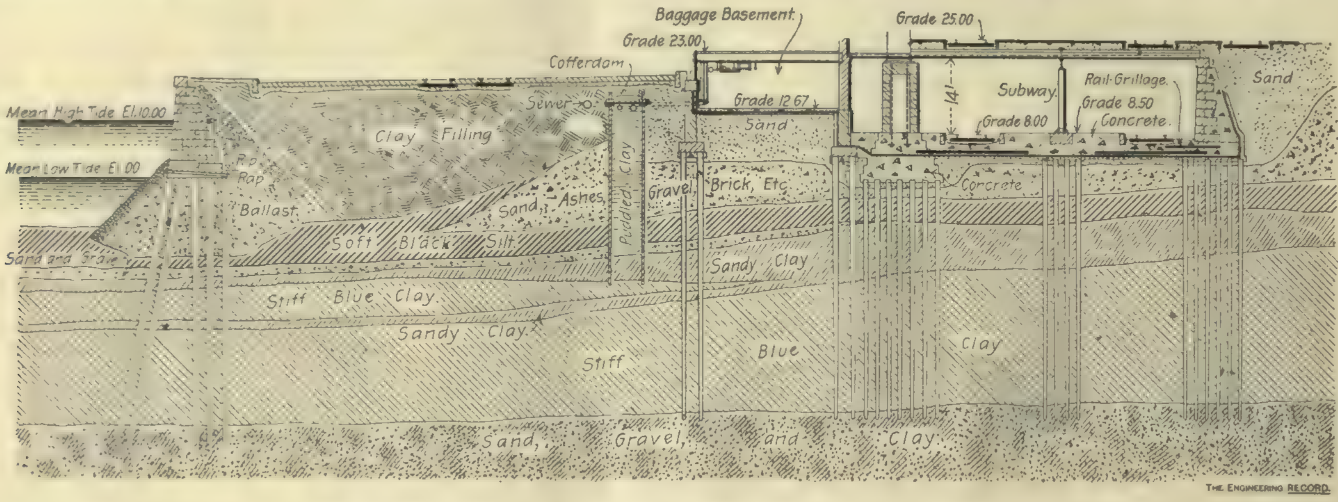


FIGURE 1.—CROSS SECTION THROUGH DORCHESTER AVENUE AND SEA WALL.

All pier foundations are built on spruce piles from 40 to 45 feet long, 12 inches in diameter at the butt and 6 inches in diameter at the tip. They are driven to their full depth, or until the penetration does not exceed 12 inches in twelve blows from a 2,000-pound hammer falling 20 feet. The piles were not driven until the excavation was made, and all were then cut off above water. All footing courses and pile cappings from 6 inches below cut off to 2 feet above the top of the piles are of first class Portland cement concrete, consisting of one part cement, two parts sand and five parts of screened gravel, the sand and cement being first thoroughly mixed dry and then the whole mass completely incorporated. Second class Portland cement concrete, used for loading on the waterproofing sheet, consists of one part cement, three or four parts good clean sand and six or seven parts screened gravel, gauged according to quality of gravel. All concrete is rammed in 6-inch layers. The screened gravel is of varying sized pebbles up to 3½ inches.

The power buildings, express buildings, subway extension, etc., are part of the main construction not included in the architectural composition of the head house, and their principal features correspond to the other foundation masonry and roof work. The building foundation walls, piers, etc., in general are of two-faced block stonework, in courses not less than 18 inches and not more than 2 feet high. All stones are through stones, laid on a full bed of mortar, one part Portland cement mortar and two parts of sand. All joints are thoroughly filled with cement and carefully chinked with slate spalls. Stones are of varying lengths, none less than their widths, are derrick laid, thoroughly bonded, all joints broken, and with no joints exceeding 4 inches. The stone footing courses are of dimension stones, with even beds. The pier caps are fine pointed on top beds and faces; the bottom bed jointed. The whole area of the basement under the engine room and ice plant, also the boiler room floor and coal vault floor, are of first class Portland cement concrete. All the front brick in these buildings is of first quality, hard, selected, even colored common brick. The outer 4 inches on all outside brick walls is laid up in mortar of two parts sand and one part Portland cement. All other brick walls, and the backing of the above specified walls, are made of first quality, hard, selected common brick, laid in mortar, one part of lime and one part of Portland cement to three parts of sand. All brickwork

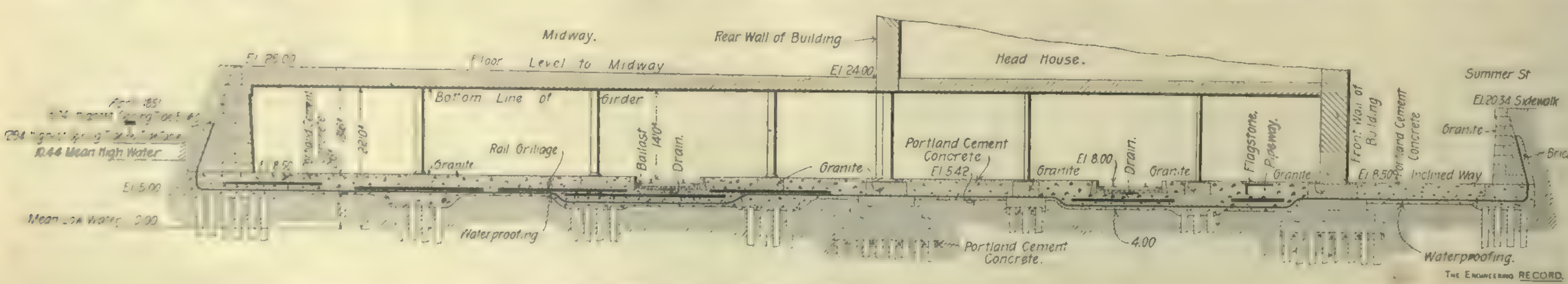


FIGURE 2.—CROSS SECTION THROUGH THE HEADHOUSE.

Throughout the work the waterproofing course consists in general of ten layers of tarred paper, lapped and swabbed with hot coal tar pitch in its final position, as follows: The first sheet is laid upon a swabbing applied to the surface of the prepared concrete floor, all laps are swabbed and each successive layer is swabbed as placed, and the top of the top layer is covered with a heavy swabbing of coal tar pitch ready for the concrete loading or the brick protective facing used in the outer vertical walls, so that the whole preparation finally

throughout is bonded with a heading course every ninth course. All the underpinning, water tables, sills and belts are of first quality Stony Creek granite. All washes, reveals and jambs of underpinning, water table, sills, belts, templates, etc., are fine pene hammered. All other exposed surfaces or face stones are quarry face. All cut stones are square and true, of even color, free from sap and spall holes, with top and bottom beds and build joints ¼-inch thick. Stones are built into walls for at least 8 inches in depth on the average, every other stone in each course being a bond stone. All stones are dogged to each other with ½-inch round galvanized iron dogs, at least 12 inches long, turned down 1½ inches into the stone, and all stones which are not bond stones are anchored to the brick backing with galvanized iron dogs, turned up 4 inches into brickwork 4 inches from inside wall, and turned down 1½ inches into the stones. All stonework is laid in Portland cement mortar, one part cement, two parts sand, derrick laid on a full, carefully laid bed of cement and wedged and pinned with slate pinners. All joints are thoroughly filled and raked out 1½ inches deep for pointing. All joints are pointed with clear Portland cement, with neatly ruled and carefully made convex joints. In freezing weather the sand, gravel and water used are thoroughly heated. The floor of the engine room consists of 4-inch brick arches, leveled up with first class Portland cement mortar, and top dressed with 1 inch of rock asphalt. The engine room is of mill construction, with steel trusses, wooden rafters and plank covering. The rafters are first quality hard pine, secured to every bearing with long lag screws. The sheeting is of first quality yellow pine stock, tongued and grooved, in width not over 6 inches, thoroughly spiked to bearings.

i. e., after keeping them in water one hour at 70 degrees Fahr. temperature. Briquettes seven days at 50 degrees, not frozen, showed a tensile strength of 290 pounds per square inch; seven days at 50 degrees, then frozen seven days at 25 degrees, 224 pounds per square inch; seven days at 50 degrees, then frozen fourteen

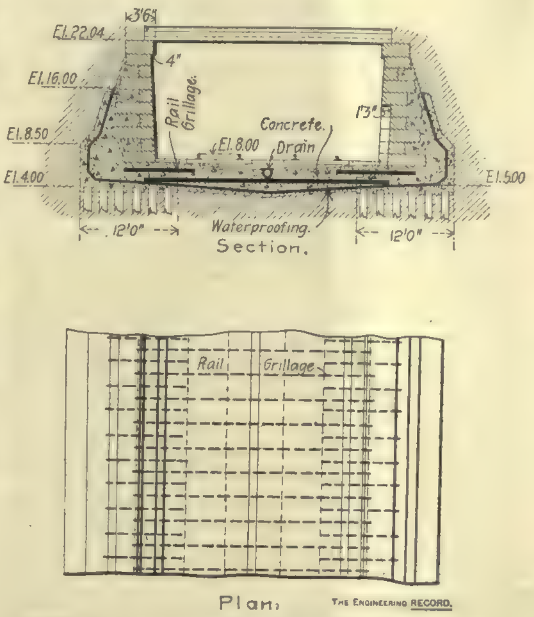


FIGURE 4.—CROSS SECTION THROUGH THE SUBWAY ON SUBURBAN LOOP.

days at 25 degrees, 234 pounds per square inch. Briquettes exposed to a temperature of 25 degrees as soon as mixed gave these results: Kept seven days, 110 pounds per square inch; kept fourteen days, 144 pounds per square inch; kept fourteen days, then fourteen days at 60 degrees, 270 pounds per square inch.

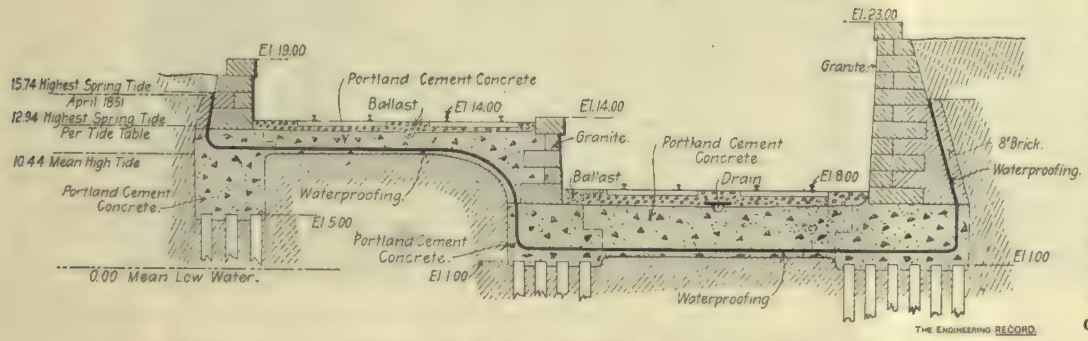


FIGURE 3.—CROSS SECTION OF SUBWAY OUTSIDE THE HEADHOUSE.

All roof timber and planking is mill planed. The exposed surfaces are left smooth and even and painted. Upon the prepared roof surfaces is laid a five-ply composition roof, warranted for five years.

(To be Continued.)

TESTS OF FROZEN CEMENT MORTAR.

In connection with the article in the preceding issue of "The Engineering Record" on the effect of frost on Portland cement a series of tests of frozen cement mortar made by Mr. Arthur G. Fogg of Roslindale, Mass., will be of interest. There is possibly an impression that mortar which has been exposed to alternate freezings and thawings ultimately becomes valueless, and Mr. Fogg's observations as summarized in his inferences in each set of tests indicate that this view is not well founded, as in some cases mortar is strengthened by freezing.

Series I. of the tests had for its object to see if Portland cement mortar will gain strength in air while in a frozen condition. The tests were conducted in February, 1895. Alsen cement mortar was mixed one to one and frozen in air in a refrigerator designed for the purpose. The figures given are the averages of five briquettes each, broken after being thawed out;

Inferences.—This series of tests shows that Portland cement mortar will gain strength when exposed to freezing temperatures whether before or after setting.

The following tests were made in January, 1896, to substantiate the foregoing: Five briquette were made, using Giant cement mortar mixed one to one. Three of them were immediately exposed to zero Fahr. and kept frozen several days, left out doors from January 4 to April 4, then broken, with the following results: 490, 485 and 425 pounds per square inch. Two of them were kept dry indoors at 50 degrees Fahr. during the same period for comparison, breaking at 220 and 275 pounds per square inch.

Series II. was undertaken January 9, 1896, with the object of ascertaining if alternate freezing and thawing in air will injure Portland cement mortar. Giant cement mortar mixed one to one at 50 degrees was placed outdoors at 20 degrees as soon as mixed and left out for twenty-four hours. It was then taken in to a temperature of 50 degrees and left twenty-four hours, then frozen again twenty-four hours. This operation was repeated several times, then left outdoors until March 6 and broken with the following results: 120, 130 and 125 pounds per square inch (representing three briquettes.)

Three other briquettes were made at the same time and kept dry indoors at 50 degrees during the same period for comparison. They broke at 260, 300 and 250 pounds per square inch.

To substantiate the foregoing, and to make the test more severe, two briquettes were made of Alsen cement mortar and mixed thin like grout, one to one, placed outdoors as soon as mixed at zero and left twenty-four hours, then taken in to 50 degrees and left twenty-four hours, etc., being alternately frozen and thawed several times. They continued to set all the time without disintegrating.

Inferences.—This series shows that Portland cement mortar is not destroyed by alternate freezing and thawing in air, but that it sets slower than when the temperature is kept either above or below freezing during the test.

Series III. was conducted in January, 1896, the object being to ascertain at what rate Portland cement mortar will gain strength while in a frozen condition in air. Giant cement mortar was mixed one to one at 50 degrees, exposed to freezing weather as soon as mixed, and thawed out just before breaking. Two briquettes kept frozen twenty-four hours showed a tensile strength of 25 pounds per square inch. Two frozen six days showed 90 and 60 pounds per square inch, average 75 pounds. Two frozen eight days showed 100 pounds each. Two frozen thirteen days showed 115 and 120 pounds per square inch, average 120 pounds. Two frozen twenty-eight days showed 165 and 155 pounds per square inch, average 160 pounds.

Comparable tests were made with briquettes kept dry indoors at 50 degrees temperature. Two briquettes kept twenty-four hours showed tensile strength of 40 pounds per square inch each. Two kept six days showed 75 and 70 pounds per square inch; average 73 pounds. Two kept eight days showed 135 and 95 pounds per square inch, average 115 pounds. Two kept thirteen days showed 140 and 145 pounds per square inch, average 143 pounds.

Inferences.—This series and Series I. indicate that freezing retards the setting of Portland cement mortar. Probably in time the frozen mortar would be as strong as the unfrozen. A long time test should be made.

Series IV. was conducted in February, 1895, with the object of ascertaining if Portland cement mortar is injured by freezing in ice or water, and if so, how near to freezing weather it is safe to use it. Alsen cement mortar made one cement to two sand was mixed at 50 degrees, packed in salted ice and kept at about 25 degrees until broken at the end of seven days.

Time between mixing and packing in ice.	Averages of 3 briquettes each, broken in a frozen state.	Averages of 2 briquettes each, broken after thawing.
0 minutes.	0 lbs. per sq. in.	0 lbs. per sq. in.
15 "	0 " " "	0 " " "
60 "	0 " " "	0 " " "
12 hours.	0 " " "	0 " " "
24 "	0 " " "	0 " " "
2 days.	95 " " "	0 " " "
3 "	192 " " "	170 " " "
4 "	230 " " "	190 " " "
5 "	252 " " "	250 " " "
6 "	312 " " "	170 " " "
Kept at 65°.	....	230 " " "

In tests made in January, 1896, Giant cement mortar one to one was mixed at 50 degrees. Three briquettes were kept at 50 degrees ten hours, then placed in water and exposed to zero temperature; kept frozen twenty-eight days. They were then thawed out and broken at 160, 170 and 160 pounds per square inch. Two briquettes were kept at 50 degrees during the same period for comparison, and these broke at 170 and 175 pounds per square inch. This cement was very quick setting.

Inferences.—It is not safe to allow a cement mortar as slow setting as "Alsen" to freeze in less than four days after it has been placed, while a very quick setting mortar may freeze in twelve hours without injury, provided the mortar is kept frozen until set. According to practice, if salt is added to the water of mixture the effects of freezing are lessened.

Series V. was undertaken in January, 1896, to see how Portland cement mortar acts when it is frozen and thawed out several times before it has had time to set very hard in water. The mortar was placed in water and exposed to freezing temperature twenty-four hours, then taken in to a temperature of 50 degrees and kept twenty-four hours, then frozen again twenty-four hours, etc., alternately. Alsen cement was used, one of cement to one and a half of sand, mixed thin as used in practice, at 50 degrees. Briquette held twenty-four hours before being frozen was completely disintegrated at the first thaw. That held two days before freezing had at the first thaw disintegrated about one-quarter inch deep; at the second thaw had disintegrated slightly more and at the third thaw showed no change. That held three days before freezing showed at the first thaw the surface disintegrated and at the second thaw no change. That held four days before freezing showed at the first thaw no effects, and its condition was unchanged on the second thawing. Giant, very quick setting cement mortar mixed one to one at 50 degrees and similarly tested showed as follows: Briquette held twelve hours before freezing, at first thaw surface disintegrated; at second thaw no change. That held twenty-four hours before freezing was not affected at the first thaw and showed no change on the second.

Inferences.—This test indicates that Portland cement mortar is injured more when it alternately freezes and thaws than when it remains frozen before it has set hard. The tensile strength of mortar when soft is not sufficient to resist the expansive force of ice. This series, like Series IV., indicates that Portland cement mortar should not be allowed to freeze before it has set hard, unless it is kept free from water and ice.

Series VI. was undertaken in January, 1896, to see how much strength Rosendale cement mortar will gain when in a frozen condition in air. Crescent cement mortar made one to one was mixed stiff. Two samples frozen as soon as made, kept frozen four days and then thawed out, gave each a tensile strength of 60 pounds per square inch. Two briquettes kept at 50 degrees four days for comparison gave 90 and 85 pounds per square inch, average 87 pounds. Five briquettes frozen as soon as mixed and kept out doors in the changeable weather three months gave 350, 370, 385, 385 and 370 pounds per square inch; average 370 pounds. Five briquettes kept at a constant temperature of 50 degrees dry during the same period of three months for comparison gave 170, 175, 145, 160 and 170 pounds; average 165 pounds.

Crescent cement mortar mixed one to one, thin as used in practice, showed: Three briquettes exposed to 25 degrees as soon as made and kept frozen twelve hours, then taken in to 50 degrees and kept twelve hours, then frozen again several times alternately during two months: 205, 205 and 195 pounds per square inch; average 202 pounds. Three briquettes kept at 50 degrees in dry air during the same period of two months, for comparison: 135, 145 and 165 pounds per square inch; average 148 pounds.

Inferences.—Rosendale cement mortar is not injured by freezing in air. It is in fact strengthened (a conclusion reached by other experimenters).

Series VII. was also conducted in January, 1896, with a dual object. First, it was endeavored to learn if Rosendale cement mortar is injured by being frozen in water or ice. Series IV. was repeated with Rosendale cement (Crescent) mortar mixed one cement to two sand, stiff, and at the end of seven days they were entirely disintegrated. Five briquettes were mixed one to one at 50 degrees, kept ten hours and then placed in water and frozen at zero. They were kept frozen one month, and in thawing them out they all crumbled up.

The second object was to see how long Rosendale cement mortar has to set before it can stand freezing in water. Eight briquettes were allowed to set for varying lengths of time before freezing. Briquette 1 set twenty-four hours before freezing at a temperature of 25 degrees; briquette 2 set thirty-six hours, froze at 25 degrees; briquette 3 set three days, froze at 27 degrees; briquette 4 set five days, froze at 25 degrees; briquette 5 set fifteen days, froze at 22 degrees, and briquette 6 set twenty-one days and froze at 15 degrees. All these briquettes were thawed out in twenty-four hours and all crumbled. Briquette 7 set twenty-eight days, froze at 21 degrees, was thawed out at twenty-four and forty-eight hours and cracked. Briquette 8 set six weeks, froze at 25 degrees, was thawed out at twenty-four, forty-eight, seventy-two, etc., hours and was not affected.

Inferences.—When Rosendale mortar is mixed very stiff it is not safe to let it freeze in water in less than six weeks, and as mixed in practice it probably is not safe in less than two months.

"The Engineer, His Work, His Ethics, His Pleasures," is the title selected by Mr. Charles W. Hunt for his excellent presidential address before the American Society of Mechanical Engineers, which was noticed in these columns December 3. It has been printed in attractive pamphlet form and it is possible that copies may be had from the author, Allen Street, West New Brighton, N. Y.

THE DESTRUCTION OF A DAM AT TAMPA.

A large dam belonging to the Consumers' Electric Light & Power Company, of Tampa, Fla., was destroyed on the night of December 13 under conditions which render it probable that the disaster was caused by some malicious person or persons. Mr. George D. Munsing, general manager of the company, sends the following general information concerning the plant and the accident:

"We have a dam across the Hillsborough River about 8 miles from the center of Tampa, 22 feet high by 600 feet long from end to end of wing dam. Two hundred and fifty feet of this dam is composed of concrete masonry, 135 feet of it being weir and 115 feet masonry flumes, which contain four pairs of 36-inch McCormick wheels, or about 1,600 horse power, 22 feet head. At the north end of the weir, or the far side of the river, were located our flood gates, which were 15 feet wide. Beyond this gate the dam was composed of dirt, with a sheet piling of timber through the center. The masonry wall, which held the dirt at the end of the gate, was 100 feet long at the base, 7 feet thick and 30 feet high. A quantity of dynamite evidently was placed at the bottom of the gate on the lower side of the dam against this wall; also a quantity at the center, and near the top. When this was exploded it shattered this wall of masonry, breaking through the gates, and in less than a half hour 225 feet of the wing dam, including this masonry wall, was carried down the stream. The fall from the dam to the mouth of the bay being only a few feet, the water could not pass away very rapidly; therefore it backed up into our power house, which is located on the south side of the river just below the masonry flumes, which is 50x150 feet, containing two 300 kilowatt alternators, two 200 direct-current machines, besides other smaller electrical machinery, and two 400 horse-power engines, which were used as auxiliary in time of low water. All the machinery in the power house was submerged in water for some three or four hours. As yet we are unable to estimate the loss, but it will probably reach $75,000, including the damage on machinery, etc."

Superintendent Munsing sent with this note a newspaper clipping which states that ever since the building of the dam there has been more or less trouble with the people owning property above it, where the slack water caused them annoyance. Many protests were made against building the dam, and since its construction these protests changed to threats that it would be cut. Three previous attempts to blow up the structure were frustrated by the guards constantly on duty.

NORTH WING COMPLETED.

NORTH WING AND WALL BLOWN OUT.

VIEWS OF THE TAMPA DAM BEFORE AND AFTER ITS WRECK.

CONSTRUCTION OF SHORT SPAN RAILWAY BRIDGES.

Under the title of "Notes on Railroad Bridge Construction" Mr. Henry Goldmark, M. Am. Soc. C. E., recently presented a valuable practical paper to the Engineering Society of the University of Michigan. Mr. Goldmark noted the great mileage and low ton-mile rates of the railways of the United States and criticised their roadbeds, tracks and bridges as inferior to those abroad. He took up only "ordinary" railway bridges, which he defined as spans up to 175 feet long. These comprise the great majority of all bridges, and may properly be considered as a part of the roadbed over which trains usually pass at full speed. The construction of these bridges should be governed entirely by traffic requirements. The design of long spans over rivers is a different problem, which is, to a large extent, independent of and sometimes itself influences the conditions prevailing on the rest of the line.

He considered that, as a part of the roadbed, any bridge is objectionable. For small waterways, Mr. Goldmark recommended square box culverts, with stone slab covers, and cast-iron pipes up to a diameter of 6 feet or more. Culverts of circular section up to 8 feet or more in diameter and built entirely of cement have also been used on some Western roads. On the new water supply system for the city of Boston, now under construction, many miles of such conduits are being built of concrete instead of brick. Their use on railway work is likely to be more common in the future. The wooden molds can be used many times in different places, and improved methods of mixing and ramming the concrete can be employed where there is much work of the kind to be done. Portable machinery would insure a more homogeneous mixture than can be obtained by hand work. It seemed to Mr. Goldmark a mistake to insist on the use of Portland cement in all cases. The native natural cements cost less than one-third to one-quarter as much, and if used in somewhat more generous proportions, give a sufficiently strong product at much less expense.

A further use of cement mortar may here be referred to, namely, its application to the repair of masonry structures disintegrated by the weather. For this purpose, a very strong dry mixture with the best Portland cement must be used, and, if possible, mixed by machine. The masonry must be thoroughly cleaned, loose pieces removed and the joints raked out to a depth of several inches. A wooden mold is placed, so as to leave an intervening space of from 4 to 10 inches between the lagging and the old surface of the masonry. This interval is filled with the cement mortar or beton, which is thoroughly rammed into all crevices and joints. In this way, an entirely new surface is put over the old work, which is protected from the weather and more firmly united. Mr. Goldmark had occasion within a year or two to examine carefully some repairs of this kind made on the Erie Railway nearly 20 years ago. The surface of the cement mortar was found to be absolutely perfect and free from cracks. It was very hard and showed plainly the shapes and joints of the timber lagging used in the molds. The structures thus repaired comprised a large number of arch culverts and bridge piers. The method was described by Mr. O. Chanute, Past. Pres. Am. Soc. C. E., the chief engineer of the railroad, in a paper read before the American Society of Civil Engineers in 1880. The original masonry was, in many cases, in the last stage of decrepitude, while at present, after 20 years' service, the culverts and piers, as protected, are entirely sound, and promise to last a long time. The cost of such repairs is only a small percentage of what new masonry would cost, particularly where a culvert is built under a high embankment, making the expense of excavating it very great.

The selection of durable building stone is by no means easy. Mineralogical study may be of some assistance, though the test of actual use is the only certain guide. In many localities, such as Chicago, no reliable local stone can be found, and the nearest available quarries are fully 150 miles away, so that the freight rate adds nearly $1.50 to the cost of each cubic yard. In such localities the use of hard burned brick and concrete would give a good, reliable substitute for stone. Brickwork is thus used in the northern part of Germany and in Holland, almost to the exclusion of stone.

In most bridge piers and abutments, as well as in arches, great compressive strength and hardness are not essential in the stone used, as the stresses developed are small. Soft sandstones can often be found which can be cheaply worked, and weather perfectly. The cost of cutting them is $2 to $3 cheaper per cubic yard than for the harder limestones.

The cost of masonry may also be reduced by omitting all copings, ornaments and unnecessary cutting, and by using concrete or rubble for backing. In fact, if carefully built with good cement mortar, rubble masonry is a very good substitute for cut stone, and is too little used for ordinary railroad work. It is the standard construction for the best built German railroad lines, where the art of making a good quality of masonry with cheap materials has reached a high stage of perfection. The bad reputation which rubble masonry has obtained in the United States is due largely to the poor, shiftless work palmed off on railroad companies under this name.

For that portion of the work which is below ground rubble or concrete should generally be used. In wet pits or in localities where it is dangerous to the track to keep an excavation open for any great length of time, the use of concrete permits the filling in of the foundation in a shorter space of time than the employment of any other material.

The foundation for arch culverts should, of course, be especially unyielding. Where the bedrock does not come to the surface piles are generally used, though they are not very desirable, unless the amount of material in the abutments is sufficiently great to make the resultant pressure on the foundation nearly vertical. Where the bedrock is only from 6 to 10 feet below the ground, the choice of the best method of foundation becomes difficult. Piles are rather short under these conditions, and are likely to yield sideways if the soil is at all soft. In several instances short piles driven in a soft bottom caused the failure of well built bridge abutments reared upon them.

A method of foundation used by the speaker in a similar situation may be of interest. The structure to be supported was an 8-foot culvert for a double track railroad under an embankment about 20 feet high. There was a firm soapstone at a depth of 9 feet below the ground, overlaid by a soft wet clay. The building of a concrete footing would have doubled the cost of the culvert. For this reason, it was decided to use instead of concrete a bed of crushed rock resting on the soapstone. The material used consisted of crushed tailings from a zinc mine, the size of the separate pieces varying from 2½ inches to that of a pea. The pit was excavated to the bedrock and the crushed ballast shoveled directly into it from a car standing on a trestle immediately above, so that the fall of 20 feet or so caused the filling to become well compacted. Water from a hose was used to wet it down and cause it to settle more closely. This foundation presented much the same appearance as a good natural bed of gravel, and has proved entirely satisfactory. Its cost was about one-fifth of that of a concrete or masonry foundation.

A somewhat novel substitute for timber piles may also be mentioned here which has recently been used by Mr. H. W. Parkhurst, engineer of bridges, on the Illinois Central Railroad in places where an ordinary pile foundation would come above the line of permanent ground water. The method employed consists simply in driving piles, spaced as usual, but withdrawing each pile as soon as it is driven and filling the hole with concrete. All the stone piles are then covered with a thick bed of concrete, on which the masonry pier is built. The advantage of reaching hard bottom is thus obtained at a moderate cost.

The timber trestles on American railroads have a greater aggregate length than all other forms of bridging. Certain designs differing only in details have become standard. They are undoubtedly of ample strength, even under heavy traffic, and, in fact, are often stronger than the iron bridges on the same line. They are always subject to great danger from fire, and some of our worst railroad accidents have been due to the burning of trestles. Even when well built, they are hard to keep in good alignment and grade, and need many minor repairs from time to time. For this reason, they occupy much of the bridge superintendent's time and attention, and use up a great part of his appropriation. The desirability of replacing trestles by some more durable construction should always be borne in mind. This will usually involve the preparation of comparative plans and estimates by the engineering department. On many roads timber trestles are renewed several times, when it would be really good policy to rebuild in stone or iron. A valuable improvement in trestle floors has lately been made by using a ballasted floor, on which the track can be laid as on the ordinary roadbed. In this case a continuous timber floor is built on the caps of the bents wide enough to hold the crushed rock or gravel filling. The added security against fire first led to the adoption of this form of construction for the long trestles of the Louisville & Nashville Railroad. It has since been used on the Illinois Central Railroad and on other southern lines.

Wooden bridges are gradually going out of use, though they have given excellent service in the past. At present prices, the cost of steel spans is but little greater, and the latter are of course preferred. The history of American railroad bridges built of timber is of great interest. A large number of different types were introduced from time to time, and gradually discarded in favor of those that best stood the test of actual service. With nothing to guide them but their own judgment and common sense, the early bridge builders accomplished results which challenge our admiration. Their successors have more science and experience and more mechanical resources in various kindred industries to draw upon, but in many cases have not built structures as well adapted to the work they have to do. Of many interesting truss forms, the Howe truss and the Town lattice are the only ones still used, apart from combination bridges, in which iron members play a prominent part.

The Howe truss is used all over the world and is too well known to need description. The Town lattice is still quite largely used on New England and Canadian railroads, and gives good satisfaction. The trusses are generally built with at least two thicknesses of web timbers and three chords. Three by 12 inch pine is usually employed throughout, with carefully fitted oak pins at all intersections. The framing must be very carefully done, but if they are well built the trusses are very stiff, durable and inexpensive.

Combination bridges in which all compression truss members are of wood, while the tension ties and the floor beams are of iron, are quite generally used. They can, of course, be

built of ample strength, but, at least for short spans, it is very hard to devise details which shall not produce a loose jointed structure with much unnecessary vibration and "back lash" in the different parts.

The iron spans are the most important and expensive structures on railroad lines and should receive the most careful study from railway managers and engineers. Unfortunately, these officials have, in the past, quite generally divested themselves of their responsibility in the matter by depending on bridge building firms for both designs and construction. Notwithstanding the high standing of our large bridge building companies, there are many strong reasons why it is unwise for railroads to entrust them with the preparation of plans instead of merely the execution of designs worked out by engineers in the direct employ of the railroads. It would lead too far to give these reasons in full; it will be sufficient to point out the fact that in all competitive designs the first cost in the shops will be sure to cut altogether too great a figure, instead of the much more important considerations of permanence and rigidity. The experience of examining many existing bridges in different parts of the country built under various conditions has convinced me that the competitive system is certain to give unsatisfactory results.

In selecting the type of bridge to be used for such spans as commonly occur on railroads, the necessity for rigidity must always be borne in mind and a stiff construction selected, even if it is more expensive than some other design of equal static strength. From this standpoint pin connections, while an excellent detail for long spans, are very poor for the majority of railroad bridges, especially in case eyebars are used for tension members. Recent practice favors plate and riveted lattice girders up to lengths of 125 to 150 feet. There can be little doubt that they are likely to supplant all other forms except for very long spans. Some engineers are much troubled by the fact that the stress determinations in plate and lattice girders are apparently more complex than in pin bridges. In fact, for a long time our specifications prescribed a lower unit stress in plate girders than in any other type, although the test of experience was all the time loudly proclaiming their greater strength. Many well designed plate girders were condemned and removed from the track because their strain slightly exceeded 12,000 pounds per square inch, while pin bridges, with 3x¾ inch suspenders carrying 15-foot panels, were allowed to remain because the orthodox unit stress laid down for such cases was not exceeded.

A properly prepared strain sheet is, as we all know, a very valuable guide in bridge design if used with intelligence and judgment. Unfortunately, the last named proviso has not always been borne in mind; the strain diagram has often become a sort of fetich, and any structure which could be made to conform to it has been thought fit to use. On many, if not most of our railroads, may still be found bridges which conform quite well to the usual strain sheet requirements, but are actually far below a proper standard of strength. This may be the case, even where the details and connections are not exceptionally weak, simply because the entire design is bad. It is a mistake to speak of such structures as being theoretically correct and practically bad. As a matter of fact, the designs are at fault, because they do not take account of important forces and conditions which need to be considered. They are as bad in theory as in practice.

The flooring is the part of the bridge which first receives the weight and impact of the moving load. For this reason it should have an ample margin of safety, both for ordinary conditions and in case of accident to rolling stock. Derailments are unfortunately of very frequent occurrence, and no floor is well designed which does not make careful provision for carrying trains which reach the bridge with one or more trucks off the track, or which become derailed on the bridge. On a prominent railroad, I was informed by the superintendent that there was not a single bridge on his line the ties of which were not marked by the passage of at least one derailed truck. My own experience tends to corroborate this seemingly exaggerated statement. The only safe floor is one which is practically continuous, and so designed as to allow a derailed wheel to roll over it in safety.

Deck bridges are free from the danger of a passing car striking the trusses, and for this reason, among others, are to be preferred whenever they can be used. They are also more easy to brace laterally, and are less expensive, particularly if the timber ties are laid directly on the top chords. The masonry for deck spans is also cheaper than for through bridges, and it will often be found practicable to build a series of short plate girder spans resting on masonry piers for less money than a longer deck through combination or Howe truss. Of course, the hydraulic conditions must be such as to allow this arrangement of piers. Even on deck bridges the floor should be of sufficient width to make the risk of having a derailed train run off into the stream no greater than on the approach embankment on either side. This has rarely been done, although the widening of bridge floors is the greatest improvement as to the safety of our bridges that can be made.

A word should be given to the so-called "continuous" iron floor systems. They are quite usual in England, and are being introduced on some of our roads, particularly in cities. Such floors, whether built of troughs or simply of I-beams covered by top plates, make a very secure platform for trains, whether off or on the rails. The principal objections are their greater cost and the necessity of frequent inspection where the troughs are filled in with ballast. For trunk lines, they have proved satisfactory on the New York Central Railroad, and are likely to be used more largely on roads of the better class, though they will hardly displace the wooden floor until timber is much more expensive than at present.

At the present time, when the most important structures are of iron, there is an opening for men who have a detailed knowledge of bridge engineering. Such knowledge can only be obtained by work in the draughting room, the shop and in the erecting gang. It should include experience in the inspection of material in the steel works, the rolling mill and the bridge shop.

PRELIMINARY REPORT, NICARAGUA CANAL COMMISSION.

"The Honorable, the Secretary of State, Washington:

"Sir: We have the honor to acknowledge the receipt of your letter of the 19th inst., enclosing a copy of a resolution of the Senate of the 15th of December, requesting a report of the progress made by this Commission in investigating the question of the proper route, the feasibility, and cost of construction of the Nicaragua Canal.

"This Commission has understood the law, by which it was appointed, approved June 4, 1897, to require that all routes heretofore proposed, having any merit, are to be considered, new routes that appear to have merit are to be developed, and the entire region of canal possibilities to be examined with sufficient thoroughness to enable a just and comprehensive comparison of the various routes to be made, and the most desirable one selected. In short, to enable this Commission to make a complete and exhaustive report.

"With this in view, the Commission visited Nicaragua, personally examined the entire canal region from ocean to ocean, and employed some seventy engineers, with their laborers and helpers, for ten months, in making careful surveys and examinations of the canal region. Some meteorological and hydrological observers are still continuing in Nicaragua, with a view to obtaining a full year of observations of that nature.

"The required field work has been obtained. The reduction of this field work, together with the compilation and comparison of former surveys going back nearly fifty years, has been in progress for more than two months.

"The Commission believes that the construction of a canal across Nicaragua is entirely feasible.

"The estimates for two of the best known characteristic routes have been nearly completed. These routes are known as the Maritime Canal Company's route and the Lull route. Their estimated cost is approximately $124,000,000 and $123,000,000, respectively. The assumed dimensions are considerably greater than ever before proposed, both in length of locks and in width, depth and radius of curvature of canal.

"These increased dimensions have been made necessary by the demands of modern commerce, size and draft of modern ships, etc. This has necessarily made a corresponding increase in the estimated cost, and is in no way inconsistent with the estimates made from former surveys, which contemplated a much smaller and cheaper canal.

"A canal of smaller dimensions, just sufficient for present needs, is being estimated for. Such a canal would cost considerable less than the estimate for a canal suitable for modern necessities, which is referred to above.

"It is the opinion of this Commission that, of the two routes herewith estimated for, the one called the Lull route is the more desirable, because it is easier of construction, presents no problems not well within good engineering precedents, and will be a safer and more reliable canal when completed. It also believes that the dimensions and form of construction preferred by the Commission are better than the cheaper form with smaller dimensions, which would undoubtedly call for expensive improvements within a short time after its completion.

"Both of the routes referred to above admit of variations, which may reduce the cost. These are now being considered by the Commission.

"The work necessary for an exhaustive discussion of and report upon the entire canal problem is being pushed as rapidly as its great magnitude permits, and, when completed the report will be submitted without delay.

"We are, sir, with great respect, your obedient servants,

"J. E. Walker, Rear-Admiral, United States Navy, President of Commission.

"Lewis M. Haupt, Civil Engineer, Member."

"I concur with the other members of the Commission in respect to the progress of the work and the feasibility of the canal, but I think, in view of the increased size of the canal estimated for, and the difficulties incident to work in tropical countries, that the estimate is lower than it should be by about 20 per cent.

"Peter C. Hains, Colonel Corps of Engineers, Member."

The Massachusetts Institute of Technology has received over $968,000 during the past year, according to the annual report of President Craft, and $400,000 more is expected. The actual expense of instructing the students is stated to average $330 a year, while only $200 is paid as tuition. The balance of $130 has to be made from Government and private gifts. The report emphasizes the value of the instruction in small classes in the laboratories, and states that in the Institute as a whole there is now one instructor, excluding the lectures, to every eight or nine students.

SEWAGE DISPOSAL BY BACTERIA BEDS AND THE SEPTIC TANK.

The interest in bacterial or biological methods of sewage disposal seems to be increasing, if anything, in Great Britain, and it is noteworthy that Mr. Baldwin Latham and other engineers, who were somewhat skeptical concerning these methods of treatment when they were first talked about three or four years ago, are now convinced of their importance. Among recent valuable contributions to the literature of the subject is a lecture delivered before the Society of Engineers by Mr. George Thudichum on the design of such plants as employ coarse bacteria beds, like those at Sutton, or a septic tank, like that introduced at Exeter.

In preparing plans for such works there are three governing conditions, the available fall, the nature of the soil, and the possibility of the sewage containing substances injurious to bacteria. Of these, he states that the first two determine which system should be adopted, for if the sewage is delivered at an elevation of less than 4 feet above the point at which it must be discharged the septic tank possesses an advantage, because no head is lost in the tank and the whole fall can be utilized for the final filtration. If the sewage must be pumped in any case, or is delivered by gravity at a sufficient height to allow the two filtrations of the Sutton system, the adoption of one or the other system is to be decided upon other considerations. The extent of the beds for the final filtration will be the same in either case, and the difference in first cost will be the difference between the expense of a coarse-grain bacteria bed and that of a septic tank. "Where the soil is light and porous, so that all tanks and beds must be built of brickwork on concrete bottoms, it is possible that such difference may be extremely small, since the extra cost of covering the septic tank will be compensated by its being of smaller cubic contents than bacteria beds to do the same work, and by its requiring no bed material. Where, however, the nature of the soil is such as to permit of the construction of bacteria beds in the open ground, merely puddling the bottom and sides, the advantage from a pecuniary point of view is entirely with the system adopted at Sutton. On suitable land, such as the heavy clay at Sutton itself, bacteria beds can be made by merely excavating and burning the soil, laying drains on the bottom and returning the burnt ballast; and this has actually been done at a cost, for a bed 3 feet in depth, of 8 cents per square foot or about $3,530 per acre. In places where the bacteria beds must be erected above the ground level, but where clay is readily obtainable, such beds can be prepared at a relatively small cost; and in these instances, also, the first installation will cost less on the Sutton than on the septic system."

With regard to the third consideration, that of the sewage possibly containing matter injurious to the life of microbes, Mr. Thudichum has found, as a matter of experience, that the majority of manufacturing effluents, especially if diluted with a reasonable proportion of ordinary domestic sewage, will yield to the influence of either aerobic or anaerobic organisms. This was shown by experiments with sewage from Leeds containing effluents from tanneries, galvanizing and copper works, and the solid matter from shoddy; in the case of Maidstone, waste liquids from tanneries and breweries; at West Bromwich, pickle liquor from galvanizing works; at Yeovil, the effluent from the yards of fellmongers and leather dressers; and in various instances in which the sewage to be treated was highly charged with refuse from gas works, margarine factories, dairies and distilleries. "Taken as a whole, the experience of the last two years goes to prove that in the large majority of cases the manufacturing refuse which may be present in the sewage does not prevent the application of the principles of biological treatment throughout, while in cases in which preliminary precipitation or other treatment is necessary the final purification can be best effected by means of the fine bacteria bed."

As an example of the truth of these statements, the case of the Worcester Park outfall works is cited. The successful working of the sewage farms is rendered practically impossible by the nature of the ground, which is a heavy clay, water-logged in wet seasons, and full of cracks when dry, which allows the sewage to pass directly into the underdrains without being purified. A part of the sewage containing considerable quantities of brewery refuse is delivered by gravity near the highest part of the farm. While coarse and fine bacteria beds were under construction an instructive expedient was adopted as a means of treating this sewage, which was the only portion of the total 960,000 gallons received at the farm that had caused annoyance. The author's account of this temporary system of treatment reads as follows:

"A plot of land of about 1 acre in area having been selected, the main effluent drain was locked, and the sewage (which in order to reach the highest portion had to be backed up in the outfall sewer) was allowed to flow on to the land until no more could be received; in fact, the whole plot was considered and treated as a Sutton bacteria bed. This operation occupied about three days. At the expiration of this period the damming of the outfall sewer was stopped, and the sewage allowed to flow freely for a short time into precipitation tanks, in order to remove any accumulation of sludge from the sewer; the backing up was repeated, and the sewage diverted on to a second plot treated in a similar manner to the first. The valve locking the latter was opened and the water gradually discharged from the plot. The work was continued in this way, using the plots alternately, and the result was a remarkable improvement in the quality of the effluent. That which before was black and stinking was clear and had only a slight sewage odor, analysis bearing out the conclusions arrived at from inspection by sight and smell. Such an operation must, of course, not be looked upon as a typical bacterial treatment. The time occupied in filling the bed, and consequently the period during which the organisms are submerged, is far too long, while the bed material is so fine that the re-entry of air is necessarily imperfect, and choking of the surface by the suspended matters in the raw sewage would take place probably at an early date."

The permanent plant for this place, designed to treat 960,000 gallons daily, has coarse beds of 4,500 square feet area and 3 feet of burnt ballast retained on a half-inch sieve, and fine beds, for the second treatment, of 4,950 square feet area and 3 feet of burnt ballast which has passed a half-inch sieve, but has been freed of fine dust. The beds were constructed by puddling the bottom and sides of an excavation, and laying agricultural drains on the bottom, which discharge into an outlet pipe controlled by a valve. The cost of the beds was $1,600.

In introducing these bacteria beds where chemical precipitation has previously been employed to effect the clarification of the sewage, the advice given by Mr. Thudichum is to utilize the precipitation tanks as sand catchers and coarse beds. For the latter purpose a system of drains is laid on the floors, and the basins filled with burnt ballast, coke or other suitable material. Fine beds can be constructed as already indicated, and the effluent from these run over the land of the farm when the crops need to be irrigated or discharged into the river at other times. "The immediate benefits," he says, "derived from such a conversion of the method of treatment are well marked, the use of chemicals is abandoned, saving the cost of both materials and labor. The collection and subsequent treatment of sludge is abolished, since there is no sludge, merely a small quantity of rags, paper and similar matter collected by the screens, and amounting in ordinary cases to about 30 barrow loads per million imperial gallons, the sludge item also making a marked difference in the working cost. * * * The Sutton works themselves form a typical instance of the advantage of conversion. By the time the alterations are completed the whole cost will have been less than $10,000, while the annual saving in working expenses already or to be effected amounts to no less than $2,500, or about 16 cents per head of population."

It is interesting to notice that the author, who is associated with Mr. W. J. Dibdin in the introduction of the Sutton process, says there are a number of features of this system which can be clearly determined only by the co-operation of engineers. Among them are the questions relating to intercepting the sand in the sewage, the working life of the coarse beds and the fineness of the screens. The last does not arise in connection with the septic tank, as all organic matter enters it. The sand question remains, however, and the life of the final bed remains to be studied, for the effluent from the septic tank at Exeter contains considerably more suspended organic matter than that from a coarse bacteria bed.

The useful life of these coarse beds has not yet been determined. That first built in Sutton, which has been in service over two years, is stated to be in excellent condition still and giving as good results as those obtained after it had been in operation a couple of months. There is reason to believe, however, that the water capacity of a bed diminishes according to the time it has been in continuous service, increasing after each period of rest, but never equaling that of the bed in its early stages. A considerable part of this loss in capacity is attributed to organic growths in the interstices of the bed, which, indeed, must develop to a certain extent before the full purifying powers of the bed are obtained. But there must also be a quantity of mineral matter from the sewage deposited in the bed, much of which can never be brought into solution and thus carried away with the effluent.

The interception of the sand in the sewage before it reaches the beds is a subject closely connected with their life. Where cities have the separate system of sewerage it is not very important, but where street washings pass through the sewers to the disposal works the subject requires careful attention. At the Barking outfall works of London there are thousands of tons of road sand which has been removed from the precipitation channels, where it settled as soon as the velocity of the sewage was checked. Several hundred tons of such sand is brought down after a heavy storm following a period of drought. This sewage-carried detritus should not be allowed to pass to a bacteria bed, as it would become choked in a short time, and the question to be solved is to what rate must the flow of sewage be reduced, or how long must it remain quiescent in settling tanks in order that the sand may settle to the bottom and the organic matter in suspension still remain in the sewage. Too short a period will allow sand to enter the bacteria bed, and too long a period will permit the subsidence of the suspended organic matter and the production of sludge. In the Sutton system, the life of a fine-grain bed is not affected by these considerations. The effluent from the coarse bed contains only a small amount of suspended solids, chiefly organic, and the fine bed will not become silted, although its water absorbing capacity will be somewhat reduced by the organic growths which must develop.

So far as the labor required by this method

of disposal is concerned, night attendance has been dispensed with in many recent cases by providing a pair of beds, coarse and fine, each having a water capacity sufficient to take the whole of the night flow. Syphons are provided, so that in case the level of the water in the bed exceeds the definite height, because of rain or some other cause, there is an automatic discharge from the coarse bed to the fine or the fine bed to the farm land, as the case may be.

In view of the present interest in the possible use in the United States of these methods of treatment for handling the effluent from small sewerage systems, what Mr. Thudichum says of such plants in England is particularly timely. "For dealing with the sewage from a small community, such as a public school, or an asylum, or a small hamlet, one of two biological methods may be employed, according to the fall available. In the first method, which may be on the lines of either the Sutton or of the septic system, or a combination of the two, the sewage is passed continuously through the tank, or for 24 hours on to a coarse bed, and then on to fine beds, where it remains for two hours and is then discharged. If bacteria beds only are employed, they should be four in number, two coarse and two fine, each of sufficient capacity to take a whole day's flow. The sewage, or the overflow from the cesspit, where such exists, is allowed to pass into one of the coarse beds for 24 hours and is then diverted to the second bed, the effluent from the first being discharged into the corresponding fine bed. Here it is allowed to remain during two hours and is then finally removed. By this method there is no doubt far more anaerobic action in the coarse bed than is the case where the system is worked normally; but the rest, which is given every alternate day, gives an opportunity for the destruction by oxidation of the organic matter retained by the bed. The attendance required is very slight, and can be readily given by a gardener. It consists merely in turning a few valves, with an interval of three hours between the first and second operations, and in an occasional raking of the surface. If the fall be insufficient to admit of the employment of two sets of beds, the septic tank and the fine beds only can be employed; and in this case the alternating gear used with the latter is essential, as otherwise the attendance would prove a severe tax.

"In the second method it is presupposed that the sewage cannot be delivered at or sufficiently near the surface to be passed on to a bed. In this case the best plan is to provide a storage tank, a coarse-grain and a fine-grain bacteria bed, each of the three being capable of containing the sewage of an entire day of 24 hours. At a fixed time on each day the sewage should be pumped from the storage tank into the coarse bed, should remain there two hours, and then be passed into the fine bed, and after a similar period of rest in the latter be finally discharged.

"The sewage from the Claybury Asylum of the London County Council has been treated by a single pair of coarse-grain bacteria beds with perfect success for over three years. At Radley College an installation has recently been completed in which the overflow from a cesspit is treated by two pairs of beds, two coarse and two fine grain. These beds were constructed by excavating, the sides being of brickwork and the bottoms of clay puddle. The coarse beds are each 16x10 feet by 3 feet deep, and the fine beds each 16x12 feet by 3 feet deep. The bed material is coke, that in the coarse beds being all rejected by a screen having a half-inch mesh, and that in the fine having all passed a mesh of three-eighths of an inch, with the fine dust removed. The water capacity of each bed is 160 cubic feet; that being the maximum quantity of sewage which they have to deal with daily."

The discussion on this paper brought out some valuable information. According to the report in the "Surveyor," Mr. Baldwin Latham stated that the effluents from a system of biological filters or contact chambers, to use his name, with which he was experimenting, were equal to the best effluent obtained from irrigation in England. The sewage of Bilston is charged with salts of iron and is the color of mahogany. When it had all been liquefied by an arrangement corresponding to the septic tank, which need not be closed, it is passed through a contact filter, with surprising results. The amount of albuminoid ammonia has been reduced to 0.03 and 0.028 grain per imperial gallon, even though the sewage contains the refuse from galvanizing works and as much as 28 grains of chlorine per imperial gallon. At Friern Barnet the results were not quite so good as those at Bilston. The sewage showed 1.16 grains of albuminoid ammonia per imperial gallon and the effluent 0.05 grain. In the case of Manchester the sewage contained a great quantity of manufacturing effluents of every description, especially those from chemical and dye works, but after treatment by contact filters the amount of albuminoid ammonia was only 0.07 grain per imperial gallon.

Dr. Rideal referred to the lack of definiteness in such terms as coarse and fine beds. In one case what was termed a coarse bed was made of material which would not pass through a half-inch screen, and a fine bed was made of material which would pass through; in another case the fine material had to pass through a three-eighths-inch screen. At Exeter the bed used to treat the effluent from the septic tank was made of material intermediate in size between Mr. Thudichum's coarse and fine sizes. Then again, it was important to notice that the fine screening of the Sutton process produced 30 barrow loads of refuse per million gallons of sewage in the case of the Worcester Park works, and this refuse must be dealt with in some other way.

Mr. E. G. Mawbey stated that the sewage of Leicester was treated on clay land for eight years, but during the last four years the population had been increasing at the rate of 6,000 a year, and it became necessary to buy more land or adopt some means of clarification. The system finally constructed for preliminary treatment comprised a detritus tank, a settling tank and coarse filter beds. Since the construction of these works it was found that the amount of land necessary for the final treatment was reduced to a little more than half the original area.

THE MORTON BUILDING, NEW YORK CITY.

The Morton Building, which fronts on Ann and Nassau Sts., New York City, is of an irregular approximately T-shaped plan, with extreme dimensions of about 110x140 feet, in process of erection on the site of a recent serious fire. It is of modern fireproof office construction, twelve stories high, with cast-iron columns and steel beams and girders, weighing in all about 4,800,000 pounds. There are in each tier forty-four columns, and the maximum weight of one story is about 300,000 pounds. The columns are both square and circular in cross-section, with heavy side-brackets arranged, as far as possible, symmetrically, to take balancing loads on opposite sides. Instead of being set radial to the columns, the main girders are tangent to the columns, thus securing extended bearings and several bolts in the brackets, as shown in Figure 1, which is a view of an interior column. The top flange of a lower section of a column line at any story has its surface exactly in the plane of the top of the floor girder, and a steel diaphragm plate is set over it and projects each side to connect with the top flanges of the girders. The lower flange of the adjacent upper section of the column is seated on this plate and bolted through it to the lower one.

The shape and dimensions of the floor plans are awkward for erecting the framework, and all the members are handled and assembled by the system of fixed and movable derricks indicated in Figure 2. All material is delivered by trucks in Nassau Street, and hoisted to the last completed floor either by a stiff-legged derrick with a 45-foot boom, or by a large guyed derrick with a 72-foot boom, which commands all the central area of the building. The rear and the extremities of the wings are commanded by a traveling two-boom derrick that can receive material direct from the large hoisting derrick, and can carry it to both extremities of the two wings. The three large derricks erect all the columns and heaviest members, and are supplemented by three small stiff-legged boom-derricks, which are easily moved around and set the lighter pieces. The large guyed derrick and the small movable ones were illustrated and described in "The Engineering Record" of November 26, in the account of the Phelps, Dodge & Co. Building. The two-boom derrick was illustrated in "The Engineering Record" of June 5, 1897, where it was shown with a stationary mounting on a timber tower. To adapt it for traveling

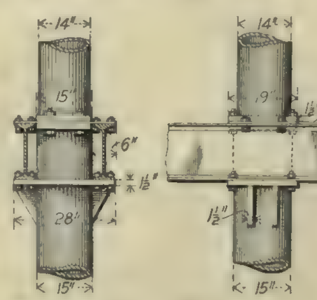


FIG. 1

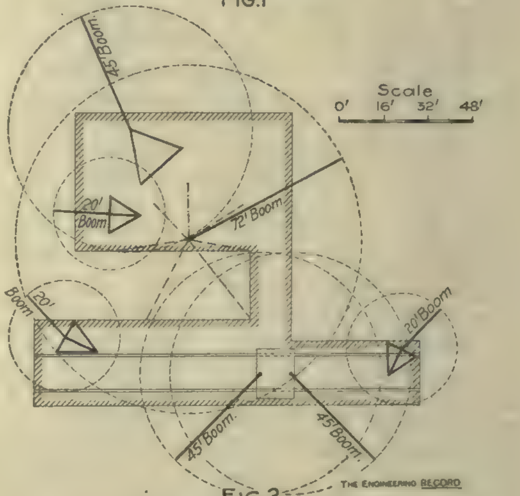


FIG. 2

CONSTRUCTION OF THE MORTON BUILDING, NEW YORK CITY.

service, there was bolted to each end of each longitudinal sill timber a pair of vertical steel plates projecting downward sufficiently to receive the axle of the cast-iron drum-like wheel, with wide tread and inside flange, which rolls on an 8x12-inch timber laid on top of the floor beams. The derrick has sufficient stability for moderate loads, but is provided with pairs of flat hooks, or clamps, to engage the upper flanges of the floor beams and to secure direct anchorage, if necessary. These hooks swing loosely in a heavy ring, which is swiveled to the bottom of a vertical screw, which in turn passes through a nut in the transverse sill and terminates above it in a horizontal hand-wheel, by which it may readily be screwed up to a bearing.

The work on the building was begun during the late period of warfare with Spain, and the erection gang has shown its patriotism and a quaint humor as well, in naming the different derricks. Thus there is "Admiral Dewey," the guyed derrick, "Commodore Schley," the stiff-legged derrick, and "Teddy Roosevelt," the traveling derrick. The small derricks cruising around

wherever required correspond to the mosquito fleet, the "Wasp," "Spider" and "Hornet." The engines for the hoisting derricks are permanently set in the basement and are operated by signals delivered by a cord; the other derricks are operated by engines at their own level, furnished with steam from a boiler below, delivered through iron vertical pipes and flexible hose with lateral connections. All the derricks are hoisted from story to story by the guyed derrick, which also lifts itself every second tier.

The building was designed by Messrs. Clinton & Russell, architects, of New York City; and Mr. J. H. Wells, their structural engineer. The cast-iron columns are furnished by the Hay Foundry and by Messrs. J. B. & J. M. Cornell, and the steel work by the New Jersey Steel & Iron Co., Mr. Charles E. Hewitt, M. Am. Soc. C. E., treasurer. Mr. H. A. Greene, Assoc. M. Am. Soc. C. E., is engineer in charge of the erection, and Mr. W. F. Leaman is superintendent of erection.

POWER HOUSE OF THE CAPITAL TRACTION COMPANY.

A little more than a year ago the power house that operated the cable lines of the Capital Traction Company in Washington, D. C., was burned, bringing the entire system to a standstill. In re-equipping the lines it was decided to use electricity, and as the overhead trolley cannot be used in Washington, the General Electric Company's conduit system was made use of, as it had sufficiently demonstrated its success upon the F Street line in Washington and in New York City to warrant its use by the Capital Traction Company.

No small problem was involved in changing the former cable conduit over to the electric system, but the work was done successfully and rapidly under the direction of Mr. D. S. Carll, M. Am. Soc. C. E., superintendent and chief engineer of the road, and by Mr. W. B. Upton, principal assistant engineer. Figure 1 shows a sectional view of the conduit as it now is. An angle iron was riveted to each slot rail to deflect the drip from the electrical conductors, and the necessary conductors, insulators, etc., were put in place, the whole work being done with little disturbance to the street.

The new power house is located on the banks of the Chesapeake & Ohio Canal in Georgetown. The present power house is 300 feet long by 60 feet wide and 65 feet high, and is divided into two parts by a brick wall, the eastern end being occupied by the engines and dynamos and the western end by the boilers. West of the main building is the coal handling building. Facing the power house on the other side of the canal is a large car barn and repair and machine shops.

Figure 2 is a view of the boiler room, and Figures 3, 4 and 5 show a plan, cross section and longitudinal section of the boiler room respectively. It is about 163 feet long and contains eight Cahall-Babcock & Wilcox boilers, each of 300 horse power, arranged in four batteries. The smoke flues pass into a steel brick-lined stack 9 feet in diameter and 150 feet high, standing on a 25-foot brick base, giving it a total height of 175 feet. The stack was built by the Campbell & Zell Co., of Baltimore, and is equipped with automatic damper regulators. The furnaces are provided with Roney mechanical stokers, built by Westinghouse, Church, Kerr & Co., and driven by three small Westinghouse engines.

The coal is taken directly from the canal barges on the canal by coal handling machinery, furnished by the Steel Cable Engineering Company, of Boston, Mass., and operated by electric motors. As shown in Figure 5, this machinery is housed in a small steel structure forming the western annex to the main building. A 30 horse-power motor operates a tub elevator, which raises the coal from the canal boats and dumps it into a receiving hopper, whence it passes to a weighing hopper with a capacity of 2,000 pounds. After weighing, it drops through a chute into a crusher driven by the same motor. After crushing the coal drops

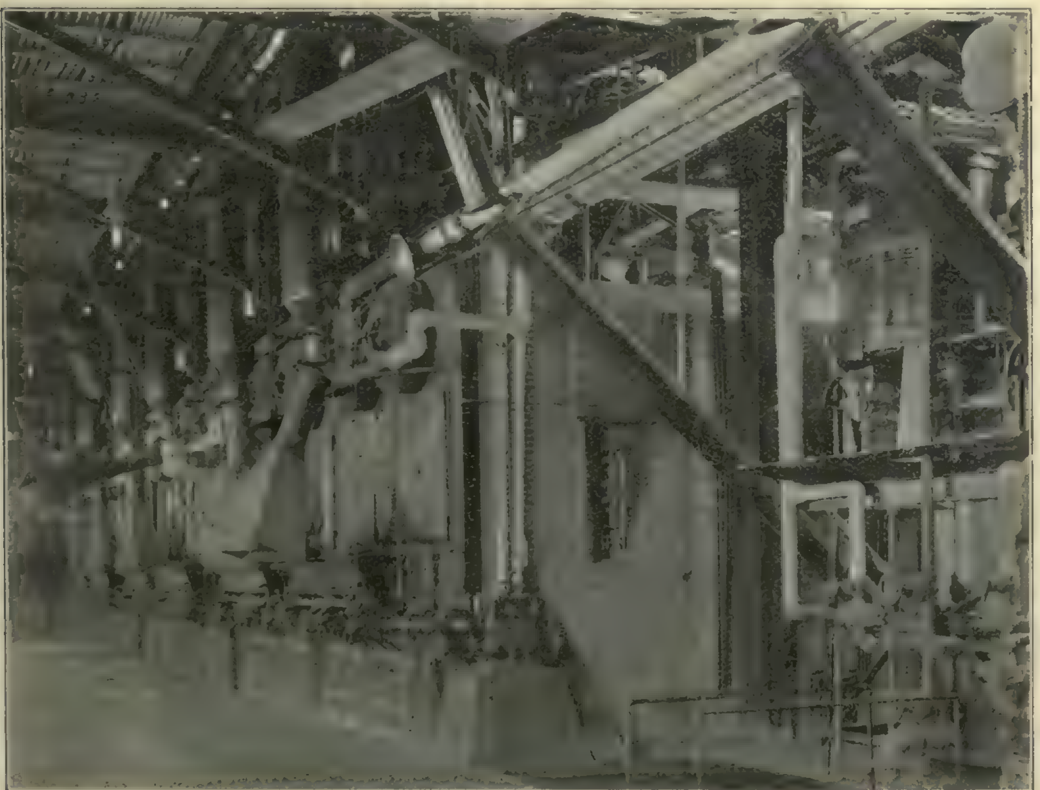


FIGURE 2.—VIEW OF BOILER ROOM, CAPITAL TRACTION COMPANY, WASHINGTON, D. C.

into the conveyor, which is driven by a 15 horse-power motor. The conveyor carries it up and dumps it into the coal bins over the boilers. The returning buckets pass down the eastern side of the boiler room and through a tunnel below the boilers, where they catch the ashes from the ash hoppers and bring them out on the return journey, dumping them into an ash tank, from which they are transferred to either canal boats or to carts. The capacity of the conveyor is 30 tons per hour.

Figure 6 shows the details of construction of this conveyor. The system consists of interlapping steel pans, each pan being securely bolted to a steel axle having self-lubricating wheels, which move upon ordinary T rails. For connecting the pans and moving them a double strand of steel cable is employed, the cables being so placed as to be under the pans when receiving coal and above them when discharging.

The coal bins have a capacity of 2,000 tons and are of unusual construction, as will be seen from Figure 4, the cross section of the boiler house. The bins are two in number, and each is V-shaped in cross section, as shown. The framework is of steel construction, and between the floor beams concrete arches are laid. The

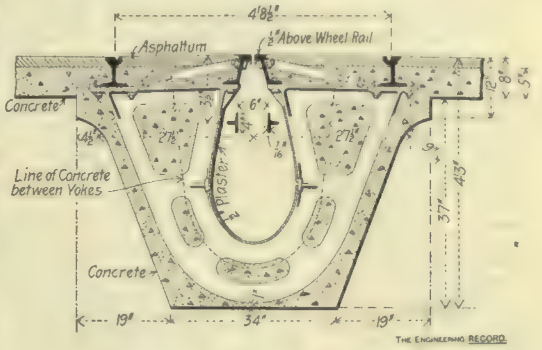


FIGURE 1.—SECTION OF CONDUIT.

bin in the rear contains coal that is usually held in reserve for an emergency. From the front bin the coal is chuted to a measuring hopper over each furnace, and having a capacity of about half a ton. The coal from the rear or reserve bin can be chuted through three supplementary chutes set between the boilers to the conveyor in the ash tunnel, and can then be carried up again and dumped into the forward or main bin. Space has been left behind the boilers for the installation of economizers should their use be decided upon. Behind the boilers a bathroom for the engineer and lavatories for the men have also been fitted up. Water for the boilers is pumped from a well in the basement of the engine room, supplied from the canal, into a 4,000-gallon tank, from which it passes into two Loomis-Manning filters having a capacity of 300,000 gallons in 24 hours, thence through the feed pumps to the primary heaters, then into a supplementary feed-water heater and thence to the boilers. Water can also be taken from the city mains.

The main steam-piping is arranged on the loop system, as shown in Figure 7, a plan of the engine room. It is suitably cross-connected, so that any boiler or engine may be cut out without interfering with the operation of the plant. A separator is placed in the main steam line, and the whole system is covered with Keasbey & Mattison's magnabestos covering and is equipped with Chapman heavy pressure steam valves.

The engine room is shown in plan, cross section and part longitudinal section by Figures 7, 8 and 9 respectively. Figure 10 is an interior view of it. The engines, of which there are five, were furnished by the Edward P. Allis Company, and are of the horizontal tandem compound condensing type, with cylinders 20 and 40 inches in diameter and 42-inch stroke. Each is rated at 800 horse-power when running at 100 revolutions per minute with a steam pressure of 140 pounds. The engines are provided with double-ported valves and double eccentrics, and the governors have a safety attachment which automatically shuts off the supply of steam to the cylinder in case the governor should fail to act. Each fly wheel is 16 feet in diameter and weighs 50,000 pounds. The engines can be run condensing or free exhaust. Each engine is an entirely separate unit, with primary feed-water heater, condenser and separate free exhaust. The receivers are each 30 inches inside diameter and 12 feet 6 inches long. The condensers are of the jet type, and were made by the Deane Steam Pump Company, of Holyoke, Mass., which also supplied the feed pumps. The condenser valves are controlled by valve standards on the engine-room floor.

The generators are directly connected to the engine shafts, and four are set in facing pairs. They are standard General Electric eight-pole, 525-KW dynamos, running at 100 revolutions per minute and delivering current at 550 volts no load and 600 volts full load. In order to compensate for drop on two of the lines, 4 miles long in the one case and 5 in the other, three boosters have been provided. These boosters are generators, series wound for a maximum load of 550 amperes at 180 volts, and so proportioned as to give practically a straight line from zero potential to

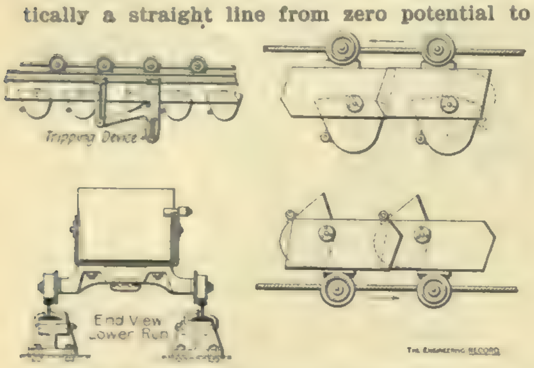


FIGURE 6.—DETAILS OF CONVEYORS.

100 volts. They are six-pole machines, each of 100-KW capacity, running at 600 revolutions. Each booster is driven by a 6-pole 110-horse power 600-revolution motor, driven from the main railroad circuit.

The switchboard, which is about 50 feet long, is built up of standard General Electric panels. It comprises five generator panels, one station panel, three booster motor panels, eight pair of feeder panels, two booster generator panels, two pair of panels for the four booster feeders, one rheostat panel, and a special panel for controlling the power house and shop motor circuits and the lighting circuits. The booster generator panels carry an arrangement of switches which allows the engineer to throw the booster current on to either of two pair of feeders, as desired. They are also equipped with circuit breakers, and in addition with an ingenious relay, which comes into action in case the motor circuit breaker trips, opening the booster circuit breaker and thereby preventing the generator from running as a motor. Dr. Louis Duncan was the consulting electrical engineer for the company.

"The Engineering Record" is indebted to Mr. Carll for blue prints from which the line cuts were made, and to the General Electric Company for photographs and information.

ENGINEERING PLANTS OF LARGE BUILDINGS.

The prime considerations in the mechanical equipment of the modern building are safety, reliability, simplicity, small space occupied, low first cost, and low expense of operation and maintenance. All these cannot, of course, be secured together, but good judgment must be used in selecting the apparatus which will best meet the requirements of the particular case. At a recent meeting of the St. Louis Chapter of the American Institute of Architects, Mr. William H. Bryan, M. E., read a paper on modern practice in this field, from which the following abstract has been prepared:

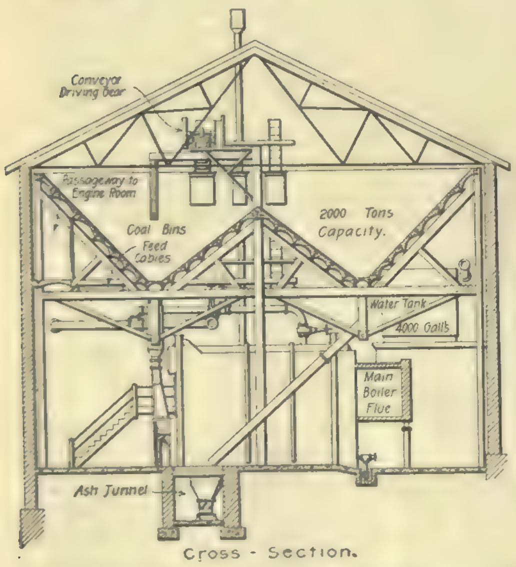
In general it may be said that the number and size of units—boilers, engines, pumps, etc.—should be such that, with any one unit out of service, for cleaning or repairs, the remaining units can handle the maximum service if called upon to do so. As the best machinery can safely stand overloads of from one-third to one-half for short periods, there should never be less than three units, each capable of doing from one-third to one-half the maximum work.

The ordinary tubular boiler is preferable where there is sufficient room, where extreme safety is not essential, and where first cost is of prime importance. Where space must be economized, however, and where extreme safety at high pressure is necessary, the water tube boiler will be found worth its increased cost. In economy of fuel, quick steaming, and dryness of steam, neither type has any advantage over the other, assuming that both are intelligently designed and operated. The working steam pressure should be 90 to 100 pounds if simple engines are to be used, and 125 pounds if compounds are selected.

The chimney should be at least 100 feet high above the grates, and higher if necessary to bring its top well above adjacent buildings. In area it should equal the aggregate tube area of the boilers. For water tube boilers one-ninth the grate area may be used. It should preferably be circular in section, and lined with fire brick. The smoke flue leading to it should be at least of equal area, circular in section, and as short and direct as possible. Where bends are unavoidable, they should be of long radius. Good draft is of prime importance in securing the best results with the fuels ordinarily burned in St. Louis. Smokeless furnaces should always be adopted, for æsthetic and sanitary as well as economical reasons. There are many good devices of this character, such as the down draft, the automatic stoker, and the firebrick arch.

The steam engines and large pumps should usually be of the compound type, where the steam is worked through two cylinders in series, thus giving an economy of 20 to 40 per cent. in the use of fuel over simple or single cylinder engines. The slow speed Corliss engine represents the highest economy, but is rarely available for buildings, on account of the space it requires, and the fact that it cannot be directly connected except to low-speed, high-priced dynamos. Compound high-speed engines occupy much less space, are capable of direct connection, regulate better, and approach the single cylinder Corliss closely in economy. Where space is extremely valuable, high-speed engines of the vertical type may be successfully employed. There are now a number of satisfactory makes on the market at reasonable figures of cost. Very close regulation of speed is now possible without danger of racing, and should be required. The variation over all ordinary ranges of load and steam fluctuations may be kept within 1 per cent., and should never exceed 2 per cent.

The dynamos should of course be of the low-speed direct-connected multipolar type, over-compounded slightly. They must be capable of standing a reasonable overload for short periods, and must not heat unduly in any parts under any conditions of service. Their regulation, non-sparking qualities and efficiency, not less than 91½ per cent. at full load, should also be guaranteed. The switchboard should be of marble or slate, so located that all parts are readily accessible. It should be provided



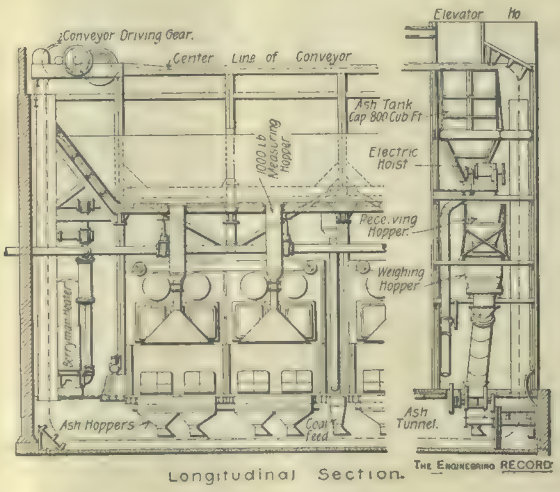


FIGURE 4.—SECTIONAL VIEWS THROUGH BOILER HOUSE.—FIGURE 5.

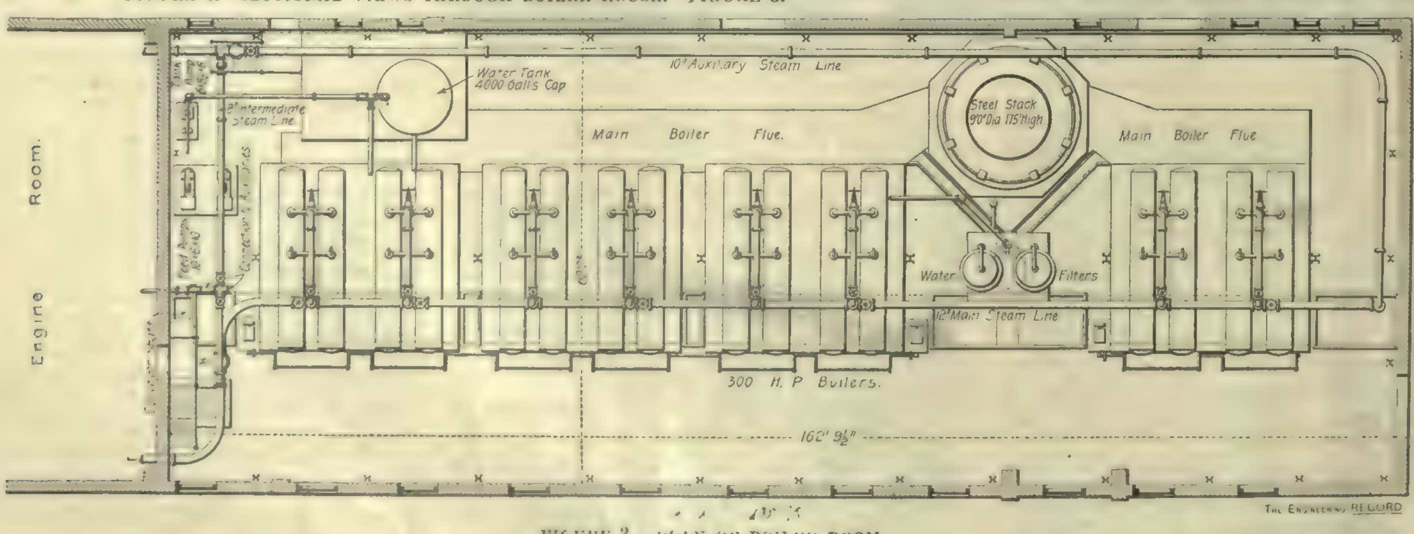


FIGURE 3.—PLAN OF BOILER ROOM.

POWER PLANT OF THE CAPITAL TRACTION COMPANY, WASHINGTON, D. C.

D. S. CARLL, M. AM. SOC. C. E., CHIEF ENGINEER.

with all necessary indicating, regulating, switching and testing instruments, including, if the plant is a large one, a recording wattmeter. There should also be provision for a connection to an external plant, for use in the event of accident to the local plant, or at night and on Sundays and holidays.

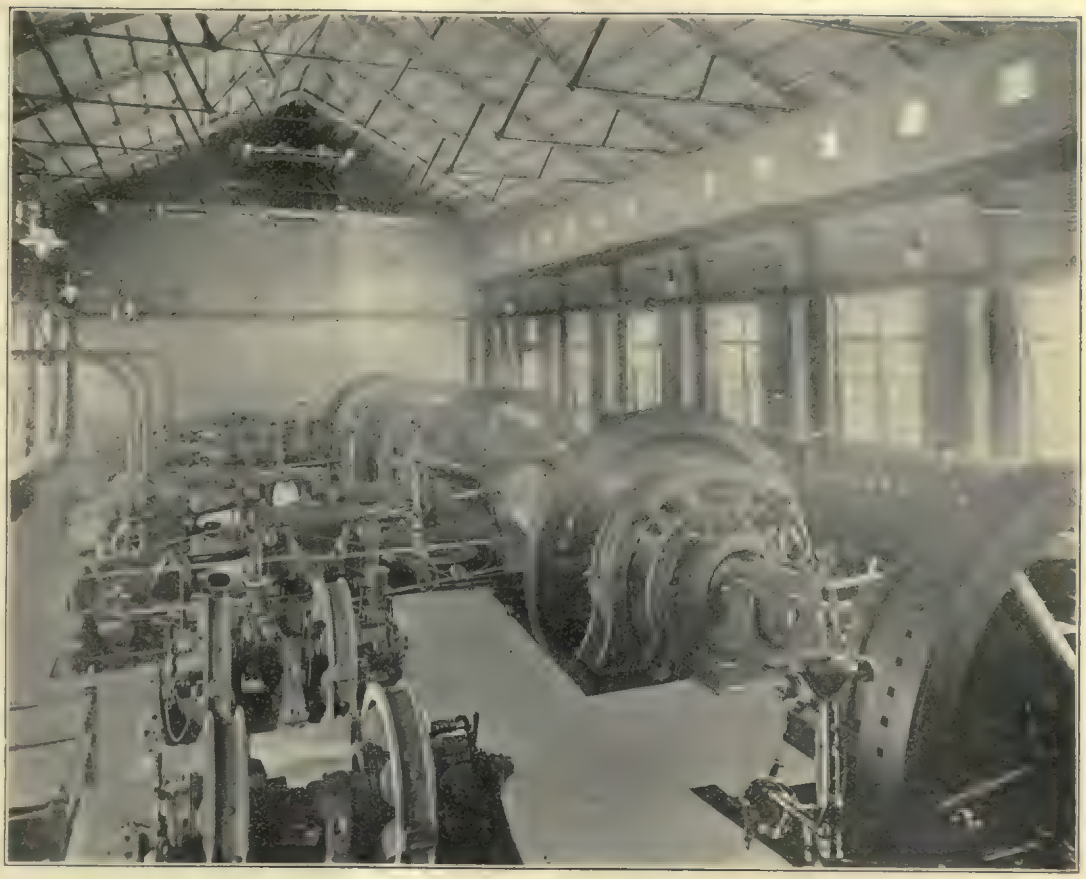
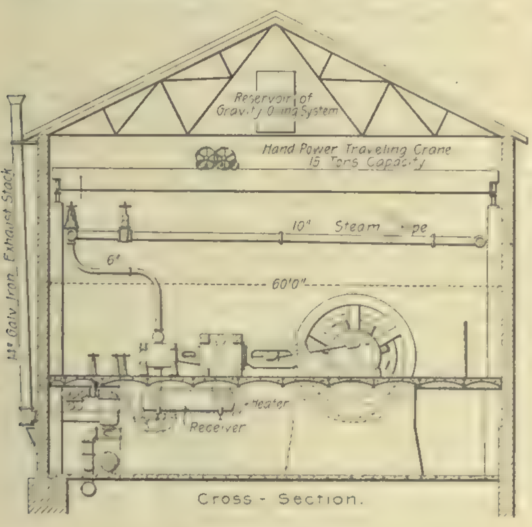


FIGURE 10.—VIEW OF THE ENGINE ROOM.

The distributing system may be either the two or three wire, at 110 or 220 volts pressure, depending upon the character of the work. Arc and incandescent lamps and motors may all be operated from the same mains and apparatus, but it is customary to bring all the wires back to the switchboard separately for ready control. The enclosed arc lamp has practically displaced all other types on account of its uniformity of operation, noiselessness, simplicity, and freedom from frequent carboning. Its efficiency, however, is very low.

The elevator system presents the most complicated problem connected with the modern building, on account of the rapidity with which advancements are being made in all the standard forms of hydraulic, electric and steam. An intelligent selection can only be made by carefully studying the requirements of the particular building under consideration. Until very recently the hydraulic elevator stood at the head, and for a wide range of service is still, in my opinion, without a peer. It has behind it a long record of excellent performance, small repair bills, great reliability and durability, and smoothness of operation. Recent improvements in using higher pressures, and high duty pumping engines, have given it a renewed lease of life. Broadly speaking, I should say that the hydraulic elevator is preferable where the speeds are high, the lifts long, where many stops and starts are made between terminals, and where the average load approximates closely to the maximum.

The principal objection to the hydraulic elevator as usually constructed is, next to its high cost, its low fuel efficiency, due to three features: First: No part of the live load can be counterbalanced—nor even all of the dead load. Second: The maximum amount of power is required, irrespective of the load—the empty car requiring as much as the heaviest load. Third: The direct acting steam pump ordinarily employed is very wasteful in the use of steam. The first two points seem to be very difficult to remedy, but the third may be met in large plants by the use of high-duty pumping engines.



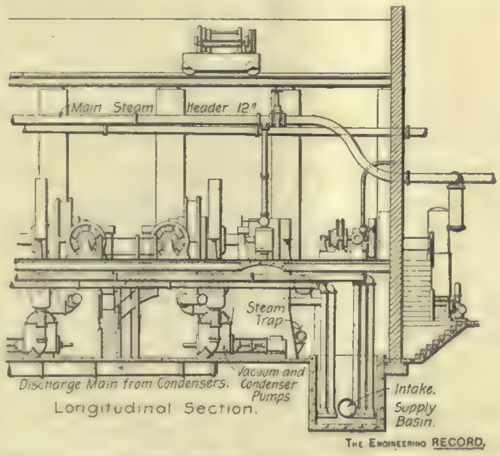


FIGURE 8.—SECTIONAL VIEWS THROUGH ENGINE ROOM.—FIGURE 9.

The electric elevator has made immense strides in the last few years, and to-day is available for a wide range of work. When counterbalanced to half the average load the power required is only that necessary for acceleration and to overcome friction, assuming that the same total load is handled in both directions. It can be counterbalanced as desired, and there is a reduction in power with light loads. Being always operated by automatic engines, preferably compound, its fuel efficiency is high. Being a drum machine, however, it has its speed and travel limitations. Furthermore, for frequent stops the starting current becomes an important factor in lowering the fuel efficiency and bringing undue strains upon the generating plant. This, however, is being very largely remedied in the most recent types. The electric elevator would seem to be preferable for moderate speeds and lifts, and where the average loads are light and the intermediate stops not too frequent. An important advantage of the electric elevator is that it is unnecessary to duplicate the generating plant. The same dynamos which generate electricity for lights furnish current for the elevator motors, and one reserve unit serves for both. This greatly simplifies the arrangement of the plant, reduces its cost and economizes space. The electric elevator has yet to demonstrate its equality with the hydraulic, however, in the matters of reliability and low cost of repairs. The latest forms, however, appear to meet all reasonable requirements in these directions.

Coming now to the heating, ventilating, and piping systems, we find that the exhaust steam from the engines is used in the heating mains. As a rule there is a surplus of exhaust in the up-to-date building, even in the coldest weather, and where compound engines are employed. The most common system is, and probably will remain, the direct. Here in the West we have come to use the single pipe system almost exclusively, on account of its greater simplicity and lower cost. Now that the rules governing its design are fairly well understood, it is in service an entirely satisfactory plan. In the design of direct heating plants two points are frequently overlooked—the necessity of heating the large amount of air which finds its way

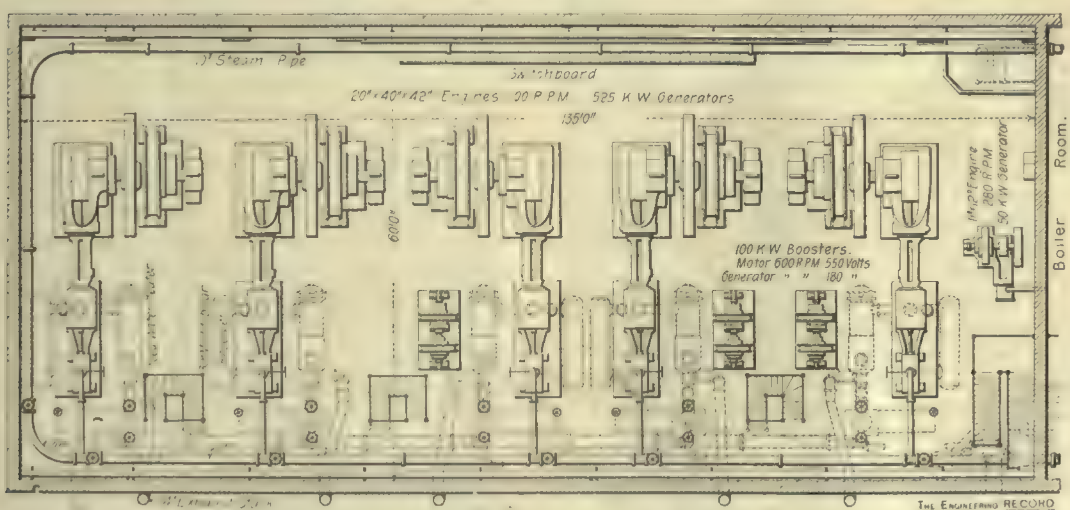


FIGURE 7.—PLAN OF ENGINE ROOM.

POWER PLANT OF THE CAPITAL TRACTION COMPANY, WASHINGTON, D. C.

D. S. CARLL, M. AM. SOC. C. E., CHIEF ENGINEER.

through the doors and windows, shafts, etc., and the heat loss due to unceiled roofs. These are of prime importance.

Among meritorious improvements recently introduced, and which are meeting with very general adoption, are the Paul and Webster systems of air removal from the radiators. They possess many important advantages, the principal ones being, first, the ability to heat the building without pressure, thus greatly relieving the engines whose exhaust is used, increasing their power and improving their economy; and, second, getting a greater amount of work out of a square foot of radiating surface, thus reducing the amount required, the space it occupies, and its cost.

THE INCREASING PRODUCTION OF ACETYLENE.

No one who watches the condition of the lighting business in this country and abroad can fail to be impressed with the activity of the promoters of acetylene. In spite of the evident disfavor with which the use of this gas was regarded by many engineers a few years ago, and in the face of some fatal accidents, it has been introduced into houses, office buildings, railway trains and even in a few instances into public lighting service. The facilities for the electric production of calcium carbide are increasing rapidly, and engineers and architects are having both the carbide and the gas brought to their attention so frequently that they can no longer be dismissed from consideration as the dangerous vagaries of enthusiastic inventors and deceitful promoters. The present condition of the calcium carbide was recently reviewed by "Engineering," and the following abstract of a part of its figures will probably surprise most readers:

The aggregate supply of carbide is now greater than the demand, though owing to the strict regulations of railway and shipping companies regarding its transport in bulk, there is scarcity in certain districts and countries. Stocks are, however, accumulating, and when the very large number of new carbide plants now in course of erection are completed, there is certain to be a rapid and marked decline in prices. At the end of 1897 carbide was offered for sale in large quantities at $90 per ton (packages extra), and the wholesale price in France has already fallen to $68 per ton. As the cost of production is believed to vary from $39 to $58 per ton, according to the cost of electrical power and skill of the management, it is evident that the margin for profit is being rapidly limited. The number of factories now producing carbide is estimated to be thirty-two, distributed as follows:

United States, 4: Niagara (2), Appleton, Sault Ste. Marie.

Canada, 1: St. Catherine's.

Great Britain, 3: Foyers, Birmingham, Ingleton.

France, 10: Le Bathie (2), Bellegarde, St. Béron, N. D. de Briançon, Froges, Sechilienne, Chapareillon, Lancey, Crampagna.

Germany, 4: Frankfort, Bitterfeld, Rheinfelden, Augsburg.

Switzerland, 4: Neuhausen, Valorbes, Vernier, Vernayaz.

Italy, 3: San Martino, Papiguo, Ivrea.

Spain, 1: On the Ebro.

Sweden, 1: Trolhatten.

Belgium, 1: Brussels.

The amounts of carbide produced in these factories vary greatly, those at Niagara being the largest. According to Cowles, the Niagara Works produced 1,250 tons in 1897; Sault Ste. Marie, 267 tons; Appleton, 200 tons, and St. Catherine's, 535 tons, a total of 2,252 tons for America; while in Scotland, Foyers produced 357 tons. The present capacity of the Niagara plants is said to be 10,000 tons per annum; but they are certainly not working continuously. In England a 400-horse-power steam plant has been recently started at Cradley Heath, near Birmingham, and a 200-horse-power steam plant at Ingleton. The capacity of the Foyers factory has been given as equal to 16 tons of carbide per week by Cowles, but he states that the company cannot yet sell this amount.

The new works of the Wilson Aluminum Company for carbide production at Lynchburg, Va., built to replace the Spray factory, which was destroyed by fire, contains furnaces absorbing 2,700 horse-power generated by an 18½-foot fall of water in the vicinity. The output of this works is expected to reach 10 tons of carbide per day.

The new plant of the Neuhausen Aluminum Company at Rheinfelden is now in operation. This plant has cost $580,000, and 5,000 horse-power has been rendered available for the production of calcium carbide and aluminum, at a cost to the consumers of only $9.75 per electric horse-power year. The works upon the Ebro, in Spain, are intended to have a capacity of 30,000 tons of carbide per annum when completed. The factory at San Martino, in Italy, started to produce carbide in February of this year; 1,000 horse-power is to be utilized at this spot.

At the works of MM. Corbin and Chedde in Haute Savoie, 3,200 horse-power is said to be utilized in the manufacture of carbide. Four Theury dynamos, each delivering 800 amperes at 700 volts, form the installation here. At La Praz, 3,000 horse-power is used for the production of aluminum and calcium carbide.

The factories at Sault Ste. Marie and at Niagara are to be greatly enlarged. At the former place the Union Carbide Company, which controls all the American works, is arranging for a 20,000 horse-power plant; and a 5,000 horse-power extension is also contemplated at Niagara. New carbide factories are at present in course of erection at the following places:

United States, 2: Holcombe Rock, Va., 2,400 horse-power, water; Hinton, Va., 1,200 horse-power, water.

Canada, 1: Three Rivers, near Quebec.

Great Britain, 1: Birmingham, steam.

France, 4: St. Etienne, Epierre, Chute de Giffre, Serres, 500 horse-power, water.

Germany, 1: Meran, 2,500 horse-power, water.

Switzerland, 3: Gampel, 2,500 horse-power, water; Via Mala, 6,000 horse-power, water; Klosters.

Spain, 1: Brega, 2,500 horse-power.

Bosnia, 1: Iajce, 5,000 horse-power.

Norway, 1: Sarpsborg, 5,000 horse-power, water.

In connection with these developments, the firm vorm. Schuckert et Cie., of Nuremberg, are supplying electrical generating machinery of an aggregate capacity of 20,500 horse-power; and when all this is in operation an output of 22,000 tons of carbide per annum is expected.

In addition to the above fifteen new factories, three others are being erected in Austria by the Aluminum Company, of Neuhausen, the Elektricitäts Company, of Nuremberg, and the Acetylene Gas Company, of Vienna, respectively.

The generation of acetylene gas from the carbide still continues one of the most attractive problems to inventors, and the total number of patent applications dealing with this subject for the current year will probably exceed that of 1897.

The fact that the organ of the industry, the "Journal of Acetylene Gas Lighting," devoted a leader to the dangers created by the ignorant inventor, in its June issue, is worthy of notice. The exhibition of generators held at Berlin in March, 1898, proved conclusively the necessity for improvement in the methods of generating acetylene for illuminating purposes. The similar exhibition held at the Imperial Institute in London in July and August of this year, owing to the wise regulations and tests framed by the committee, did much to weed out the more worthless forms of generator, and has materially assisted the healthy development of the industry. The flotation of new companies for the exploitation of valuable patent rights in this and other countries goes on apace. As regards the actual application of acetylene to lighting purposes, a very large number of installations (experimental and otherwise) are now in operation, and only the briefest reference to the original description of these is possible. The Naphy burner is still the best upon the market, although Wolff, in a lengthy article upon acetylene burners, agrees with Prof. Lewes that the perfect burner for acetylene has yet to be invented.

In Prussia, considerable use is being made of acetylene for lighting isolated railway stations, and also for train lighting. For the latter a mixture of oil gas and acetylene is used (3 to 1), and the necessary generating and compressing plant has been erected at Grünewald, near Berlin. This plant has a capacity equal to 21,180,000 cubic feet of the gas per annum, and 3,000 tons carbide will, it is said, be consumed here. According to Prof. Lewes this gas has an illuminating value double that of oil gas. The railway stations at Olivia, near Dantzig, and at Schönsee, in West Prussia, have been provided by the Allgemeine Carbid und Acetylen Gesellschaft, of Berlin, with lighting installations, which will also be extended to the towns; and plans are in hand for similar schemes of illumination at Dantzig, Mecklenburg and Augsburg. A 300-light acetylene generating and lighting plant is being installed at Simonius' cellulose factory, at Kelheim, in Bavaria.

France was the first country in which acetylene was applied to train lighting. Acetylene has been used on the French railway between Maisons Alforts and Daveil Vigneux. Whether this section of the line is still worked by acetylene is not clear. The railway station at Pantin, on the line of the Compagnie de l'Est, has also been successfully lighted by acetylene.

In Austria the only trial of acetylene as an illuminant on a large scale appears to have been in Vienna, where an experimental installation for lighting the Hofburg has been in operation for some time.

In the United Kingdom the post office and a large store at Kingussie, N. B., has been lighted by acetylene, and the township of Portsoy in the same district is to be lighted in the same manner. Coal gas had been costing $2 per 1,000 cubic feet in this benighted place, so there is a fair field for a rival illuminant. Messrs. Joyner & Co., of Birmingham, gas fittings manufacturers, have also established an acetylene lighting installation in their factory. As coal gas in this city is nearer 56 cents per 1,000 cubic feet than $2, the advantage of acetylene will be less marked than in North Britain.

In the United States, the city of Wabash, Ind., is to be lighted by acetylene gas, and, if the installation is successful, all the cities of Indiana the lighting of which is under the control of C. F. Diedrich, will be provided with acetylene generating plants. New Milford, Conn., has also adopted acetylene for town illumination, and has erected a generating plant and a 300 cubic foot gas holder for storing the gas. In Canada acetylene has been in use for some months for train lighting between Ottawa and Waltham, and successful trials of its use for a similar purpose have also occurred on the Canadian Atlantic express between Ottawa and Montreal.

VENTILATING AND HEATING OF A NEWARK CHURCH.

One of the handsomest churches in Newark, N. J., is St. Columba's Church, now about completed, and situated on the triangular block bounded by Pennsylvania Avenue, Thomas and Brunswick Streets. It is built of light colored sandstone and joins a parish house of the same

attractive construction, forming a continuous structure, surmounted by a square steeple. The main entrance of the church is at the junction of Pennsylvania Avenue and Brunswick Street, and is indicated on the building exterior by a porch of granite columns surrounding a semicircular vestibule. The nave is covered with an arched roof. The apse contains the sanctuary, and the parochial residence adjoins the church at this end. Figure 1 is a plan of the basement of the church, and Figure 2 of the main floor. The heaters for the building are placed under the apse, and a single room is situated at the other end of the basement for a meeting hall. The central part is unexcavated. There are four sections of pews in the auditorium, as shown in Figure 2, and a gallery for organ and choir is built in the ecclesiastical west, over the vestibule.

The church is warmed by steam, partly by direct radiation and in part by a heated supply of fresh air, which is designed to furnish about one-third of the necessary heat. There is no working machinery in the plant, the heated air rising from heating stacks through floor registers and maintaining a natural circulation. Air is carried from the building through a shaft containing the smoke flue of the steam heaters, and it receives therefore sufficient heat to ensure a continual upflow. The heating and ventilation plant was designed by Mr. W. M. Mackay, of New York City, and the installation is in the hands of Messrs. Walter P. Dunn, Incorporated, of Newark, N. J. The architect for the buildings was Mr. Charles Edwards, of Paterson, N. J.

Air may enter either side of the building, as shown in Figure 1, and a proper supply is therefore more certain whatever the direction of wind may be out of doors. Two ducts carry the air from the two openings toward the center, where they unite and lead to indirect heating radiators. The ducts, as will be noticed, are located in the unexcavated portion of the basement, and are built of 4-inch brick walls, on a cement bottom, and covered with bluestone. The inlets at the foundation walls are protected with iron gratings. The indirect surface is of pin radiators, divided into four sections, enclosed also in 4-inch brick casings, and each tempering a separate supply, which is discharged through a floor register measuring 20x24 inches in size. These are in a line in front of the sanctuary, and are shown in Figure 2. The heated air rises through the registers with a velocity which, according to the design, should be 5 or 6 feet per second, and at a temperature of about 110 degrees; this is 50 degrees above the temperature which it is desired to maintain in the main body of the church. At the top of the church the air becomes cooler and slowly descends, diffusing toward the back of the church. The floor of the pews is a platform about 5 inches above the main floor, and vent openings, fitted with 3x20-inch registers, are located at frequent intervals in the risers of the platform. The more or less vitiated air reaching the floor passes through these and under the seats in the nave to two long narrow galvanized-iron boxes connecting at the bottom with two ducts of galvanized iron placed under the floor, as shown in Figure 1. The two ducts unite and carry the air to the brick stack enclosing a wrought-iron smoke flue, 14 inches in diameter. The base of the brick chimney is lined with firebrick, and a Hitchings boiler front, provided with a grate, is installed. The aspirating flue may thus be heated in summer by a fire on the grate below, and sufficient heat imparted to the air to cause the desired draft. The doors of the Hitchings boiler front serve also for facilitating the cleaning out of the flue.

The steam is generated by two No. 89 Royal steam heaters, each capable of supplying 2,025 square feet of net radiating surface, and three steam connections are made with them. One main is used to heat the auditorium, including the indirect surface, another supplies the radiators in the part of the church encircling the sanctuary, while the third is connected with ceiling coils in the basement room. Each of these may thus be used independently, and only one heater need be fired during mild weather.

The steam piping is carried as shown, pitching from the boilers 1 inch in 10 feet, and return pipes carry the condensation back by gravity, so that no pumps or returning traps are necessary. Along the pews, the direct radiating surface consists of long pipe coils, as shown. The supply pipe for these rises to a point 10 inches above the platform floor, and from it a horizontal pipe runs to the rear of the church, dropping slightly, so that the condensation follows the current of steam. At the end a return bend connects with a similar pipe leading back to the starting point. In the nave, the two pipes are on opposite sides of the partition which divides the pews. Where the radiators are small but one connection is made, and the water condensed returns against the steam for a short distance. The room in the basement is heated from two ceiling coils of 1¼-inch pipe to a temperature of about 70 degrees.

One of the interesting features of the plant is the method of keeping the air in the church in circulation when it is unoccupied, and a large consumption of coal is unwarranted. The air, instead of seeking an exit through the chimney vent shaft, may pass under the seats in the two aisles of the church, or those portions of the church separated from the nave by the usual row of supporting columns. Registers are placed in the risers of the platforms at these pews, as shown in Figure 2, and are also 3x20 inches in size. The air passes under the pews in the two aisles to each end of a duct, shown in Figure 1, which connects at its center with the fresh air brick duct previously described. A weighted damper at the junction, operated by chains and pulleys in the boiler room, allows the use of air from the church or from the outside atmosphere, as desired. The air from the church may thus reach the indirect radiators, from which it rises into the church, displacing cooler air. Much of the direct surface may thus be cut off when the amount of fresh air supplied to the building is very small, and when, as a result, the initial temperature of the air at the indirect surface is somewhat higher than that outside the church.

The parochial residence is a two-story building, with attic and cellar, and is heated by hot water in a system entirely separate from the church. A No. 47 Royal hot-water heater is installed in the basement, with a capacity of supplying 1,500 square feet of net radiating surface. Mains at basement ceiling are graded upward from heater 1 inch in 10 feet, and in general, riser connections are taken from the top of the mains. First floor connections are taken from the cellar mains, and in cases where the direction of the branches crosses that of the floor joists the connection is necessarily at the side, to prevent cutting the timbers. Distributing fittings of the O-S make are placed in the risers to intercept a part of the water for the second floor radiators. An expansion tank is located in the bathroom on the attic floor, about 2 feet above the highest radiator.

It may be of interest to add that the volume of air in the church to be heated is 240,000 cubic feet, and the amount of heating surface is 1,724 square feet in direct radiators and 780 square feet of indirect. The cubical contents of the house is about 40,000 cubic feet, for which 1,230 square feet of hot-water radiating surface has been installed. Both plants have been in operation over two months, and, it is claimed, are giving satisfaction.

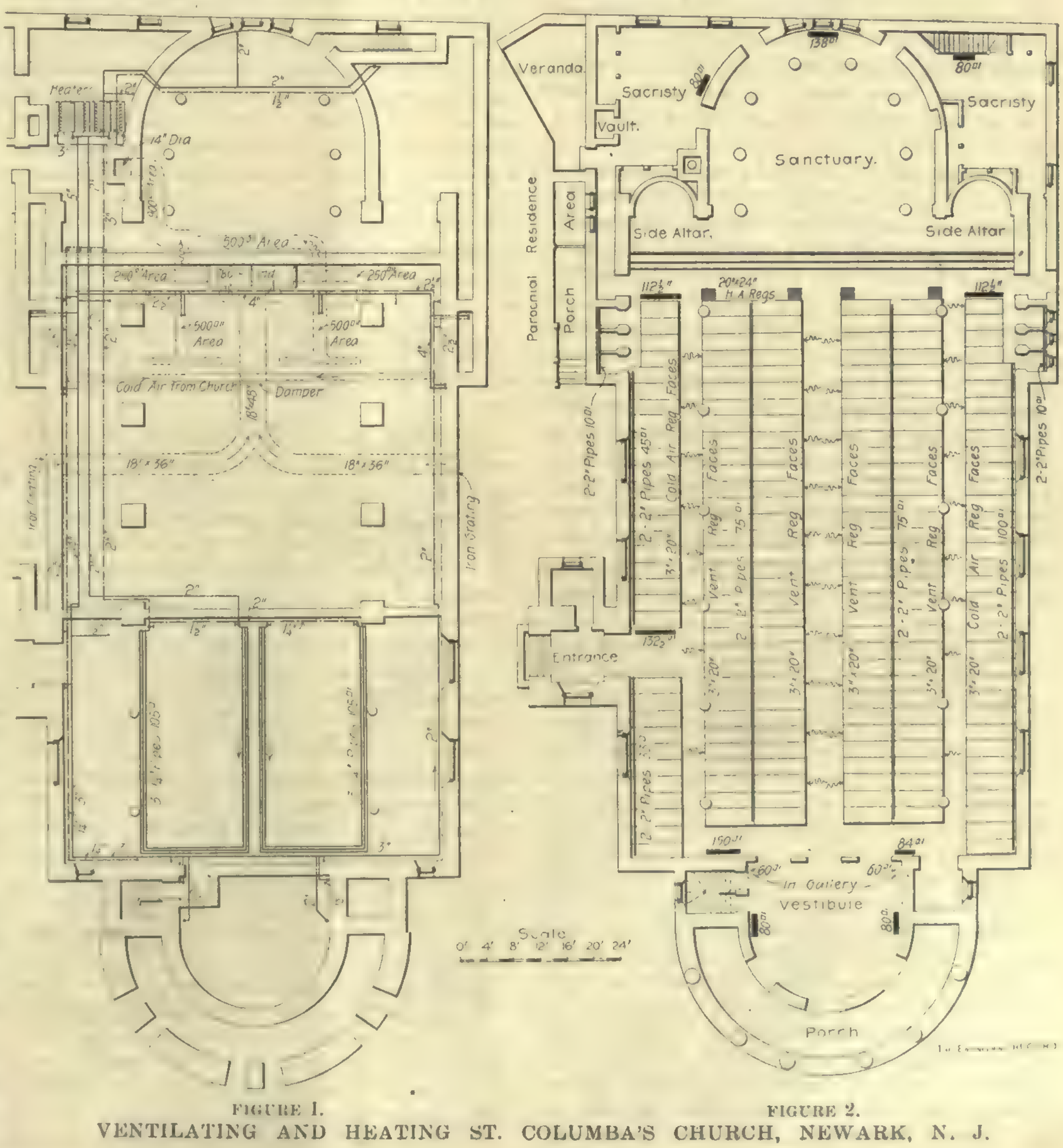


FIGURE 1. FIGURE 2.
VENTILATING AND HEATING ST. COLUMBA'S CHURCH, NEWARK, N. J.

TRADE PUBLICATIONS.

The Buffalo Forge Company, Buffalo, N. Y., has issued a folder illustrating the latest developments in the design and construction of its horizontal and upright engine types. The illustrations are made from photographs and a page only is devoted to a description of the typical features.

The Hoppes Manufacturing Company, Springfield, O., has issued a sixteen-page pamphlet catalogue of steam separators, oil eliminators, exhaust steam feed water heaters and live steam feed water purifiers. Sectional views of different types of apparatus are given, together with tables of dimensions and prices.

"Transformer Design and Operation" is the title of a pamphlet brought out by the General Electric Company, New York City, in which there has been reprinted two important papers upon the subject of electrical transformers. One is a paper recently presented by Mr. W. E. White, General Manager of the Omaha Electric Light, Heat and Power Company, before the American Institute of Electrical Engineers, and the other, which was by Prof. Winder E. Goldsborough of Purdue University, was presented to the National Electric Light Association. The General Electric Company has added some information concerning the transformers it makes, and will furnish to those desiring it a copy of the pamphlet, which will be of value to all interested in the subject.

ENGINEERING SOCIETIES.

The Engineers' Club of St. Louis held its annual dinner at the Mercantile Club December 21, with 41 members and 18 visitors present. President Bryan announced that the result of the letter ballot for officers for 1899 had been as follows: President, B. H. Colby; secretary, E. R. Fish; treasurer, Thomas B. McMath; librarian, E. J. Jolley; directors, J. H. Kinealy and John A. Laird; members of the Board of Managers of the Association of Engineering Societies, J. B. Johnson and Richard McCulloch. There was no one elected vice-president, as none of the candidates had received a majority of the votes cast.

In the absence of the newly elected president, Mr. B. H. Colby, Mr. William H. Bryan retained the chair during the remainder of the evening. The first toast on the programme, "The Engineer of To-day," was discussed by Mr. Bryan. Col. E. J. Spencer spoke on "Our Late Unpleasantness." Mr. Richard McCulloch responded to the toast, "Our Bachelors." Prof. J. H. Kinealy spoke on the toast, "The Engineer in Mechanics." The president then called upon Mr. Robert Moore to speak on "The Engineer as a Citizen." Mr. Moore warned engineers not to allow an interest in engineering to absorb their attention so completely as to prohibit them from performing the duties of a good citizen. Informal remarks were made by Mr. M. L. Holman and ex-Governor F. A. Tritle, of Arizona.

The American Society of Civil Engineers met December 21, Mr. G. W. Tillson presiding. In opening an informal discussion on building laws Professor W. H. Burr considered the laws of New York City as bad, if not worse, than those of other cities. Some of their most serious defects were the absence of requirements for cement and the imperfect column formula where the denominator used gives twice the strength tests have demonstrated the columns to possess. He believed cast-iron columns should be absolutely excluded from buildings, as they have long been from bridges, and that if cast-iron and steel columns were made with the same factor of safety the steel would be found cheaper in every way. He alluded to the innumerable imperfections incident to cast-iron columns and to the lack of standards for quality of steel and for determining the compression in flanges. The absence of supervision over details caused some dangerous and fantastic constructions. Much of the work in important buildings is well designed by competent engineers, although there is no law providing for wind bracing in tall buildings. While the standard for sanitary and plumbing requirements was probably higher than for other departments, Professor Burr thought it should be revised and made more rigid, and that the sole aim of the law should be to secure the best possible construction.

Mr. George Blakeley considered no building law could be rigidly interpreted, but must be in the nature of a specification. He referred to arbitrary requirements for live loads on floors, and thought the amount should be considerably reduced and the total summations modified in tall buildings, although not to the extent of ignoring live loads on the foundations. He criticised the provision for higher loads on cast-iron than on steel columns, and considered many of the faults of cast-iron columns due to bad manufacture and inspection.

Mr. George B. Post traced the development of the New York building laws, which, he said, originated when steel and wrought-iron members were unknown and cast-iron was considerably used for columns and girders. The law was intended to apply to five or six-story buildings, with a unit frontage of 25 feet or its multiple, and really answered very well for them and for speculative tenements, although entirely inadequate for modern high buildings. He referred to the excessive requirements for floor loads, and believed special provision should be made for extinguishing fires in tall buildings. The house and elevator pump service usually installed in them might readily be made efficient for considerable protection, provided steam and water could be assured when wanted, as is not now the case. He described the use of interior stand-pipes connected to the pumps and to the roof tank, and with check valves and hose connections at the street level for fire engines.

Mr. J. F. O'Rourke believed many of the tall buildings in New York could not have been better than they are if the building law had been perfect. He thought, however, the foundation requirements should be modified so as to make a special provision for the treatment and loading of particular kinds of soil in different cases, and that when it was possible for foundations to be carried to the solid rock modifications should be made in the amount of unit strains allowed on caissons. The largest that he knew of are nominally only 12 tons per square foot, though in reality it amounted to less than 6 tons, because the live loads assumed could never be attained.

Mr. George Hill thought that the New York building law should first be improved, then the municipal administration and then the regulations of the Building Department perfected to carry it out efficiently. He believed the Building Department should be composed of five members of the American Society of Civil Engineers, some of them also being members of the Institute of Architects, and that they should approve the regulations formed by the different heads of the department for the details of construction. The commissioner should have charge of the execution of the law, and there should be special heads of the departments of fireproof construction, light and ventilation and plumbing. The law should be subject to modification as occasion required, and he believed discretionary powers would be successfully used, because on all points where the present building law is silent, reasonably good work is invariably secured.

Mr. W. H. Breithaupt read some extracts from the law, showing how inexact and ambiguous are its requirements, especially regarding piles, piers, walls, cast-iron and steel, and for proportioning girders, and he noted that it scarcely recognized civil engineers.

Mr. G. A. Just believed the objections to the law, as it now stands, are largely due to interpretation and neglect, and that engineers should manifest an interest and aid the commission in modifying the law, which, he hoped, would not fail to recognize the engineering profession definitely.

Mr. O. Lowinson believed that the building law should have three branches—specifications, judicial and administration—that structural elements should all be examined by able engineers, who, perhaps, need not be officers of the department, but might, as in some European cities, be in private practice and receive special fees.

Mr. J. C. Wait believed no building law would be constitutional that extended beyond the provisions for the health and safety of the community, and that detailed specifications would inevitably be legally attacked. He was in favor of entrusting the details of design to the engineers and architects without subjecting them to any more supervision than is exercised on physicians' prescriptions or the actions of other professional men.

Brief remarks were also made by Mr. M. Lewinson, Mr. R. W. Lesley and Mr. H. DeB. Parsons.

The Secretary announced that on January 4 a paper will be presented by Mr. Julius Kahn on the "Coal Hoists of the Calumet and Hecla Mining Company," and that the annual meeting will be held January 18 and 19. It is expected that the business meeting will occupy only a part of the first morning, and the afternoon will be devoted to various short excursions. A ball or assembly will be held in the evening, and on the second day there will be an excursion by steamer, probably to the ship-building yard at Elizabethport and to the Navy Yard. In the evening there will be an illustrated lecture by Mr. E. Wegmann on the old Roman aqueducts, which will be succeeded by a smoker. After adjournment the usual collation was served.

NOTES.

The Design of the Steel Work of the South Park Conservatory, Chicago, illustrated in the preceding issue of "The Engineering Record," was made in the office of Mr. D. H. Burnham, the architect, Mr. E. C. Shankland, M. Am. Soc. C. E., then structural enginer. The shop drawings were made by the Kenwood Bridge Company, which built the trusses.

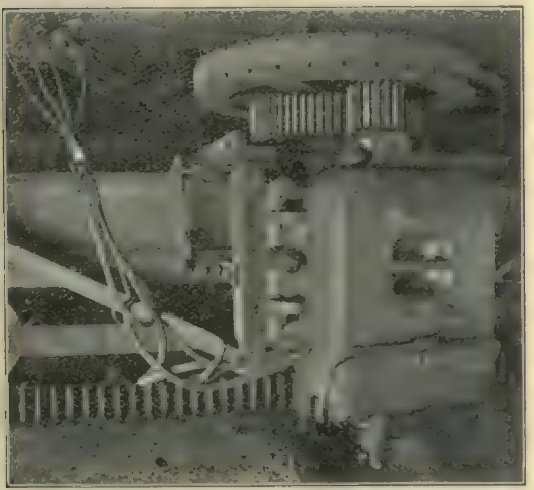
The Purification of Water by Ozone, referred to on December 3 as practiced at Oudshoorn, Holland, has been investigated by Dr. E. Van Ermengem in behalf of the Minister of Agriculture of Belgium. He is stated in "Engineering" to have reported the following general conclusions: "The ozonization of river water contaminated by abundant organic matter of vegetable origin and colored by humus yields extremely satisfactory results from the point of view of improvement of its physical characteristics, its organoleptic properties becoming perfect after this treatment. The purifying action of the ozone, as testified by the various chemical modifications produced, and, especially, by the notable reduction of the substances which produce an acid solution with permanganate, is considerable on toxines and the various products of microbe life. Water contaminated by filtration from sewers or by the products of putrefaction, etc., can be rendered wholly inoffensive by suitable ozonization. Open waters, even when containing numerous microbes of very refractory species, are undoubtedly sterilized, provided the percentage of permanganate does not exceed certain limits; the degree of concentration of ozone and the time of contact to obtain sterilization vary with different waters and the extent of their befouling. There can be no doubt that with the system employed at the Oudshoorn works considerable volumes of perfectly sterilized water can be obtained, and that the sterilization is effected in a regular and constant fashion, through practically unlimited periods."

ELECTRIC DRAW TURNING, HAMILTON AVENUE BRIDGE.

The Hamilton Avenue drawbridge, which spans the Gowanus Canal, in Brooklyn, N. Y., was formerly operated by three or four men who, by means of a capstan, were able to open or close it in from four to five minutes. Now, however, by employing the electric current, the same result is said to be obtained in about 50 seconds, and but one man is needed. The saving both in time and labor is manifest. This bridge is approximately 150 feet in length, and the road or driveway, 32 feet wide, has a sidewalk on either side, which gives the bridge a total width of 41 feet. The total weight revolved is 175 tons.

The electrical equipment consists of a GE-800 motor, bolted in a vertical position to the circular drum in which the bridge rests. The pinion on the armature shaft engages in a gear on an intermediate shaft, which in turn transmits the power by means of another pinion to the circular, stationary main rack on the support for the bridge rollers.

The current employed is taken from the local trolley circuit and is brought to the bridge piers by standard submarine cables laid under the Gowanus Canal. At the pier, the current is carried to a double overrunning trolley circuit, laid around the center of the draw. The motor leads are carried through iron pipes clamped to the girders. The controller used is the R-13, which is similar to those used for electric traction work, but all operations are controlled by one handle. Two levers are placed beside the controller, one of which operates the brake and the other drops the latches. The necessary cut-outs, lightning arrester, circuit breaker and switches are placed in the keeper's house on the land, at one end of the draw. The complete installation was made by the General Electric Company.



ELECTRIC DRAW TURNING MECHANISM.

The average current required to open the bridge is 35 amperes, but this is used for only about 15 seconds, as sufficient momentum is obtained to carry the bridge through the remainder of the quarter circle. The bridge is used only between the hours of 6 A. M. and 6 P. M., and the average number of turns per day through the year is 27. After the completion of a few modifications in the original installation this plan was operated for twelve months at a nominal cost for repairs of about five cents, i. e., one carbon brush and one pair of fuses. Indebtedness is acknowledged to Mr. H. S. Wynkoop, assistant in charge of gas and electricity of the Department of City Works of the former city of Brooklyn, for the information contained in this article.

NOTES.

A Flywheel Failure occurred in the power house of the Pittsburg & Birmingham Traction Company, Pittsburg, Pa., on the evening of December 11. The wheel, 15 feet in diameter, was used with a 300-horse-power engine, controlled by an automatic governor and driving two generators by belt. The valve stem broke about ten minutes after starting, permitting the engine to run away and cause the accident; but, aside from a few large holes in the roof, some broken plate-glass windows in an adjacent bakery and a disabled throttle valve, little damage was done.

An Innovation from the Orient is described as follows in "Indian Engineering," of Calcutta: "An estimate amounting to Rs. 55,770 has been sanctioned for the provision of a proper water supply for Aijal, the headquarters of the Lushai Hills, as the present supply is very bad and usually fails altogether at the end of the rainy season. The scheme contemplates the storage of rainwater by means of a collecting area of corrugated iron sheets, part of which forms the roof of the storage reservoir. The work is in progress."

A Steel Safe Deposit Vault at the Lafayette Bank in Cincinnati, O., has been recently partly removed by a novel method, under the direction of Mr. James E. Stacey, of the Stacey Manufacturing Co., builders of iron and steel tanks. The vault was built about thirty-five years ago of 2-inch steel plates screwed together and the screws then cut off. To take it down, an arc-light wire was tapped, the current run through several transformers and taken into the building. A connection was then made with a 1-inch copper rod having a rubber handle and terminating in a carbon; the current was turned on and the red hot carbon placed against the steel, when, in less than a minute a hole half an inch deep was made. At first an alternating current of 50 volts and 225 amperes was used, which burned a hole through the 2 inches of hard spring steel in two minutes. Since then a direct current with a voltage of 220 and a carbon 1½ inches in diameter has been used. With this a hole can be burned through the steel in about 55 seconds.

PERSONAL.

Mr. Abram Wing has resigned his position as superintendent of the Iowa Water Company, Ottumwa, Ia.

Mr. Harry T. Porter has been appointed chief engineer of the Pittsburg, Bessemer & Lake Erie Railroad.

Mr. E. A. Kent, of Buffalo, N. Y., has been appointed supervising architect of the Buffalo post office building.

Messrs. Litt Bloodworth, Jr., and Howell Erwin have been elected to the Board of Water Commissioners of Atlanta, Ga.

Mr. Elwood Mead, State Engineer of Colorado, has been appointed chief assistant and consulting engineer to Mr. A. C. True, United States director of experiment stations for the purpose of planning and carrying out Government irrigation projects in the West.

Mr. Edward M. Boggs has established offices at 535 Stimson Block, Los Angeles, Cal., for the practice of civil and hydraulic engineering. Mr. Boggs has been in practice on the Pacific Coast for the past eleven years. For five years he was professor of civil and hydraulic engineering in the University of Arizona, and he has just concluded service as chief engineer for the Southern California Power Company, having charge of the construction of the Santa Ana Canal.

OBITUARY.

Mr. W. T. Bowles, a contractor of Richmond, Va., died in that city December 23.

Mr. Emmet Alva Little, city engineer of Menasha, Wis., died December 27. He was formerly city engineer of Neenah, Wis.

Mr. John H. Snyder, a retired builder of Baltimore, Md., died in that city December 13.

Mr. B. C. Williams, a contractor of Hazlehurst, Ga., was shot and killed in a dispute over business matters December 20.

Mr. Charles Hillman, president of the Charles Hillman Ship & Engine Building Company, of Philadelphia, Pa., died in that city December 22.

Mr. William Henry Platt, for forty-five years connected with the Lackawanna Iron and Steel Company, died in New York City December 25.

Mr. John W. Chalfant, member of the firm of Spang, Chalfant & Company, and a prominent steel manufacturer of Allegheny, Pa., died December 28.

Mr. Daniel Morris, who died in Atlantic City, N. J., December 21, was formerly surveyor of State railroads in Pennsylvania. He had surveyed and mapped Atlantic City.

Mr. Joseph Sherman, who died at New Baltimore, N. Y., December 18, was a civil engineer who had been engaged as inspector for the government on the Hudson River improvement.

Mr. Albert C. Robinson, who died at East Kingston, N. H., December 18, was formerly superintendent of water-works at Knoxville, Tenn., and other places in the South, but had recently practiced as an architect.

Mr. Stephen A. Morse, founder of the firm of Morse, Williams & Company, builders of elevators, died in Philadelphia, Pa., December 22. He was a native of New England and had made a number of inventions pertaining to machinery and elevators.

Mr. L. O. Lathrop, who died at Plano, Ill., December 25, had studied architecture with Mr. J. M. Van Osdel, formerly a well-known architect of Chicago, and assisted in the building of the Tremont and Palmer Houses. He was afterward engaged in bridge service for the Government.

Mr. John Z. O'Brien, who died at Sayville, N. Y., was a civil engineer, who had been engaged in laying out the Rensselaer & Saratoga Railroad, and was afterward chief engineer of the Long Island Railroad. He was inspector of street cleaning in New York City under Mayor Havemeyer.

Mr. Isaac Bradford, who had been mayor of Cambridge, Mass., for four terms, died December 19. He received a scientific education, and was for several periods, covering a long range of years, engaged with work on the American Ephemeris and Nautical Almanac, and he had been employed by the United States Coast Survey to perform the astronomical and telegraphic time computations of the transcontinental longitude work of 1869.

Major Frederick H. Smith, who died in Baltimore, Md., December 24, was a well-known civil engineer. He was a native of Pittsburg, Pa., but studied in Kentucky, and on the outbreak of the civil war he joined the engineer corps of the Confederate Army under Generals Johnston and Hood and was engaged in planning the defenses of Atlanta. He removed to Baltimore after the war, was appointed to a position in the City Commissioner's Department, and for eight years was engineer in charge of bridges.

Mr. Hillary Messimer, who died at Reading, Pa., December 16, was superintendent of motive power and machinery of the Calumet & Hecla Mining Company, Calumet, Mich. He served for nine years in the engineer corps of the U. S. Navy, and was connected at various times with the Philadelphia & Reading Railroad Company, with Coxe Brothers & Co.'s mines, at Drifton, Pa. He engaged in the introduction of American anthracite into Europe and South America, and established the manufacture of nuts and bolts at Kansas City, Mo.

CONTRACTING NEWS

OF SPECIAL INTEREST TO

CONTRACTORS, BUILDERS, ENGINEERS, AND MANUFACTURERS

OF ENGINEERING AND BUILDING SUPPLIES.

For Proposals see page ix.

WATER.

Jacksonville, Ill.—A. M. Upham, Supt. of Water Works, writes that one to two miles of cast-iron water pipe will be required about Jan. 1.

Sault Ste. Marie, Mich.—H. C. Thompson, Supt. of Water Works, writes that a 5,000,000 gal. pump will be purchased in 1899.

Minneapolis, Minn.—J. H. McConnell, Supt. of Water Works, writes that about Feb. 1 the Water Department will require 17,059 ft. of 6-in., 5,318 ft. 8-in., 2,030 ft. 12-in. and 769 ft. 16-in. pipe.

Winslow, Ariz.—F. W. Nelson, Secy. of the Farm & Fireside Co., writes that work on the irrigation system which is to be constructed at a total estimated cost of $250,000 has been suspended until spring.

Baltimore, Md.—D. G. Adelsberger, Engr. of the Tuxedo & Embla Parks Water & Light Co., writes that bids are now being asked for water works to consist of steel water tower, pump house, deep well pump and 2 miles of 4, 6 or 8-in. pipe, with gates and hydrants.

Shreveport, La.—We are informed that the city has under consideration the purchase of the entire plant of the Shreveport Water Works & Sewerage Co.

Wamejo, Kan.—F. S. Haacke, City Clk., writes that the contract for water works construction was awarded Dec. 16 to W. W. Cook, Junction City, Kan., for $22,473.

Malden, Mass.—J. W. Jordan, Supt. of Water Works, writes that about April, 1899, the Water Works Department will require 15,000 ft. of 6 to 12-in. pipe, 15 4 to 6-in. hydrants and 30 4 to 12-in. gates.

Martinsburg, W. Va.—J. M. Shaffer, Supt. of Water Works, writes that bids will soon be asked for a pumping engine of 2,500,000 gals. capacity.

Binghamton, N. Y.—About 6,000 ft. of 12-in., 6,000 ft. of 8-in. and 6,000 ft. of 6-in. pipe will be required in April. D. Felter, Supt. of Water Works.

Huntsville, Ala.—It is stated that a bill has passed the Legislature authorizing the issue of $20,000 water works bonds.

Spring Lake Beach, N. J.—It is stated that the borough has issued $75,000 bonds for purchasing the beach front, sewer system, water pipes in the streets, etc.

Rockport, Ind.—It is stated that the citizens of Rockport are in correspondence with the State Board of Health with regard to the establishment of a water plant.

Brazil, Ind.—A special election will probably be called to vote on the sale of the water works.

Frederick, S. D.—It is probable a stock company will be formed for the purpose of obtaining an artesian water supply.

Martinez, Cal.—Press reports state that George W. McNear has completed arrangements for providing a supply of water for Martinez, Port Costa, Crockett and Valona. It is proposed to lay about 13 miles of pipe connecting the artesian well and storage reservoir and the towns mentioned.

Whitesboro, N. Y.—At a recent special election it was voted to expend $1,200 per annum for five years for a gravity system of water works, to consist of 30 hydrants, with necessary piping and a 1,500,000 gal. reservoir.

Ridgefield, Conn.—It is stated that the contract for water works construction has been awarded to the Sanitary Construction Co. of Hartford.

Knoxville, Tenn.—According to local reports the City Council contemplates purchasing the plants of the Knoxville Water Co. and the Lonsdale-Beaumont Water Co.

Lakefield, Minn.—Press reports state that there is agitation for water works and the matter will probably be voted upon at the spring election.

Goshen, Ind.—Bids are wanted Jan. 13 for 15,000 ft. of water mains. I. D. Wolfe, City Clk.

Washington, D. C.—Bids are wanted Jan. 26 at the office of Washington Aqueduct for furnishing and delivering at shafts of aqueduct tunnel, brick, cement, sand, special castings and bolts, as advertised in "The Engineering Record."

Cheboygan, Mich.—Bids are wanted Jan. 21 for sinking an artesian well, as advertised in "The Engineering Record."

McConnellsville, O.—Bids are wanted Jan. 25 for $20,000 water works bonds. L. J. Weber, Mayor.

South Bend, Ind.—Bids are wanted Jan. 11 by the Board of Water Works Trustees for two 150 h. p. water tube boilers.

Tuskegee, Ala.—Mayor W. W. Thompson writes that Alber & Byrne, Engrs., Birmingham, Ala., have been engaged to prepare plans and specifications and superintend the construction of water works to cost about $17,000 and an electric light plant to cost about $7,000. Bids will be received about Feb. 1.

Wamego, Kan.—Bids are wanted Jan. 24 for $25,000 water-works bonds. F. S. Haacke, City Clk.

Canby, Minn.—Bids are wanted Jan. 24 for a system of water-works. Oscar C. Olson, Village Recorder.

Mobile, Ala.—T. P. Brewer, Supt. of City Water-Works, writes that the construction of the new system of water-works and sewerage will begin Jan. 1. Contractors, M. T. Leuman & Co., Louisville, Ky., for water-works, and T. J. Shea, of Quincy, Ill., for sewer system.

Newport, Ky.—Geo. Hornung, Supt. Water-Works, writes that in Júne, 1899, about 450 tons of 10 and 6-in. cast-iron pipe and specials, 55 hydrants and 140 water gates, will be required.

Independence, Mo.—During 1899 about five miles of water pipe and 30 hydrants will be required.

Beloit, Wis.—We are informed that about March 15 5,000 to 10,000 ft. of cast-iron pipe will be required, and possibly one power pump.

Elgin, Ill.—R. R. Parkin, Supt. of Water-Works, writes that a few miles of water pipe will be laid in February.

Eastlake, Ala.—A bill has passed the House to incorporate the Eastlake Water & Power Co.

Washington, D. C.—Local press reports state that W. A. MacFarland, Supt. of the Water Dept., has prepared plans for a 15,000,000-gal. reservoir to be built opposite the Brightwood Driving Park.

Arkansas City, Ark.—The Artesian Water, Ice Light & Fuel Co. has been incorporated with a capital of $25,000. The object is to establish and operate a system of water-works, to manufacture ice, etc. The incorporators are H. Thane, J. E. Lacy, Geo. R. Lacy and others.

Cuyahoga Falls, O.—An election will probably soon be held to vote on the issue of $60,000 bonds for a system of water-works.

Waco, Tex.—Local reports state that the Bell Water Co. has purchased a site for a reservoir, which is to be built at once. Additional wells are to be drilled near the reservoir.

San Francisco, Cal.—Fire Marshal Towe has prepared plans for a salt water system for fire protection. Estimated cost, $100,000.

Tifton, Ga.—The construction of a water-works system is being agitated.

Arlington, Mass.—The town has voted to enter the metropolitan system of water-works. B. D. Locke, Town Clk.

Joliet, Ill.—About March 1 the following supplies will be required: 5,000 ft. of 8-in., 1,500 ft. of 6-in. pipe, 13 hydrants and 20 gates. S. F. Tompkins, Supt. of Water-Works.

Nashville, Tenn.—The sum of $7,500 has been appropriated for water meters in the 1899 budget.

Ishpeming, Mich.—We are informed that about Jan. 15 three pumps will be required. P. H. Devine, Supt. of Water-Works.

Bozeman, Mont.—It is stated that bids are wanted Jan. 17 for $165,000 water-works bonds. Geo. D. Pease, City Clk.

Mayville, N. D.—A committee is stated to have been appointed to investigate the question of constructing works

York, Pa.—Henry W. Birkinbine, Gen. Mgr. of the York Water Co., writes that an order has been placed with the National Pipe & Foundry Wks., Scottdale, Pa., for 20-in. pipe.

Vailsburgh, N. J.—Bids are wanted Jan. 11 for 31,680 lin. ft. of 4-in., 6-in. and 8-in. cast-iron pipe, 14,000 lbs. special castings, valves, etc., for a system of water-works. Eugene A. McMurray, Boro. Engr.

Berea, O.—Bids are wanted Feb. 6 for $30,000 water-works bonds. T. J. Quayle, Mayor.

Cleveland, O.—Bids are wanted Jan. 27 for 4 water cylinders, also repairing and rebuilding Worthington pumping engine No. 4 at the Division St. pumping station. George R. Warden, Dir. Pub. Wks.

Eldorado, Colo.—A franchise has been granted to the Eldorado Mining, Milling & Power Co. to establish a water and light plant.

Philadelphia, Pa.—The Councils' Water Commitee on Dec. 24 decided to ask for $80,000, in addition to the $100,000 already suggested by the Finance Committee, to repair and extend the reservoir system.

East Hampton (L. I.), N. Y.—The Home Water Co. has been incorporated; capital, $25,000. Directors: J. T. Gardiner, William Fletcher, Winchester, Adrian H. Larkin, of East Hampton, and others.

Macon, Ga.—The Macon Gas Light & Water Co. is stated to have decided to erect an 850,000 gal. water tank or stand pipe in Vineville.

Lakeport, Cal.—It is stated that the proposition to construct water-works carried at the recent election.

Marion, O.—A committee has been appointed to report the feasibility of purchasing the water company's plant.

Big Rapids, Mich.—It is stated that a $5,000 water bond issue has been voted.

Highland, Ky.—Articles of incorporation have been filed by the Highland Water Co.; capital, $50,000. Incorporators: James Southgate, C. F. Stricker, of Newport, and others.

Meriden, Conn.—The following appropriations have been made for 1899: Streets, $38,733; sewers, $9,250; sewer (construction), $25,000, and water, $55,664.

Jersey City, N. J.—It is stated that the following bids were opened Dec. 27 for water pipe, price per ton: Fox & Engel, 253 Bway., New York, 6 in., $17.75; 8 in., $17.75; 12 in., $17.50. M. J. Drummond & Co., 192 Bway., New York, 6 in., $18.40; 8 in., $18.40; 12 in., $18.40. R. D. Wood & Co., Philadelphia, 6 in., $19.20; 8 in., $19; 12 in., $18.50. McNeal Pipe & Foundry Co., Burlington, N. J., 6 in., $18.60; 8 in., $18.60; 12 in., $19.10.

New Richmond, O.—Chas. R. Day, City Clk., writes that contracts have been awarded as follows for water-works and electric light plants, as advertised in "The Engineering Record":

Rumsey & Co., Seneca Falls, N. Y.—Pump, $1,950.

American Pipe & Foundry Co., Chattanooga, Tenn.—Pipes and special castings, $6,766.07.

R. D. Wood & Co., Philadelphia—Hydrants, 6-in., $22.50; 4-in., $19.80.

Bourbon Copper & Brass Wks., Cincinnati—Valves, 10-in., $18.50; 8-in., $13.00; 6-in., $9.00; 4-in., $5.65.

Standard Boiler & Bridge Co., Bellaire, O.—Building (including brick smoke-stack), boilers, well and intake, reservoir and pipe laying, $11,268.30.

Westinghouse Electric & Manufacturing Co., Pittsburg—Electric light systems complete, $5,000.

Engine not yet contracted for.

Plant to be completed by 1st of June, 1899.

SEWERAGE AND SEWAGE DISPOSAL.

Denver, Colo.—Local reports state that the Board of Aldermen has passed the Capitol Hill storm sewer bill. The work contemplated involves the expenditure of about $400,000.

Wellsville, O.—A committee has been appointed to secure plans and specifications for a system of sewerage.

New Britain, Conn.—The Sewer Commissioners have decided to have prepared by Engineer Samuel M. Gray estimates of cost of different systems of sewage disposal.

Independence, Mo.—Sewer bonds to the amount of $75,000 have been sold.

Steelton, Pa.—Jno. D. Young, Secy. of Council, writes that the borough has voted to build a sewerage system during the summer of 1899. Bids will be asked within a short time.

Buffalo, N. Y.—Bids are wanted Jan. 11 for brick and tile sewers on Hopkins St. and South Park Ave. R. G. Parsons, Secy. Bd. Pub. Wks.

Springfield, Mo.—Bids are wanted Jan. 3 for sewers. T. A. White, City Engr.

Shreveport, La.—See "Water."

Mt. Vernon, N. Y.—Bids are wanted Jan. 17 for a lateral sewer in Pearl St. Edwin W. Fiske, Mayor.

Winchester, Va.—P. W. Boyd, Supt. of Streets and Water, writes that the city has under consideration the sewering of Main St.

Mobile, Ala.—See "Water."

Philadelphia, Pa.—An appropriation of $20,000 has been recommended for branch sewers to connect with the Manayunk intercepting sewer.

Ft. Wayne, Ind.—City Engineer Randall has been instructed to prepare plans for the new South Wayne sewer, which will probably be from 6 to 7 ft. in diameter.

Newark, N. J.—City Engineer Adam has been instructed to prepare a notice of intention to build about 12,000 ft. of pipe sewers for Forest Hill.

Lorain, O.—Local reports state that a system of sewers is to be built in the section of the city adjoining the steel plant.

Niles, O.—The Sewer Commission has under consideration plans and specifications for a system.

Scranton, Pa.—It is stated that bids are wanted Jan. 5 for a sewer on Von Storch Ave. and Honesdale St. M. S. Lavelle, City Clk.

Rochester, N. Y.—It is stated that bids are wanted Jan. 5 for pipe sewers. Edwin A. Fisher, City Engr.

Natchez, Miss.—Bids are wanted Jan. 5 for 300 ft. of 18 in. and 24-in. pipe for surface drainage. L. M. Dalgarn, City Engr.

New Orleans, La.—An ordinance has passed the City Council providing for sewerage, drainage and water-works improvements. The taxpayers will vote Feb. 2 on the proposition to levy a special 2½-mill tax for a term of 30 years.

San Francisco, Cal.—Plans and specifications have been adopted for a main sewer south of Golden Gate Park.

Springfield, Mass.—The contract for the completion of the North-end sewer has been awarded to F. T. Ley & Co., of Springfield, for $8,537.

Meriden, Conn.—See "Water."

Asbury Park, N. J.—Joseph Harris, Township Clk., writes that the Sanitary Sewer & Sewage Utility Co., of 56 Pine St., N. Y. City, has applied to Neptune Township for a franchise to construct sewers.

Dunmore, Pa.—An ordinance is before the Council which provides for the issue of $60,000 bonds for sewers in 3 sewer districts.

Buffalo, N. Y.—Local reports state that the following bids were received for Van Rensselaer St. sewer: Andrew Beaser, $74,974; John Harrer, Buffalo, $79,700; Henry Harter, $85,978; John Mumm, Buffalo, $93,657; Thomas F. Moore, Buffalo, $96,872; W. G. Smith, $96,838; William Franklin, Jr., $101,614; Ritzmann & Miller, Buffalo, $45,522; Brown, Stabell & Griffiths, Buffalo, $109,920; George Dark & Thomas Dark, Jr., Buffalo, $120,500; Christopher Smith, Buffalo, $134,334.91.

Scranton, Pa.—The following bids were opened Dec. 8 for a system of lateral sewers in the 16th district: *a*, complete, 4,352 lin. ft. of 8, 10, 12 and 15-in. pipe, 30 manholes, 12 basins and 140 house connections (about 2,634 lin. ft.); *b*, extra manholes; *c*, extra basins; *d*, extra house connections: V. H. O'Hara, *a*, $2.75 per lin. ft.; *b*, $35; *c*, $90; *d*, $1 per lin. ft. M. J. Gibbons, *a*, $2.35; *b*, $50; extra basins; *c*, $80; *d*, $1.25. Donohoe & O'Boyle, *a*, $2,475. Bidders all of Scranton.

BRIDGES.

Sacramento, Cal.—It is proposed to build in the summer of 1899 a $10,000 drawbridge near Walnut Grove, Cal. J. C. Boyd, Co. Surveyor.

Bangor, Me.—The construction of a bridge across Kenduskeag stream is stated to be under consideration.

Los Angeles, Cal.—Sawyer & Arthur are stated to have received the contract for three bridges for $13,664. J. D. Mercereau is stated to have secured the contract for the 6th St. bridge at $6,890.

Washington, D. C.—It is stated that a bill has passed in the Senate authorizing the Choctaw & Memphis R.R. Co. to construct bridges over the Arkansas and other navigable rivers in Arkansas.

Geneva, O.—It is stated that a 180-ft. steel swing bridge will be built across Conneaut harbor.

Davenport, Ia.—It is stated that the Chicago, Milwaukee & St. Paul Ry. proposes building a steel viaduct at the Orphans' Home crossing.

Boston, Mass.—Bridge Commissioner W. J. Marvin in his annual report recommends the building of 2 bridges across the Charles River to replace the Craigie and North Harvard St. bridges.

Des Moines, Ia.—The construction of a bridge at 2d St. is stated to be under consideration.

Portland, Me.—The plan for the construction of an overhead bridge, from York St. to the Portland bridge draw, is under consideration by the Boston & Maine and Maine Central R.R. Estimated cost, about $300,000.

Selma, Ala.—Bids for $65,000 bridge bonds, opened Dec. 21, have been rejected by the County Commissioners.

Stockton, Cal.—Plans are being prepared for a 240-ft. steel drawbridge to be erected by the Santa Fe Railroad Co. across the San Joaquin River west of Stockton.

Jefferson, Wis.—The Milwaukee Bridge & Iron Co., Milwaukee, Wis., is stated to have received the contract for an iron bridge across Crawfish River for $4,800.

Shelbyville, Ind.—Contracts for the construction of county bridges have been awarded as follows: Three to the New Castle Bridge Co. for $19,004 and three to A. E. Smiley, Rushville, Ind., for $15,375.

Batavia, N. Y.—The construction of a bridge at Jackson St. over the tracks of the Central and Erie R.R. is being constructed.

McMinnville, Ore.—Press reports state that the County Commissioners have authorized the construction of 2 bridges.

Climax, Minn.—The construction of a bridge across Red River is under consideration.

Cleveland, O.—Plans have been prepared, according to local press reports, by the Cleveland, Cincinnati, Chicago & St. Louis Ry. for a lift bridge over the Cuyahoga River, near Columbus St.

Bridgeport, Conn.—The Board of Aldermen has passed a resolution to ask the Legislature for authority to issue bonds for permanent improvements, including $60,000 for Yellow Mill bridge.

Oswego, N. Y.—The eastern approach to the bridge crossing the Oswego River at Bridge St. is to be rebuilt at a cost of $11,425 (not including pavement construction). Two-thirds of the cost will be paid by the city and one-third by the county.

Chicago, Ill.—Bids are wanted Feb. 20 for the substructure and superstructure of a railroad bridge across Chicago River near Taylor St., also a bridge for Taylor St., as advertised in "The Engineering Record."

Montgomery, Ala.—See "Electric Railways."

Minneapolis, Minn.—The Toledo Bridge Co., Toledo, O., have received the contract for widening the stone arch bridge over east channel of Mississippi River for $10,990. For list of bidders, see our issue of Dec. 17.

Tupelo, Miss.—Bids are wanted Jan. 2 for building several county bridges. N. Jones, Clk. Bd. Supervisors.

Carrollton, Ky.—J. J. Orr, County Auditor, writes that a company has been organized to build a bridge across the Kentucky River and induce the building of an electric railway, eight miles in length. The city has taken $5,000 worth of the company's stock, and the county $20,000 worth. Probable cost of work, $75,000.

Charleston, S. C.—It is stated that the Coast Line will build 28 trestles between Denmark and Robbins.

Omaha, Neb.—Revised plans have been prepared by City Engineer Rosewater for the 16th St. viaduct.

Orangeville, Ind.—It is stated that the building of a bridge is under consideration.

Cambridge, Mass.—We are informed that Cambridge and Boston will build a steel bridge about one-half mile long across the Charles River, at West Boston Bridge. L. M. Hastings, City Engr.

St. Paul, Minn.—It is stated that plans have been approved and the City Clerk instructed to advertise for bids for rebuilding the 6th St. Bridge.

Batavia, N. Y.—The cost of building a bridge to connect Chestnut and Law Sts. has been estimated at $3,000.

Detroit, Mich.—It is stated that the building of a $3,500 bridge over the canal at the pumping station is contemplated.

Beverly, Mass.—Press reports state that early in the year action will be taken in the matter of building a bridge across the Danvers River from Beverly to Kirkwood.

Chester, Pa.—The King Bridge Co., Cleveland, O., is stated to have secured the contract for a 163-ft. span iron bridge over Chester Creek at 9th St., for $44,968.

Mallory, Minn.—Bids are wanted Jan. 4 for a 60-ft. steel span for the Mallory bridge. John Gleason, Co. Aud.

Scranton, Miss.—It is stated that bids are wanted Jan. 2 for a steel bridge. F. H. Lewis, Clk. County Court.

Corydon, Ia.—Bids are wanted Jan. 10 for building steel bridges during 1899. W. E. Dennis, Co. Aud.

New York, N. Y.—The Board of Aldermen has refused to authorize the issue of $100,000 bonds to provide for preliminary work on two new East River bridges.

Fort Scott, Kan.—The following bids for a steel truss bridge over Mill Creek were opened Dec. 20 by S. S. Davis, City Clk.: New Columbus Bridge Co., Columbus, O., $2,670; St. Louis Bridge Co., St. Louis, Mo., $2,599; Mo. Valley Bridge & Iron Wks., Leavenworth, Kan., $2,389; Kansas City Bridge Co., Kansas City, Mo., $3,234; Wrought Iron Bridge Co., Canton, O., $2,300 and $2,380; A. M. Blodgett, Kansas City, Mo., $2,460; Canton Bridge Co., Canton, O., $2,400.

Lorain, O.—The following bids for building a county bridge were opened Dec. 22: King Bridge Co., Cleveland, O., $145,000, $145,200 and $140,000; Variety Iron Wks. Co., Cleveland, O., $150,000; Youngstown Bridge Co., Youngstown, O., $154,000; Groton Bridge & Mfg. Co., Groton, N. Y., $148,800; C. L. Strobel, Chicago, Ill., $144,100, $146,050 and $144,150; Wrought Iron Bridge Co., Canton, O., $148,000; Mt. Vernon Bridge Co., Mt. Vernon, O., $150,000; Toledo Bridge Co., Toledo, O., $150,000; J. G. Wagner & Co., Milwaukee, Wis., $147,000; Edge Moor Bridge Wks., Wilmington, Del., $149,000; Horseheads Bridge Co., Horseheads, N. Y., $160,000; Massillon Bridge Co., Massillon, O., $150,000; Champion Bridge Co., Wilmington, O., $155,000.

Boston, Mass.—The following bids for the superstructure of fixed spans of bridge on Sumner St. extension were opened Dec. 29 by Wm. Jackson, City Engr.: Pencoyd Iron Wks. (A. & P. Roberts Co.), Philadelphia, Pa., $47,732; Berlin Iron Bridge Co., East Berlin, Conn., $48,194; Edge Moor Bridge Wks., Wilmington, Del., $50,960; Wrought Iron Bridge Co., Canton, O., $48,900; New Jersey Steel & Iron Co., Trenton, N. J., $48,941; Pennsylvania Steel Co., Steelton, Pa., $49,479; Pittsburg Bridge Co., Pittsburg, Pa., $53,550; King Bridge Co., Cleveland, O., $53,800; Vermont Construction Co., St. Albans, Vt., $56,000; New England Structural Co., Boston, Mass., $57,328; Massillon Bridge Co., Massillon, O., $58,800; Boston Bridge Wks., Boston, Mass., $59,000; Harrington, Robinson & Co., $62,850.

PAVING AND ROADMAKING.

Meadville, Pa.—D. T. McKay, Jr., writes that the contract for 3,120 sq. yds. of brick paving has been awarded to Ross & Robinson, Meadville, at $1.24 per sq. yd.

Hamilton, O.—We are informed that about $150,000 worth of pavement will be laid in the spring. L. A. Dillon, Engr. in Charge.

Indianapolis, Ind.—Bids are wanted Jan. 4 for paving the alley north of St. Clair St. with brick. M. A. Downing, Chmn. Bd. Pub. Wks.

Newport News, Va.—Geo. W. Fitchette, City Engr., writes that about 10 miles of pavement will be laid next year.

Lynchburg, Va.—L. P. Rodes, City Engr., writes that 18,000 sq. yds. of granite rubble will be required shortly.

Newport, Ky.—W. L. Glazier, City Engr., writes that 8,000 sq. yds. of macadam and 4,000 sq. yds. of brick pavement is to be laid.

Pittston, Pa.—The proposition to issue $22,000 bonds for paving will be voted upon on Feb. 21.

Jacksonville, Fla.—Local press reports state that the contract for paving Main St. was awarded Dec. 23 by the Board of Public Works to W. M. Lasley, of Chattanooga, Tenn., at $1.47 per sq. yd.; total, $31,503.57.

Eau Claire, Wis.—Local press reports state that several streets are to be paved next spring with vitrified brick.

Hamilton, O.—It is stated that David Folz Asphalt Co., of Cincinnati, has secured the contract for paving 2d St. with asphalt for $46,099.

New York, N. Y.—The resolution authorizing the Commissioner of Highways to repave Sixth Ave. from 13th to 23d St. with asphalt was adopted by the Board of Aldermen Dec. 20.

Seacliff, N. Y.—The appropriation of $8,000 for streets and sidewalks was voted for on Dec. 21.

Omaha, Neb.—Property owners have petitioned for asphalt pavement on Farnam St.

Crownpoint, Ind.—It is stated that the Brownell Improvement Co. of Chicago has the contract for macadamizing 12 miles of road in Lake County. Contract price, $124,500.

Bridgeport, Conn.—Mayor Thomas P. Taylor has approved the resolution asking the Legislature for permission to issue $100,000 worth of permanent pavement bonds.

Nashville, Tenn.—The City Council has adopted the budget for 1899, appropriating $20,000 for opening, widening and extending streets.

Camden, N. J.—The opening of bids for asphalt paving on 6th and State Sts. has been indefinitely postponed.

Oskaloosa, Ia.—It is stated that bids are wanted Jan. 10 for 15,600 sq. yds. brick paving, 8,900 lin. ft. Portland cement curbing, and 500 cu. yds. grading. Sam Ver Ven, City Engr.

Rochester, N. Y.—It is stated that bids are wanted Jan. 5 for asphalt paving on South Fitzhugh St. Edwin A. Fisher, City Engr.

Natchez, Miss.—L. M. Dalgarn, City Engr., writes that about 20,000 yds. of brick or asphalt pavement is to be laid in the spring.

Brighton, N. Y.—Bids are wanted Jan. 9 for the improvement of East Avenue Road, in the towns of Brighton and Pittsford. Campbell W. Adams, State Engr. and Surveyor, Albany, N. Y.

Boston, Mass.—Local reports state that the Metropolitan Park Commissioners have decided to build a boulevard connecting Revere Beach reservation and Middlesex Fells reservation.

Meriden, Conn.—See "Water."

Worcester, Mass.—The Street Commissioner in his annual report asks for an appropriation of at least $60,000, to be used in extending smooth pavements.

Washington, D. C.—The contract for improving Connecticut Ave., extended, west of Rock Creek, has been awarded to E. G. Gummel, Washington, at the following prices per sq. yd.: Grading, 23 cts.; repairing macadam, 69 cts., repairing cobble, 18 cts.; resetting curb, 17 cts.; relaying brick sidewalk, 12 cts.

Syracuse, N. Y.—Local reports state that the following bids were opened Dec. 27 for paving Townsend St.: Charles T. Hookway, brick, $16,552.80; M. R. Grannis, brick, $17,721.40; Henry P. Buryard, of Buffalo, asphalt, $16,627.60; Empire Contracting Co., New York City, asphalt,* $19,883.80; Syracuse Improvement Co., Syracuse, N. Y., asphalt, $20,303.30; Asphaltina Construction Co., asphalt, $20,571.10; Warren-Scharf Asphalt Paving Co., New York City, asphalt, $20,641.50.

*Contract awarded.

Jacksonville, Fla.—The following bids for 21,431 sq. yds. of brick pavement on Main St., work to include grading and curbing, were opened Dec. 22 by the Board of Public Works: W. M. Lasley, Chattanooga, Tenn., *$1.47 per sq. yd.; S. S. Leonard Co., Jacksonville, $1.49⅓; J. E. Bryan, Jacksonville, $1.58½; Geo. R. Foster, Jr., Jacksonville, $1.75.

*Contract awarded.

Boston, Mass.—The following bids were opened Dec. 23 by Supt. of Streets B. W. Wells for cutting and filling a half mile section of Columbia Road and for building an extension of the culvert under the N. Y., N. H. & H. R. R. The estimated filling is about 110,000 cub. yds., including about 40,000 cub. yds. of gravel for slopes and beach surface, the slopes next the water of Old Harbor to be covered with a layer of not less than 4 ft. in thickness, and the remainder to be not less than 2 ft. in thickness (*a*, culvert; *b*, filling per cub. yd.; *c*, total): H. P. Nawn and N. S. Brock, *a*, $2,400; *b*, 87 cts.; *c*, $98,100. D. F. O'Connell, *a*, $2,300; *b*, 79 cts.; *c*, $98,200. Simon J. Donovan, *a*, $2,386.24; *b*, 69½ cts.; **c*, $78,836.24. John W. Hensby, *a*, $2,295; *b*, 69 cts.; *c*, $78,195. Bidders all of Boston.

*Contract awarded.

POWER PLANTS, GAS AND ELECTRICITY

Statesboro, Ga.—J. A. Scarboro writes that estimates will be received on the following: Boilers, 100 H. P., two 40 H. P. engines, shafting, wood and iron working machinery, etc. Second hand machinery can be used if in good condition.

Tuskegee, Ala.—See "Water."

Pine Island, Minn.—E. L. Peck of Zumbrota is said to be considering the matter of extending the electric lighting system to this place from Zumbrota.

Richmond, Ky.—The Richmond Electrical Co. has been organized; capital, $10,000. J. D. Hauss, Cincinnati, Pres.; French Tipton, Richmond, Vice-Pres.; John W. Crooke, Richmond, Sec.

Jersey City, N. J.—The Boulevard Commissioners are said to be considering the question of improving the electric light plant at Snake Hill.

Peoria, Ill.—The Council has passed an ordinance granting W. H. Becker, owner of the Niagara Bldg., the right to lay, operate and maintain in the streets of the city a system of pipes and conduits for conveying steam and power to private consumers.

New Richmond, O.—See "Water."

Eau Claire, Wis.—The Chippewa Valley Electric Ry. Co. is stated to have decided to put in a power plant.

Minneapolis, Minn.—The General Electric Co., of Schenectady is stated to have received the contract for equipping the power house of the St. Anthony Falls Water Power Co. with electrical machinery; amount of contract said to be about $100,000.

Edwardsville, Ill.—It is stated that plans have been completed for an electric light plant for the Edwardsville Electric Light & Power Co. Geo. D. Pogue, Engr.

Pontiac, Ill.—Frank Smith of Dwight has applied for a franchise for an electric light plant.

Indianapolis, Ind.—See "Public Buildings."

Milo, Me.—The Milo Electric Light & Power Co. has been incorporated to supply electricity in Milo, Brownville and Sebec; capital, $10,000. Julian d'Este of Boston, Pres.; Frank E. Guernsey of Dover, Secy.

Cincinnati, O.—The County Commissioners are said to be considering the question of installing an electric light plant in the court house.

State Center, Ia.—The question of constructing an electric light plant is reported as being considered.

Chelsea, Mass.—The Massachusetts Pipe Line Gas Co. is stated to have received permission to lay pipes through the streets.

Gloucester City, N. J.—See "Fires."

Cloquet, Minn.—F. McCormack of Duluth is stated to have applied for a franchise for an electric light plant.

Sedalia, Mo.—It is stated that W. H. Powell, cashier of the Citizens' Bank, will apply for a franchise for an electric light plant.

Iowa City, Ia.—The Iowa City Electric Light Co. has received the contract for lighting the city for 5 years at $72.50 per lamp per year.

Seattle, Wash.—Gribble & Druhame, of Tacoma, are stated to have received the contract for the construction of a power station for the Snoqualmie Falls Power Co., at $25,000. C. H. Baker, Pres.

St. Helena, Cal.—The St. Helena Light & Power Co. is stated to have received a franchise for an electric light plant.

East Chicago, Ind.—Geo. W. Wilson & Co., of Chicago, are stated to have received the contract for constructing the electric light plant for the East Chicago Light & Power Co., at $34,500.

Jamaica (L. I.), N. Y.—The Queens Borough Electric Light & Power Co. is stated to have filed plans for a new plant at Far Rockaway, to cost $30,000. D. H. Valentine, Pres.

Moravia, Cal.—It is reported that the Moravia Electric Co. will put in a new plant at once.

Danbury, Ia.—Plans are stated to be under discussion for an electric light plant.

Brooklyn, N. Y.—The Westinghouse Electric & Mfg. Co., Pittsburg, has received the contract from the Kings County Electric Light Co. for furnishing two generators, of 4,000 h. p. each; contract price said to be $80,000.

Thibodaux, La.—We are informed that it has been voted to construct an electric light plant; also that plans and specifications will soon be completed. F. Zernott, Mayor.

Mt. Vernon, Ind.—Bids are wanted Jan. 17 for lighting the city for a period of 10 years. Edward E. Highman, Chmn. Light Com. of the Common Council.

Eldorado, Colo.—See "Water."

Albany, N. Y.—The Board of Supervisors is said to be considering the matter of establishing an electric light plant.

Redlands, Cal.—It is reported that the Redlands Electric Light & Power Co. will receive bids for power house, 4 generators, 4 water motors, 10 miles of 22 to 28-in. pipe, 13 tunnels, 80 miles of transmission line, switchboard and transformers. F. G. Ferand, Secy.; F. C. Finkle, Engr., San Bernardino.

Cleveland, O.—The bid of the Cleveland Electric Illuminating Co. was the only one submitted Dec. 21 for lighting the city by electricity during 1899, their bid being $89.88 per arc light.

Menahga, Minn.—It is reported that bids will be received about Feb. 1 for an electric light plant. Carl Eastwood is said to be interested.

Kansas City, Mo.—Bids will be received Jan. 1 for an electric light plant for the union depot. Edw. S. Washburn, Pres.

Belding, Mich.—It is reported that bids will be received Jan. 20 for street lighting.

Spartanburg, S. C.—It is stated that bids will shortly be received for lighting the city by electricity. A. B. Cavert, Mayor.

Fountain City, Wis.—The following total bids for an electric light plant were opened Dec. 21 by A. M. Patitz, Engr. in Charge, Milwaukee: Western Electrical Construction Co., Chicago, Ill., alternating, *$3,825; direct current, $4,550. Jul. Andrae & Sons, Milwaukee, Wis., $5,375.

*Contract awarded.

ELECTRIC RAILWAYS.

Clinton, Mass.—The Clinton & Hudson St. Ry. Co. is stated to have received a franchise.

Queenstown, Md.—Right of way is stated to have been secured by the Queen Annes R.R. Co. for a branch line from this place to Centreville, a distance of about 7 miles.

Pensacola, Fla.—The Pensacola & Northwestern R.R. Co. is stated to have been granted right of way for a railroad to be operated by steam or electricity.

Tipton, Ind.—Chas. L. Harry, Supt. Kokomo St. Ry. Co., is stated to have petitioned the Commissioners of Tipton and Hamilton counties for a franchise. E. H. Shirk, Pres. Tipton National Bank, is said to be interested.

Bridgeport, Conn.—The Bridgeport Traction Co. is said to be considering the matter of extending its line from Putnam Park to Bethel. Ramon Radel, Pres.

Kenosha, Wis.—The Kenosha Traction Co. is stated to have applied for a franchise.

Waitsfield, Vt.—The citizens are stated to have voted to bond the town to aid in building an electric railway from Montpelier to Warren.

New Castle, Ind.—The New Castle Electric Ry. Co. is stated to have received a franchise in Henry county.

Chattanooga, Tenn.—The Chattanooga Rapid Transit Co. is stated to have been granted the right of way for a line to Chickamauga Park.

Rockville, Md.—The County Commissioners are stated to have granted a right of way to the Washington & Rockville Ry. Co.

Flint, Mich.—D. L. Davis, of Pontiac, is stated to have received a franchise.

Waltham, Mass.—The Boston & Lexington St. Ry. Co. is stated to have received a franchise on Lexington St.

Mamaroneck, N. Y.—The Board of Directors of the Tarrytown, White Plains & Mamaroneck Ry. Co. are stated to have voted to extend the line from Mamaroneck through Larchmont to the New Rochelle line.

Clayton, Mo.—The St. Louis County St. R.R. Co. is stated to have petitioned the County Commissioners for permission to change the motive power of its road to electricity. M. B. Greensfelder, Pres.

Carrollton, Ky.—See "Bridges."

Pontiac, Mich.—The Township Board of Rochester is stated to have granted a franchise to John Winters and O. H. Law, of Detroit, for an electric road from this place to Rochester.

Montgomery, Ala.—It is reported that arrangements are being perfected to build the Montgomery & Wetumka Electric Road. An iron bridge is included in the construction.

Chicago, Ill.—The People's Street Ry. Co. has been incorporated; capital, $10,000. Incorporators: Jos. W. Latimer, R. R. Reynolds and others.

Kansas City, Kan.—At a meeting of the County Commissioners on Dec. 23 a franchise was granted to F. N. Wilcox to construct an electric line along the Reedy and Leavenworth roads.

Roselle, N. J.—The Westfield & Elizabeth St. Ry. Co. is stated to have applied for a franchise.

Macungie, Pa.—The stockholders of the Emaus line are said to be considering the matter of extending the line from Emaus to this place.

Harvey, Ill.—It is stated that the Chicago Traction Co. will probably extend the line in the spring from Blue Island to Harvey.

North Chicago, Ill.—The Chicago & Fox Lake Electric Ry. Co. is reported to have applied for a franchise.

Templeton, Mass.—The matter of constructing an electric railway between Gardner and Templeton is said to be under consideration. Percival Blodgett is said to be interested, also the Bay State Metal Co. of East Templeton.

Sanford, Me.—We are informed that bids will be asked in May, 1899, by the Sanford & Cape Porpoise R.R. Co. for constructing an electric line from Biddeford to York Beach, at an estimated cost of $4,000. Percy A. Richardson, Engr. in charge, Portland, Me.

RAILROADS.

Goldendale, Wash.—The Columbia & Klickitat Ry. Co. has been incorporated to build a railroad 30 miles long connecting Rytle with Goldendale. Capital, $300,000. Incorporators: E. S. Rytle, P. C. O'Reilly and A. E. Hammond.

Fort Sill., Okla.—It is reported that the Chicago, Rock Island & Pacific Ry. Co. will build a branch line from this place to Chickasha, a distance of about 40 miles.

Humboldt, Tenn.—A charter has been granted to the Humboldt, Dyersburg & Tiptonville R. R. Co. to build 100 miles of railroad; capital, $1,500,000. Incorporators: F. S. Bates, J. S. McTighe and others.

Clinton, Ia.—It is stated that the Davenport, Rock Island & Northwestern will petition the Council for a franchise. Frank P. Blair, Mgr., St. Paul, Minn.

Arkansas City, Kan.—The Kansas Southwestern Ry. Co. has been incorporated; capital, $8,000,000. Directors: Samuel Barker, of Hamilton, Ont.; John Penman, of Paris, Ont.; Albert A. Newman, of Arkansas City, Kan.; W. E. Blackburn, of Anthony, Kan., and others.

Burnsville, W. Va.—A charter has been issued to the Sistersville, Pennsboro & Burnsville R. R. Co., with a capital of $200,000, to construct a railroad from Sistersville to Burnsville; principal office to be located here. Incorporators: M. K. Duty, L. P. Wilson, J. V. Dotts, and others.

Port Angeles, Wash.—The Port Angeles Eastern R.R. Co. has been incorporated to construct and equip a line of standard gauge railway from Port Angeles easterly to a point at or near Junction City; capital, $500,000. Directors: William Martell, of Port Angeles; John Lehman, of Chicago; Arthur Shute, of Ellsworth, Me., and Isaac C. Atkinson, of Boston.

PUBLIC BUILDINGS.

Chicago, Ill.—Frank V. Newell, 145 La Salle St., is stated to have prepared plans for a $150,000 apartment house for the Drexel Apartment Co.

Carlisle, Pa.—The First Lutheran Society is stated to have decided to erect a $16,000 church.

Atlantic City, N. J.—It is stated that the Delaware & Atlantic Telephone Co. will shortly erect a central station to cost about $50,000. Mr. Westbrook, Gen. Mgr.

Chicago, Ill.—The plans of McMichael & Morehouse, Herald Bldg., Chicago, are stated to have been accepted for an $80,000 church for the St. Josaphat R. C. congregation. Rev. F. Lange, Pastor.

Toronto, Ont.—C. H. Rust, City Engr., writes that an election will be held Jan. 2 to vote on the proposition to improve St. Lawrence market at an estimated cost of $150,000.

Douglass, Ga.—Bids are wanted Feb. 25 for a court-house. Judge C. A. Ward, Chmn. Bd. Co. Commrs.

Danville, Ill.—It is reported that the L. J. Mueller Furnace Co., 197 Reed St., Milwaukee, has received the contract for heating 12 soldiers' barracks and one laundry in the Danville, Ill., branch of the National Home for Disabled Volunteer Soldiers. Contract price said to be $35,000.

Oshkosh, Wis.—The plans of Wm. Waters of Oshkosh have been accepted for a $50,000 public library.

Danbury, Conn.—Tracey Bros. of Waterbury have received the contract for the court house at $37,678.

Centralia, Ill.—It is stated that the Baptist Society will erect a $12,000 church.

Bridgeport, Conn.—See "Bridges."

Indianapolis, Ind.—It is stated that $75,000 will be expended in improving the Spencer hotel. The improvements include an electric light plant. D. A. Bohlen, 95 E. Washington St., Indianapolis, is said to be preparing the plans.

Madison, Minn.—The plans of Buechner & Jacobson of St. Paul are stated to have been accepted for the proposed court house.

Sea Isle City, N. J.—Thos. M. Leeds. 1025 Race St., Philadelphia, is stated to have received the contract for an academy for the Sisters of St. Joseph, at $20,000.

Boston, Mass.—Wheelwright & Haven, Tremont Bldg., Boston, are stated to have prepared plans for a 5-story office building for the Suffolk Real Estate Trust. J. Morris Merideth and Geo. Von L. Meyer, Trustees.

Knoxville, Tenn.—Bauman Bros., of Knoxville, are said to be preparing plans for a new city hospital.

Atlanta, Ga.—The following bids are stated to have been opened Dec. 21 for an annex to the court house (*a*, granite; *b*, marble; *c*, oolitic; *d*, sandstone; *e*, limestone; *f*, oolitic limestone), Butler-Ryan Co., St. Paul, Minn., *a*, $144,080; *f*, $143,420; *b*, $146,920; *d*, $144,350. F. P. Heifner, Atlanta, Ga., *a*, $136,561; *b*, $139,111; *c*, $135,611; *d*, $134,461. Lewis B. Beman, Cincinnati, *a*, $145,835; *b*, $148,672; *e*, $144,789. Wm. Bensel & Co., Atlanta, *b*, $137,000; *a*, $135,400; *c*, $133,600. Gude & Walker, Atlanta, *a*, $131,010; *f*, $130,040; *b*, $133,560; *d*, $129,900. Chapman & Son, Atlanta, *a*, $149,278; *c*, $148,233; *b*, $152,083; *d*, $149,267.

All bids were rejected as being $30,000 in excess of appropriation.

Charleston, S. C.—The following bids for the Auditorium Building were opened Dec. 23 by Samuel Lapham, Chmn. Com. (*a*, without stucco, etc.; *b*, with stucco, etc.): Nicholas Ittner, *a*, $32,447; *b*, $34,347. Robt. McCarrell, *a*, $32,250; *b*, $34,450. E. N. Jenkins, *a*, $33,025; *b*, $35,465; J. T. Snelson, *a*, $33,237; *b*, $35,857.

Bidders all of Atlanta.

FIRES.

Gloucester City, N. J.—The plant of the Gloucester Gas Co. is said to have been damaged by fire on Dec. 23 to the extent of $15,000. Mr. Chew, Supt.

Minneapolis, Minn.—Elevator X, on the Hastings and Dakota Division of the Chicago, Milwaukee & St. Paul Railway, was burned Dec. 29; loss, about $200,000.

NEW FACTORIES.

The Abbeville Cotton Mills, Abbeville, S. C., will erect a two-story frame building, 100x244 ft., and install two Babcock & Wilcox 150 h. p. boilers.

MANUFACTURING NOTES.

The fan system of heating for the new Canada Atlantic Railway shops at Ottawa, Ont., will be that of the Buffalo Forge Company, and will be installed by E. A. Wallberg, Montreal, Canada.

The United Gas Improvement Company of Gloversville, N. Y., is erecting a new plant, consisting of generator house and boiler and engine house. The building is about 50x80 feet, and will be fireproof throughout. The trusses are clear span, with no interior columns, and rest directly on side walls of brick. The steel work was furnished and erected in place by the Berlin Iron Bridge Company of East Berlin, Conn.

The Lombard Water Wheel Governor Company reports that the demand for its governors is constantly on the increase. During last month it received orders for upwards of 20 governors to regulate 41 water wheels which will develop 15,750 horse power. More than half of this machinery will be used in electric stations, principally in power transmission plants and electric railway stations, the rest being in textile and other manufacturing plants driven by water power.

BUILDING INTELLIGENCE.

NEW YORK, N. Y.

27 to 33 Sheriff st, br storage; cost, $30,000; o, a and b, R Hoe & Co.

71 Henry st, br store and flat; cost, $25,000; o, James Shay; a, M Bernstein.

621-629 E 9th st, 4 br stores and flats; cost, $100,000 all; o, Chas Naarden; a, Schneider & Herter.

27 E 3d st, br store and flat; cost, $22,000; o, Hyman & Oppenheimer; a, Schneider & Herter.

623-627 E 11th st, 2 br stores and flats; cost, $50,000 all; o, Leopold Kaufman; a, Schneider & Herter.

534-536 E 11th st, br store and flat; cost, $35,000; o, Hyman & Oppenheim; a, Schneider & Herter.

408-418 Cherry st, 5 br stores and flats; cost, $110,000 all; o, Goodman & Silverson; a, M Bernstein.

127-131 Broome st, br stores and flat; cost $50,000; o, Jacob Fischel; a, Horenburger & Straub.

3rd ave, n w cor 81st st, br stores and flat; cost, $100,000; o, a and b, Lorenz F J Weiner, Jr.

S s 92d st, 80 e 2d ave, br store and flat; cost $20,000; o, F J Schnugg; a, M Johnson.

S s 108th st, 100 e Columbus ave, 3 br tenements; cost $54,000 all; o, Arthur Moore; a, C A Millner.

Central Park West, s w cor 98th st, br flat; cost, $90,000; o, Mary C Dempsey; a, Neville & Bagge.

E s Amsterdam ave, 100 n 164th st, 2 br and stone stores and flats; cost $44,000 all; o, Alphonse Hogenauer; a, Henry Andersen.

142d st, n w cor Hamilton pl, 3 br stores and flats; cost $240,000 all; o, Chas F Rogers; a, Neville & Bagge.

3d ave, n e cor Wendover ave, br flat; cost, $40,000; o, Thos M Smith; a, Schneider & Herter.

N s 136th st, 350 e Willis ave, 4 br flats; cost, $88,000 all; o, Gaines & Roberts; a, Harry T. Howell.

BROOKLYN, N. Y.

118 Clinton ave, br flat; cost, $15,000; o, Rosie Russ; a, Louis Korn.

S s 8th st, 320 w 6th ave, br factory; cost $14,000; o, Chas M Higgins; a, Stone Bros.

W s Franklin ave, 340 w Montgomery st, br ice factory; cost, $12,000; o, Neiderstein & Seemann; a, F Wunder.

E s Franklin ave, 550 s Montgomery st, br tenement; cost, $11,000; o, Casper Stapf; a, W S Bandesson.

PROPOSALS OPEN.

Bids Close.		See Eng. Record.
	WATER-WORKS.	
Jan. 1.	Crisfield, Md	Nov. 12
Jan. 2.	Bonds, Stanberry, Nev	Dec. 24
Jan. 3.	Millvale, Pa	Dec. 24
Jan. 3.	Bonds, Northeast, Pa	Dec. 24
Jan. 3.	Bonds, Gaffney, S. C	Dec. 10
Jan. 4.	Oshawa, Ont	Dec. 24
	Adv., Eng. Record, Dec. 24.	
Jan. 5.	Darlington, O. T	Dec. 17
Jan. 5.	Chicago Junction, O	Dec. 17
Jan. 5.	Norfolk, Va.	Dec. 24
Jan. 6.	Bonds, West Union, W. Va	Dec. 17
Jan. 11.	Vailsburgh, N. J	Dec. 31
	Adv., Eng. Record. Dec. 31.	
Jan. 11.	Boilers, South Bend, Ind	Dec. 31
Jan. 13.	Goshen, Ind	Dec. 31
Jan. 17.	Bonds, Bozeman, Mont	Dec. 31
Jan. 18.	Winchester, Ind	Dec. 24
Jan. 21.	Cheboygan, Mich	Dec. 31
	Adv., Eng. Record, Dec. 31.	
Jan. 24.	Canby, Minn	Dec. 31
Jan. 24.	Bonds, Wamego, Kan	Dec. 31
Jan. 25.	Phœnix, A. T	Dec. 24
Jan. 25.	Bonds, McConnelsville, O	Dec. 31
Jan. 26.	Washington, D. C	Dec. 31
	Adv., Eng. Record, Dec. 31.	
Jan. 27.	Cylinders, etc., Cleveland, O.	Dec. 31
Jan. —.	Bonds, Little Falls, Minn	Dec 24
Feb. 1.	Tuskegee, Ala	Dec. 31
Feb. 6.	Bonds, Berea, O	Dec. 31
Feb. 13.	Bonds, Reno, Nev	Dec. 24
Mar. 15.	Belem, Para, Brazil	Nov. 26
	SEWERAGE AND SEWAGE DISPOSAL.	
Jan. 2.	Bonds, Hamilton, O	Dec. 10
Jan. 2.	Hamilton, O	Dec. 10
Jan. 2.	Ditch, Ponca, Neb	Dec. 24
Jan. 2.	Kingston, Pa	Dec. 24
Jan. 3.	Cincinnati, O	Dec. 10
Jan. 3.	Mount Vernon, N. Y	Dec. 17
Jan. 3.	Springfield, Mo	Dec. 31
Jan. 4.	Pipe, etc., Columbus, Ga	Dec. 24
Jan. 4.	Oshawa, Ont	Dec. 24
	Adv., Eng. Record, Dec. 24.	
Jan. 5.	Rochester, N. Y	Dec. 31
Jan. 5.	Scranton, Pa	Dec. 31
Jan. 5.	Natchez Miss	Dec. 31
Jan. 10.	Bonds, Grass Valley, Cal	Dec. 3
Jan. 11.	Buffalo, N. Y	Dec. 31
Jan. 14.	East Cleveland, O	Dec. 24
Jan. 15.	New York City	Dec. 3
Jan. 16.	Elizabeth, N. J	Dec. 24
Jan. 17.	Mt. Vernon, N. Y	Dec. 31

- Jan. 18. Aiken, S. C ....Dec. 17
- Jan. 23. Sewer pipe, etc., New London, Conn. Dec. 24
- Jan. 25. Phœnix, A. T ....Dec. 24

BRIDGES.

- Jan. 1. Cathlamet, Wash.....................Nov. 26
- Jan. 2. Quebec, P. Q ....Oct. 1
  Adv., Eng. RECORD, Oct. 1, 8.
- Jan. 2. Aspen, Colo ....Dec. 17
- Jan. 2. Newton, Ia ....Dec. 24
- Jan. 2. Tupelo, Miss ....Dec. 31
- Jan. 2. Scranton, Miss ....Dec. 31
- Jan. 3. Brookhaven, Miss...........................Nov. 19
- Jan. 4. Denison, Ia. ....Dec 17
- Jan. 4. Trent, S. Dak. ....Dec. 24
- Jan. 4. Mallory, Minn ....Dec. 31
- Jan. 10. Corydon, Ia. ....Dec. 31
- Jan. 10. Hastings, Neb ....Dec. 24
- Jan. 17. Plans, Binghamton, N. Y...........Dec. 24
- Jan. 24. St. Thomas, Ont...........................Dec. 24
- Jan. 31. Bonds, Jackson, Miss...........................Dec. 24
- Jan. --. Hastings, Neb...........................Dec. 10
- Feb. 20. Chicago, Ill ....Dec. 31
  Adv., Eng. RECORD, Dec. 31.

PAVING AND ROADMAKING.

- Jan. 2. Bonds, Tippecanoe City, O...........Dec. 10
- Jan. 4. Beaumont, Tex...........................Dec. 24
- Jan. 4. Indianapolis, Ind...........................Dec. 31
- Jan. 5. Rochester, N. Y...........................Dec. 31
- Jan. 5. Decatur, Ind...........................Dec. 3
- Jan. 7. Cincinnati, O...........................Dec. 17
- Jan. 9. Houston, Tex...........................Dec. 17
  Adv., Eng. RECORD, Dec. 17, 24.
- Jan. 9. Brighton, N. Y...........................Dec. 31
- Jan. 10. Oskaloosa, Ia ....Dec. 31
- Jan. 17. Cincinnati, O...........................Dec. 24
- Feb. 27. Yonkers, N. Y...........................Dec. 3

POWER, GAS AND ELECTRICITY

- Jan. 1. Bonds, Lawton, Mich...........Nov. 26
- Jan. 1. Kansas City, Mo...........................Dec. 31
- Jan. 2. Vincennes, Ind...........................Oct. 22
  Adv., Eng. RECORD, Oct. 22, Nov. 12, 26, Dec. 17
- Jan. 4. Columbus, Ga. ....Dec. 24
- Jan. 6. Johannesburg, So. African Repub. Oct. 22
- Jan. 12. Annapolis, Md...........................Dec. 17
- Jan. 16. Duluth, Minn. ....Dec. 10
- Jan. 17. Mt. Vernon, Ind ....Dec. 31
- Jan. 18. Winchester, Ind...........................Dec. 24
- Jan. 20. Belding, Mich ....Dec. 31
- Jan. —. Bonds, Little Falls, Minn...........Dec. 24
- Feb. 1. Tuskegee, Ala...........................Dec. 31
- Feb 1. Menahgo, Minn...........................Dec. 31
- Mar. 1. Sault Ste. Marie, Mich...........................Dec. 24
- Mar. 31. Telephone, Shanghai, China...........Nov. 19
- ——— Pleasantville, O...........................Dec. 24

GOVERNMENT WORK.

- Jan. 3. Cisterns, etc., Southport, N. C......Dec. 24
- Jan. 3. Steel plates, Washington, D. C......Dec. 24
- Jan. 5. New York, N. Y...........................Dec. 24
  Adv., Eng. RECORD, Dec. 24, 31.
- Jan. 10. Cement, Duluth, Minn...........................Dec. 17
  Adv., Eng. RECORD, Dec. 17 to 31.
- Jan. 10. Pumping engine, Charleston, S. C. .Dec. 31
- Jan. 12. Cement, St. Paul, Minn ....Dec. 17
  Adv., Eng. RECORD, Dec. 17 to 31.
- Jan. 12. Sea wall, Annapolis, Md...........Dec. 24
- Jan. 14. St. Louis, Mo...........................Dec. 24
  Adv., Eng. RECORD, Dec. 24, 31,
- Jan. 16. St. Augustine, Fla...........................Dec. 31
  Adv., ENG. RECORD, Dec. 31.
- Jan. 19. Akron, O ....Dec. 24
  Adv., Eng. RECORD, Dec. 24, 31.
- Jan. 19. Pottsville, Pa...........................Dec. 24
  Adv., Eng. RECORD, Dec. 24, 31.
- Jan. 20. Wharves, etc., Washington, D. C. .Dec. 24
- Jan. 20. Fog signals, St. Joseph, Mich ......Dec. 31
- Jan. 23. Stone, etc., New London, Conn ....Dec. 24
- Jan. 24. Batteries, Fort Monroe, Va...........Dec. 24
- Jan. 31. Dry dock, Boston, Mass...........Dec. 31

BUILDINGS.

- Jan. 2. School, Luverne, Minn...........Dec. 10
- Jan. 3. Plans, Albany, N. Y...........................Dec. 3
- Jan. 3. Ashland, Ky ....Dec. 10
- Jan. 3. Balsam Lake, Wis...........................Dec. 17
- Jan. 3. Osceola Mills, Wis...........................Dec. 24
- Jan. 3. Ventilating school, Boston, Mass...Dec. 31
- Jan. 4. Library, Owatonna, Minn...........Dec. 17
- Jan. 4. School, Wapakoneta, O ....Dec. 24
- Jan. 5. Plumbing, etc., Cincinnati, O ......Dec. 24
- Jan. 6. Albany, Ore...........................Dec. 10
- Jan. 6. School, Rochester, N. Y...........Dec. 31
- Jan. 7. Princeton, Minn...........................Dec. 24
- Jan. 9. School, Wilmington, Del...........Dec. 3
- Jan. 10. Plans, Des Moines, Ia...........................Dec. 24
- Jan. 10. Phœnix, Ariz...........................Dec. 3
- Jan. 10. Plans, etc., Boone, Ia...........................Dec. 17
- Jan. 18. Plans, Mineola, N. Y...........................Dec. 24
- Jan. 21. Washington, D. C...........................Dec. 24
- Jan. 25. Dormitory, etc., Phœnix, A. T. ....Dec. 24
- Jan. 31. School bonds, Jackson, Miss. ....Dec. 24
- Jan. —. Superstructure, Newport, R. I .... Nov. 19
- Feb. 1. School, Peoria, Ill...........................Dec. 3
- Feb. 10. Keyser, W. Va...........................Nov. 5
- Feb. 25. Douglass, Ga...........................Dec. 31

MISCELLANEOUS

- Jan. 6. Dredging, New York, N. Y........ Dec. 31
- Jan. 9. Elec. Ry. franchise, Baltimore, Md..Dec. 24
- Jan. 14. Philadelphia, Pa...........................Nov, 19
- Jan. 15. Street cleaning, Indianapolis, Ind...Dec. 17
- Jan. 18. Garbage dis., San Francisco, Cal...Dec. 31
- Jan. 19. Docks, etc., Cleveland, O...........Dec. 24
- Jan. 20. Wharfs, etc., Honolulu ....Dec. 31
- Jan. 24. Tunnel, London, England........... Nov. 5
- Jan. 26. Washington, D. C...........................Dec. 31
  Adv., Eng. RECORD, Dec. 31.
- Feb. 1. Crane, Townsville, Australia. .....Dec. 17
- Mar. 15. El. Ry., Shanghai, China........... Nov. 19

NEW SCHOOLS.

Boston, Mass.—The Committee on Accounts of the School Board reports that an annual expenditure of $500,000 for the next five years will be needed for new primary and grammar school houses.

Boston, Mass.—Contracts for ventilating and heating systems in the primary schools on Monroe and Webster Sts., amounting to $7,971, have been awarded to the Fuller & Warren Warming and Ventilating Co.

Elgin, Ill.—The School Board is said to be considering plans for a $12,000 school.

New Britain, Conn.—It is stated that an appropriation of $25,000 has been made for additions to 2 schools.

Rochester, N. Y.—Bids are wanted Jan. 6 for a school. Francis S. Macomber, Chmn. Bldg. Com., Bd. of Educ.

Boston, Mass.—Bids are wanted Jan. 3 for a ventilating and heating system in the Mechanic Arts High School. William S. Eaton, Chmn. Com. on New bldgs. of the School Com.

Marshall, Minn.—Orff & Guilbert of Minneapolis are said to be preparing plans for a $30,000 high school.

STREET CLEANING AND GARBAGE DISPOSAL.

San Francisco, Cal.—Bids are wanted Jan. 18 for a garbage crematory at Presidio. J. M. Marshall, Deputy Q. M. Gen., Cn. Q. M.

Newport, Ky.—It is proposed to build a garbage crematory having a daily capacity of 40 tons. W. L. Glazier, City Engr.

Passaic, N. J.—The City Council has adopted a resolution authorizing the Street Committee to advertise for bids for a crematory plant, to cost not more than $12,000, to be operated at an annual expense of $3,000.

Houston, Tex.—The Mayor has been authorized to appoint a committee of three to inquire into the feasibility of building a crematory.

Sacramento, Cal.—J. W. Northrop, of San Francisco, has applied to the Board of Trustees for a fifty-year franchise for a garbage plant.

Newport News, Va.—We are informed that the city has under consideration the construction of a garbage plant.

Atlantic City, N. J.—Local reports state that the following bids were received for the collection of garbage: Joseph M. Johnson, for the ensuing year, for $10,373; Benjamin F. Leeds, for first yr. $9,875, second yr. $10,575 and third yr. $10,995; Alvin P. Risley, of Pleasantville, $15,000 per yr. for 1, 2 or 3 yrs.; John Unsworth, $13,500 for 1 yr., $27,900 for 2 yrs, or $43,000 for 3 yrs; Andrew P. Jeffries and Samuel Gregson, for 3 yrs. $10,000 per annum; Sylvester Leeds, $14,100 for 1 yr., $28,800 for 2 yrs. and $43,000 for 3 yrs.; John Murtland, the first yr. $6,400, second yr. $6,800, and $7,200 for third yr. A deduction will be made in each bid if the city provides stabling for horses.

GOVERNMENT WORK.

St. Augustine, Fla.—Bids are wanted Jan. 16 at the U. S. Engineer Office for furnishing and delivering at Mullet Key and Egmont Key, Tampa Bay, broken stone or gravel, and random stone, as advertised in "The Engineering Record."

St. Joseph, Mich.—Bids are wanted Jan. 20 for furnishing boilers and machinery for 6 complete steam fog signals in sets of two at the lighthouse depot. Captain J. D. Warren, Corps of Engrs., U. S. A., Milwaukee, Wis.

Philadelphia, Pa.—Local reports state that the contract to construct storage vaults in the new Philadelphia Mint was awarded Dec. 22 at Washington to Remington & Sherman Co., of Philadelphia, at $193,670.

Mobile, Ala.—The following bids for furnishing cement, gravel, etc., at Fort Morgan, Ala., were opened Dec. 23 by Major William T. Rossell, Corps of Engineers, U. S. A., as advertised in "The Engineering Record": *a*, 12,000 bbls. of cement; *b*, 10,000 cub. yds. of gravel; *c*, 10,000 cub. yds. of broken stone—Atlas Cement Co., New York, N. Y., *a*, $2.17 per bbl. A. C. Danner, Mobile, Ala., **a*, $2.14; *b*, $2.18 per cub. yd. W. Chase Spotswood, Mobile, Ala., *b*, $2.00. Fred Visscher, Flomaton, Ala., *b*, $2.14. Edward K. Chamberlin, New York, N. Y., *c*, $3.00 per cub. yd.

*Price per barrel of cement, duty remitted.

Duluth, Minn.—The following bids were opened Dec 20 by Maj. Clinton B. Sears, Corps of Engrs., U. S. A., for revetment work, Portage Lake Ship Canals, Mich., as advertised in "The Engineering Record." Amount proposed to be expended on this work, about $60,000.

Name and Address of Bidder	Per lin. ft. Completed Work. Pile Revetment, 8,000 ft.	Special Pile Revetment, 230 ft.	Protection work, 300 ft.	Repair Work, etc., in Cut 1, 17 000 ft. B. M., per 1,000 ft. B. M.	Total.
Fitzgerald & Norris, Duluth, Minn.....	$5.81	$9.37	$4.10	$50.00	$58,715.10
Edward Gillen, Racine, Wis	10.25	7.16	13.16	58.00	88,580.80
Powell & Mitchell, Marquette, Mich...	7.58	10.50	4.00	55.00	65,190.00
Frank Campbell, Duluth, Minn	8.00	10.20	4.90	57.00	68,785.00
John M. Borgman, Kewaunee, Wis....	8.80	12.30	6.70	94.30	76,842 10
Frederick Davis, Duluth, Minn	7 68	10 33	3 91	46 73	65,783.31
Frank P. Tims, West Duluth, Minn....	7.00	10.00	4.00	50.00	60.350 00

Boston, Mass.—It is stated that bids are wanted Jan. 31 by the Bureau of Yards & Docks, Navy Dept., Washington, D. C., for a granite dry dock at the Navy Yard.

Washington, D. C.—The following bids were opened Dec. 27 by the Superv. Archt., Treas. Dept., for combination gas and electric fixtures in the U. S. Post Office: Horn & Brannen Mfg. Co., Philadelphia, Pa., $19,454.50, $20,166.50, $25,322; W. C. Vosburg Mfg. Co., Brooklyn, N. Y., $35,664.10, $26,782.25; Bradley & Hubbard Mfg. Co., Meriden, Conn., $11,377.95; Cassidy & Son Mfg. Co., New York City, $21,915.50, $29,941, $28,061; Barber & Ross, Washington, D. C., $21,567.35; R. Hollings & Co., Boston, Mass., $45,085.

Presidio, Cal.—Col. Marshall, Ch. Q. M., San Francisco, has been authorized to expend $113,339 on the pavilion hospital to be built at the Presidio.

Charleston, S. C.—Bids are wanted Jan. 10 at the United States Engineer Office for removing old and furnishing and placing new pumping engine on dredge "Charleston" in this harbor.

Tompkinsville, N. Y.—The following bids were opened Dec. 23 in the office of Engineer 3d Lighthouse district, for erecting the West Bank Lighthouse, New York Lower Bay:

Name and Address of Bidder.	1st Site.	2d Site.
R. G. Packard, 130 Pearl St., N. Y. City	$43,950	$47,775
Philadelphia Construction Co., 515 Girard Bldg., Phila., Pa.	31.400	35,400
Engineering Contract. Co., 15 Broad St., N. Y. City	32,800	36,700
W. H. Flaherty, 7 South St., N.Y. City	34,500	37,000
Jas. Symington, 16 Exchange Place, N. Y City........	35,000	40,000

The following bids were opened for the metal work for West Bank Lighthouse, Lower Bay, New York:

Name and Address of Bidder.	1st Site.	2d Site.
Emil Severin, Aurora, Ind	$18,287	$22,577
The Snead, Van Alstine, Meldrum Co., Louisville, Ky	15,430	17,150
Chamblin & Scott, Richmond, Va.	16,993	15,954
Russel Wheel & Foundry Co., Detroit, Mich	15,645	16,895
Atlanta Machine Works, Atlanta, Ga	12,445	13,930
Builders' Iron Foundry Providence, R. I	14,800	16,300
Jno. P. McGuire, Cleveland, O....	11,700	13,100

CUBA, PORTO RICO AND HAWAIIAN ISLANDS.

The "Brooklyn Eagle" states that th Drake & Stratton Co., of Pittsburg, ha received a contract from the Unite States Government for the constructio of a dock at Havana and a railroad t Morro Castle, costing about $500,000.

Electric Railway.—The San Juan Rio Piedras Railroad Co. has been in corporated at Albany, N. Y., with a cap ital of $300,000, to construct and operat an electric or steam railroad 7½ mile long from San Juan to Rio Piedra Porto Rico. Directors: Geo. H. Wa bridge, Fernando G. Echeverria, Wn B. Parsons, of New York City, an others.

Honolulu, Hawaiian Is.—Bids ar wanted Jan. 20 at the Bureau of Equi ment, Navy Dept., Washington, D. C for constructing wharves and excava ing slips in the harbor of Honolulu. B. Bradford, Ch. of Bureau.

MISCELLANEOUS.

Boston, Mass.—The contract for build ing a wall of quarry-faced granite seam-faced Roxbury stone at Jamaic Park has been awarded to D. F. O'Con neil, Boston, at $1.70 per lin. ft.

Chicago, Ill.—Local reports state th the Drainage Board proposes to adve tise at once for bids for additional wo on sections 17 and 18 at Joliet.

Duluth, Minn.—It is stated that J. Greatsinger, President of the Duluth Iron Range Railroad Co., has award the contract for tearing down and r building ore dock No. 1 at Two Harbo to the Barnett & Record Co., of Minn apolis, for $139,950.

Boston, Mass.—See "Paving and Ro Making."

Washington, D. C.—See "Water."

New York, N. Y.—Bids are want Jan. 6 for dredging on the East and Ha lem rivers in the Borough of Manhatt J. Sergeant Cram, Chmn. Commr. Docks.

THE ENGINEERING RECORD.
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TABLE OF LEADING ARTICLES.

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CONCERNING EDITORIALS.

An old and esteemed critical reader of this paper from its beginning recently asked what had become of its editorial page; he missed the big type and wide leads which formerly characterized the first few columns of each issue, and he found editorial opinions scattered through the reading pages, from the first to the last. It is believed that there may be others among its older readers who would like to know if there has been any change in the paper they have been receiving so many years, so, in extending to them and all its other readers, its heartiest wishes for a happy New Year, "The Engineering Record" desires to make a few statements concerning itself.

Some sixty years ago a technical journal was started in New York, the oldest now in existence. It was little more than a weekly newspaper, with poetical contributions, congressional reports and a thin veneer of engineering and railway news in the opening pages. It led a more or less precarious existence for years. Appeals to its subscribers for support were frequent and at one time its most interesting articles were descriptions of the comforts provided at a Philadelphia hotel kept by the editor and proprietor. From that day to this technical journalism has been conducted on the plan of daily journalism, and that plan, it is believed, has outlived its day of usefulness.

The engineer, the architect, the manager of public or private works is to-day a specialist. He wants to know everything going on in his professional or business field, whether it is important or of merely minor interest, whether it agrees with his own opinions or is adverse to them. He knows that his opinions may change when he obtains further information or has had more opportunity for reflection. He does not want the views of others so much as all the facts from which to draw his own conclusions. This condition is the inevitable consequence of the training now given in the best technical schools, an education which is destroying the importance of unwarranted precedents and substituting the clean-cut facts of scientific knowledge and ability to reason from them.

The facts and theories of modern engineering and architecture can be, in the nature of things, obtained from but three sources, in addition to personal correspondence and consultation. For elaborate articles, the various societies will always be the proper publishers, because these organizations are able to present them with an elaboration of detail no journal can give. Text books are another source, in which the studies of many men are worked over at leisure by the compiler into a connected whole. The third source is the technical journal. To-day it is by far the most important of the three sources. Its staff is in touch with engineers and architects throughout the country, and its foreign correspondents and the foreign publications enable it to follow closely the progress of works and the introduction of novelties the world over. The problem is no longer that of the editor of sixty years ago, how to fill each issue, but it is to select the best of the many interesting available articles, to give everything which should be given and keep out everything of no value. "The Engineering Record" believes this can be best done by making every reading page of equal importance, giving to every article all the attention and care it needs, and introducing whatever comments seem desirable, if short, in connection with the articles to which they refer. In this way everything on a subject is in one place, and all the pages become editorial pages in the sense that nothing is printed on them simply to make a show. Of course this journal does not vouch for the opinions advanced in many of the articles it prints, in accordance with the policy previously outlined. If it has any comments to make, it will try to state them with sufficient clearness to render big type or extra leading unnecessary, and it does not intend to waste its space tilting at the windmills of absurdity, punching straw theories set up to be knocked down, or indulging in personalities which do no good to any one and make the outsider wonder if the people can really amount to much who raise such a tempest in a teapot.

In a word, the old editorial of the technical paper is badly crowded by more important matter. When "The Engineering Record" believes an expression of its opinion on a subject is advisable, this will be given, otherwise it prefers to devote its space to other articles.

THE WATER SUPPLY PROBLEM OF PHILADELPHIA.

The more the water supply problem of Philadelphia is studied the more surprising does it appear. The citizens of that town have apparently become so accustomed to the muddy liquid their city government furnishes them that they even dare offer it to unacclimated strangers as something fit to drink. It goes without saying that the construction and maintenance of water-works is an engineering problem, but the residents of Philadelphia seem to regard it as a subject to be settled by their Councilmen. A well-known designer and manager of water-works in various parts of the country, Mr. J. W. Ledoux, M. Am. Soc. C. E., whose offices are in Philadelphia, has recently made for his own satisfaction a study of the existing conditions of that city's supply, the remedies proposed from time to time, and the probable cost of furnishing wholesome water in place of the present thin gruel of silt and sewage. What he discovered and learned as a result of this study is an astonishing commentary on the apathy of the residents in one of the largest cities of the country, and is presented here somewhat condensed from the form in which he communicated it to this journal:

"The difficulties in the way of providing relief are much greater than would appear on cursory examination; and nearly every proposed solution of the question possesses serious objections of impracticability, prohibitory cost or inadequacy. There is, however, no lack of so-called remedies, for hardly a week passes that does not herald the exploitation of a plan whereby the question may be forever settled. Some of these plans are so plausible that their impracticability is not apparent without full investigation of every element entering into their construction and operation, with due regard for the difference between a small model plant and one of the size required by Philadelphia.

"A few of the numberless impracticable schemes are herewith enumerated. One man proposes sinking artesian wells in the park, which is too absurd for a moment's consideration. Another proposes infiltration galleries or wells along the Jersey side of the Delaware. These might be successful at first, but they could not remain so. Another proposes going to springs, but always fails to state their location. Another would install a system of pipes, and introduce a separate supply of drinking water. Although theoretically, and from a certain point of view practically, correct, there are objections too apparent to the layman to warrant the hope that any such radical departure from ordinary practice would ever be adopted. Unless the rates were very high and every service metered no one could form an adequate idea of the size of mains required. Every street would have to be torn up from end to end to put in the new mains, and an extra set of service pipes would have to be run through every house. The house service pipes alone would cost several million dollars, the street mains at least as much more, so that even without the water supply the cost would reach far in excess of ten million dollars. Another proposes going to the upper Delaware, but the expense would be considered prohibitory; also that supply is not so perfect as to render artificial purification unnecessary. Another scheme is to dam the Perkiomen and other streams in that vicinity, but even if the Perkiomen were taken near its mouth a reservoir of at least 50,000,000,000 gallons capacity would be necessary to afford the full supply. Another would dam the Schuylkill above Norristown, but, to afford 300,000,000 gallons per day, over 10,000,000,000 gallons storage would be required, and the drainage of Pottsville, Reading, Pottstown and other practical objections still exist. Then comes the plan of taking the head waters of Great Egg Harbor, Mullica Rivers and others, and of practically owning the whole watershed. This latter is ingenious and possesses some good features. However, the distance is very great, the watershed too small, the supply comes from another State, the water has a dark color, expensive pumping stations and enormous conduits would be required, so that the expense would be too great to secure what might be considered an inadequate quantity of water.

"Then come the various schemes for purifying the present supply. One proposes aeration as sufficient and necessary to render the water perfect. Another proposes electrical purification. Another would aerate-filter upward through gravel and sand, using iron as a coagulant, similar to the method in use at Wilmington, Del. Another would filter downward through sand at a rate of twelve or more million gallons per acre per day, using iron as a coagulant. Another would do the same, but use asbestos as a coagulant. Another would filter at a much higher rate, and use no coagulant at all; and thus passing through the whole category of more or less impracticable and untried schemes we come to the three methods of purification sufficiently meritorious to receive the recognition of our ablest and most experienced water supply engineers.

"Any one of the three would render the water of either Delaware or Schuylkill satisfactory for all purposes. First, provide storage reservoirs holding at least 25 days' supply. Arrange the outlet pipes so as to draw at all times from near the surface of water. Second, provide for purifying the present supply by means of sand filtration at a rate not to exceed three

million gallons per acre per day. In connection therewith, provide means for sedimentation in reservoirs holding at least twelve hours' supply and clear-water basins holding at least the same quantity. Third, provide for purification of the present supply by rapid filtration at a rate not to exceed three thousand gallons per square foot per day, using sulphate of alumina as a coagulant. In connection therewith, provide for sedimentation in reservoirs holding not less than twelve hours' supply and clear-water basins holding at least the same quantity. On account of the difficulty of connecting the different pumping stations with the large storage reservoirs, the first method would be considered the most impracticable and expensive, not to speak of the cost of reservoir itself and the large amount of land necessary.

"The problem, therefore, boils down to the adoption of slow sand filtration without a coagulant or rapid filtration with a coagulant. The solution of the question would be comparatively easy if we could leave out of consideration the existence of the city's pumping stations, reservoirs and piping system; but the enormous expense involved in their installation cannot, and should not, be ignored. Therefore, whatever remedy is proposed should, if possible, utilize the city's property to the fullest extent; and Mr. Ledoux offers a method whereby this may be done by either of the two plans of filtration worthy of consideration. For the sake of economical operation, a large portion of the work of purification should be done by means of sedimentation, and the Delaware should be taken as the ultimate source from which to draw for the future additional supply. The plan has been worked out in sufficiently close detail, he states, to insure the reliability and conservativeness of the estimates of cost given."

It may be said in a general way that the plans utilize the existing reservoirs and pumping stations for sedimentation or clear-water basins or filter chambers. In the case of slow sand filtration it is proposed to convert parts of the reservoirs at the East Park, Queen Lane and Roxborough stations into covered filters having 3 feet of sand over 1 foot of gravel. The main drains are placed below the concrete bottom and are connected with the laterals laid on this bottom by tees. The remainder of the present reservoirs would be used for settling basins or for the storage of the filtered water. In the case of the Belmont and Frankford stations, it is proposed to put up the filters in entirely new chambers. About 100 acres of filter beds are to be constructed in this manner, which, with the preliminary sedimentation for which provision is made, will yield about 300,000,000 gallons of purified water daily, or over 200 gallons a day per capita.

The cost of these works is estimated as follows: East Park, $833,000; Queen Lane, $697,000; 1,800-kilowatt generating station to furnish current for low-lift electric pumping plants at these stations, $255,000; Roxborough, $213,000; Belmont, $380,000; Frankford, including new 30,000,000-gallon high-duty pumping plant, $1,362,000; total cost of improvements, $3,740,000. In making these estimates the best construction and materials are specified, and no land need be bought except at Frankford. The most serious objection to the plan is that during construction the quality of the water will be worse on account of the temporary shortage of storage capacity. No provision is made for dividing the settling basins for cleaning out the sediment, because this work can be done during the autumn, when direct pumping to the filters is unobjectionable.

In the case of mechanical filtration, it is proposed to use gravity apparatus, having a nominal daily capacity of 283,500,000 gallons, which amount can be increased 10 per cent. if necessary. The existing reservoirs will be used for sedimentation basins and clear-water reservoirs. Sulphate of alumina is to be used as a coagulant, and will be dissolved and fed by gravity into the sedimentation basins at the point of exit of the outlet pipe. Works of this sort will require an outlay of $743,000 at East Park, $433,400 at Queen Lane, $255,000 for a generating station as before, $110,900 at Roxborough, $199,000 at Belmont, and $647,000 at Frankford, a total of $2,387,000 for 46,080 square feet of filtering surface and accessory machinery and buildings.

Mr. Ledoux believes it would be more satisfactory to adopt mechanical filtration, particularly as the river waters always contain in solution enough mineral bases to effect a chemical reaction with the alum which would be used. If the city had no pumping stations, he would prefer pumping all water from the Delaware, filtering it, and then distributing it from a central reservoir. Such a plant would cost $12,900,000 with mechanical filters and $14,500,000 with sand filters, and would involve the abandonment of most of the expensive pumping machines now in use.

A Building Failure in St. Louis on December 27, 1898, again calls attention to the importance of sound construction in the design of even the simplest structures. In this case the building, a new one, was but two stories high, but on the upper floor were two large ovens for a bakery, whose president is reported to have given their weight as 200 tons.

Snails are the latest discovery in the Chicago water supply. A short time ago the proprietor of a beer garden surmised all was not right with the water received at his place. So he allowed a hydrant in his yard to run all night and the next morning found half a pint of snails the size of a pea in the sieve through which the water passed. The attention of City Engineer John Ericson was drawn to their presence and he made an investigation of the subject, with the assistance of Professor Frank Collins Baker, of the Academy of Sciences. The snail has been recognized as Bythinia tentaculata, and is an importation from Europe. It is supposed to have been brought over by vessels, from which it passed through the Hudson River, Erie Canal and the Great Lakes to the vicinity of Chicago. It has been found in this country for about fifteen years, but was first detected in Lake Michigan three or four years ago. The problem before the engineering department is to devise some method of keeping the snails out of the tunnels, for to destroy them after they have passed the cribs is out of the question.

The Sinking of a Massachusetts Highway has been referred to in so many exaggerated newspaper articles recently that the real facts of the matter, as stated by Mr. W. E. McClintock, of the Massachusetts Highway Commission, are worth notice: "The road referred to was undertaken by the Commission early in the present year. Part of it traverses a level field for the distance of about 1,200 feet. This field is covered with a good sod of English grass. One or more oak trees of large size are growing not far from the place where the road settled, and garden vegetables of various kinds are raised in the vicinity of the road. The embankment and fill over the original surface was 1½ to 2 feet in depth. The first settlement was noticed some time in October, and at that time more or less material was placed on the road to supply the loss caused by settlement. About two weeks ago, suddenly and without warning, a section of road about 75 to 100 feet long, and possibly 30 feet wide, dropped from 8 to 16 feet, pressing the ground on either side of the road upward from 6 to 7 feet above the original level of the field. The height of the material thus raised diminishes to nothing at a distance of about 50 feet from the side of the road. Fully one-third of the hole made by the settlement has been already filled, and the cost of the whole will not reach $1,000."

By the Sliding Away of earth from the 16-inch water main supplying the city of Vancouver, B. C., with water, a length of pipe 25 feet long was recently left entirely unsupported. This was a riveted pipe of No. 11 gauge steel, having joints 27 feet 6 inches apart, and was not damaged at all. The joints were made in the usual way, with a thimble of No. 8 steel on the inside and a ½ × 5-inch band of tough iron on the outside sufficiently large to allow the lead joint between the band and the thimble. The pipe remained in place for several days, until a new trench was dug. The water was then shut off and the line changed in a few hours. Several years ago the city of Vancouver had an experience with this class of pipe which shows what it can stand. Loggers felled a large fir tree over the main where there was very little covering. Such an accident would have destroyed a cast-iron pipe. While the steel main was badly damaged, and threw a fan-shaped stream of water 100 feet into the air, the supply to the city was not interrupted. This leak was stopped by putting on a cast-iron sleeve in two pieces, bolted together, each piece having a 1½-inch hole in it to allow the water to escape while the lead joints at the ends were being made. The repairs were then completed by plugging these holes. "The Engineering Record" is indebted to Mr. Thomas H. Tracy, city engineer of Vancouver, for these facts.

A Large Concrete Dam is being constructed by the Vierfontein Water Syndicate for a reservoir near Johannesburg, South African Republic, to supply the Rand mines with water for mining and domestic purposes. The site of the dam is about six miles south of Johannesburg, and is between two hills which converge together into a neck about 600 feet wide. The area of the watershed is between five and six square miles, and the area of the reservoir at the high-water contour will be about 104 acres. The maximum depth of water will be about 90 feet, and the average depth between 35 and 40 feet. The dam is a combination arch and gravity structure, the arched portion being 340 feet long and the length over all 585 feet. The total height from foundation to crest will be 120 feet. At the crest the arch will have a radius of 275 feet, which decreases to 206 feet at a point 75 feet below. About 30,000 cubic yards of concrete and masonry will be used in the construction. In order to get a good foundation it was necessary to excavate to an average depth of from 12 to 14 feet. Firm rock was then reached, and on this a layer of concrete 40 feet wide and 15 feet thick was laid. In this concrete two layers of railway rails were placed, one longitudinally near the bedrock and the other transversely about 2 feet below the top. On this concrete the masonry work of uncoursed rubble was laid, the wall being 36½ feet in width at the bottom, decreasing to 33 feet at a height of 20 feet and to 7 feet at the crest. To guard against percolation a cut-off wall was built on the upper face of the dam. Then for a space of 60 feet all loose material was removed and another cut-off wall put in. Between these walls a layer of clay 3 feet thick was laid and then a layer of earth 6 feet thick, and both were thoroughly rammed. Near the bottom of the dam are two scouring pipes, and 15 feet higher are three outlet pipes to the pumping station. From here the water is pumped about 1¾ miles to the service reservoir at an elevation of 575 feet above the dam. The materials at the site of the dam are handled by means of a Lidgerwood cableway. The rock used is quarried about half a mile away and is a hard blue quartzite. The estimated cost of dam, pumping plant, pipe mains and service reservoir is about $1,000,000. Mr. William Ham. Hall, M. Am. Soc. C. E., is consulting engineer and manager, and Mr. J. B. Rogers is the resident engineer.

THE NEW CROTON DAM.

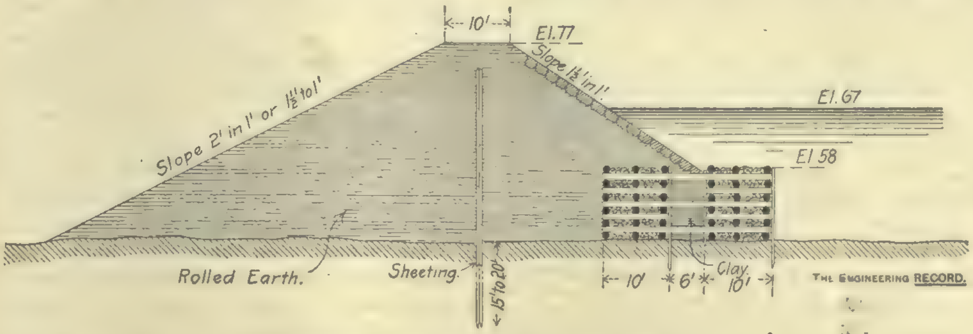
The great dam near Croton Landing, N. Y., which is to impound water for the supply of two of the boroughs of New York City, has already been described and its construction explained in an elaborate article in "The Engineering Record" of June 11, 1898. A reference to that article will explain most of the features of the accompanying engraving, which shows the present condition of the work, and has been prepared from a large composite photograph, made up of smaller special views. As the field of the picture in the line of the dam is nearly half a mile long, it has previously been impossible to secure a single large picture presenting the details clearly, and the different parts of the work without distortion or relative displacement.

This view, from the downstream side of the dam, looking east, shows the entire site of the dam and all the operations in progress there. The masonry structure, 200 feet in width at the bottom, and several times as long on top, extends far below the visible portion to foundations quarried out of the solid rock 100 feet below the top of the masonry here shown. This masonry is built of large quarry-faced rectangular stones of sizes up to 80 cubic feet each, which are set with horizontal beds in cement mortar, and are handled by stiff-legged boom derricks. These, although not systematically arranged, are generally most conveniently used in rows of three across the top of the dam, each one racking off the masonry around it up to a maximum height of 15 feet above the adjacent level. One gang of masons and helpers works with each derrick. The stone from an adjacent quarry is delivered by locomotives on the tracks shown in the center of the picture, and is either distributed on belt tracks on the lower berm of the pit slope, to the derricks on the upstream and downstream faces of the dam, or it is delivered on a platform at the north end of the dam (concealed in the picture by the diversion wall), and thence distributed to the inner masonry derricks by the cableways above, which also deliver the cement and sand to the mortar-mixing platform at each derrick.

Contract work was commenced in the summer of 1892 by the construction of diversion works to exclude the Croton River from the dam site. This comprised an upper and lower wing dam across the old bed of the river, and a new temporary channel or bypass connecting their northern ends. The bypass is a canal, 100 feet or more in width, blasted out of the rocky hillside and protected towards the dam by the massive retaining wall, conspicuously shown in the photograph. The wall is 630 feet long, 23 feet high, 13 feet thick at the bottom and 6 feet at the top. This wall and its dams in seasons of low water have only to resist the shallow stream shown in the picture, but in floods they have withstood safely a flood many feet deep, with a swift current and a volume of 15,000 cubic feet per second.

The foundation was carried down everywhere to sound, hard rock, often penetrating many feet below the loose or decayed upper portions and to a maximum depth of 130 feet below the river bed. This involved about one million cubic yards of excavation, and produced a pit 1,300×500 feet on top and 300 feet deep from the highest point of the excavated surface, which was at the right hand of the picture. Here can be seen the great height of the bank, its extreme steepness, and the three berms by which the upper part of the slope was divided. Each berm was carefully drained, and the two lower ones were made wide enough to receive the narrow-gauge railroad tracks for handling materials and spoil. Below the present top of the masonry the bottom of the pit is being backfilled with the spoil, rammed against the face of the dam, and this work especially is being pushed during the winter weather. At the extreme right of the picture is seen the core wall trench, cut through the side of the main excavation, and 75 feet deep, down into the solid rock. It is 25 feet wide, with a stepped bottom, and heavily timbered.

In the foreground on the left is the suspended foot-bridge to the contractor's office; the resident engineer's office is on the opposite side of the valley. Just above this bridge is a stream of water, discharging into the river through the side of the retaining wall. This is one of the three 12-inch deliveries from the pit-draining pumps, that have at times raised about 10,000,000 gallons a day. Across the upper end of the diversion channel is seen the railroad bridge for the track to the contractors' quarry, and at the right of that the elevated tank for the water supply to boilers, masonry, etc. Across the top



DIVERSION WEIR AT THE NEW CROTON DAM.

of the picture several flat, curved lines show the positions of the three 1,200-foot cableways, about 50 feet apart and parallel to the axis of the dam, which were installed by the Trenton Iron Company and by the Lidgerwood Manufacturing Company. The main cables are 2 and 2½ inches in diameter, and have average deflections of about 85 feet. Some idea of the great height of the finished dam and of the height of masonry yet to be built may be gained from the fact that at their northern ends (beyond the field of the picture on the left) the heights of the cables are about level with the crest of the dam, and that the new spillway in the hillside there, through which the surplus flow of the river will eventually be discharged around the end of the dam, will be about 130 feet above the surface of the water here shown in the diversion channel.

THE EXCAVATION FOR THE FOUNDATIONS OF THE CROTON DAM.
ALPHONSE FTELEY, M. AM. SOC. C. E., CHIEF ENGINEER; COLEMAN, BREUCHAUD & COLEMAN, CONTRACTORS.

As the security of the men and work in the deep foundation pit depended on the stability of the diversion dams, they were designed to be much more secure than is often the case with temporary structures. A cross-section of the upstream dam is given in the accompanying line drawing. It is built mainly of rolled earth on a prepared earth surface, in which is driven a core wall of two thicknesses of tongued and grooved three-inch sheet piling. The base of the dam is about 110 feet wide, and has on the river side a timber crib 12 feet high and 36 feet wide, which is made with three pockets, the middle one filled with puddled clay and the side ones filled with stone ballast. The upstream sides of the outer pockets are faced with sheet piles, driven four or five feet into the ground, and the timbers are drift-bolted together. The river slope is paved. The lower diversion dam is similar to the upper one, except there is a riprap of heavy stones under and at the lower side of it, and covering the top of the crib and the adjacent foot of the paved slope, so as to protect it from erosion in times of freshet.

The total height of the finished dam will be 290 feet from the bottom of the foundations and 144 feet from the top of the fill on the upstream side, where the water will be 130 feet deep. It will contain about 670,000 cubic yards of masonry, and will cost about $5,000,000, of which about $2,800,000 has already been paid to the contractors on the engineer's estimates. A maximum force of about 800 men is employed on the work, and as much as 17,000 cubic yards of masonry have been laid in a single month. Mr. Alphonse Fteley, President Am. Soc. C. E., is the chief engineer. Mr. Charles S. Gowen, M. Am. Soc. C. E., is the resident engineer, and Coleman, Breuchaud & Coleman are the contractors. Mr. Jules Breuchaud, Assoc. Am. Soc. C. E., is the member of the contracting firm in engineering charge of the work, and acknowledgment is made to him for data for this article.

THE SANITATION OF HAVANA.

It will doubtless be recalled by the readers of "The Engineering Record" that a couple of months ago General Francis V. Greene was sent to Havana to make arrangements for troops in the vicinity of that city and study its government. He found that sewers, pavements, a new slaughter house, tramways, markets, hospitals and buildings for the police, fire and health departments are needed, and drew up some interesting memoranda concerning the condition of the place. The Havana water-works are well known to American engineers through the paper describing them in the "Transactions" of the American Society of Civil Engineers, written by Mr. E. Sherman Gould, their designer and supervising engineer during construction. The city hospitals are nine in number; three in good condition, two bad and four deplorable. It is believed these can be put in proper condition in a short time if the proper amount of money is provided for the purpose. The sanitary code is a book of 51 pages, but it does not seem to be a startling success, for General Greene found dairies and livery stables in unsuitable places, and dead animals lying in the streets. All kinds of filth are thrown from the windows and doors of the poorer quarters of the city, and nearly every paragraph of the health regulations is violated constantly. The following extracts from the report give further information on the unsanitary condition of the Cuban capital:

Sewers and Drains.—The thickly populated portion of the city is about 2,600 yards from east to west, and 2,200 yards from north to south. It contains approximately 70 miles of streets, of which not more than 40 per cent. are paved. The pavement is laid of trap blocks for the most part, although some streets have large stone blocks 10x12 inches on the surface; and there are two small pieces of wood pavement. All of the pavements are worn out and in bad order. The streets not paved are covered with macadam made of soft coral rock, and are full of deep holes.

In the old city the ordinary width of streets is 20 feet, of which 15 feet is roadway and 2½ feet on each side is sidewalk. In many streets the roadway is only 12 feet wide and the sidewalk 18 inches. In the newer part of the city there are five or six streets 50 feet in width; but the others are all narrow, like those in the old city.

In various sections of the city, and particularly in the eastern part, within the lines of the ancient walls, there are small iron gratings at the intersections of streets into which rain water discharges, and thence finds its way to the harbor or to the Gulf by some sort of underground drain. But there are no records in the city offices showing the size or location of these drains or how they run; and they are rarely if ever cleaned out. They have no manholes. It is said that during the rainy season portions of Cuba and other streets near the eastern part of the town have as much as 4 feet of water standing on them after heavy rains.

There are a few houses in Havana which have private sewers connecting with the water closets and discharging into the harbor or into the Gulf. These have been constructed at private expense, under permission granted by the city authorities in past times; but no record has been kept of such permits or of the location, size or construction of the sewers, and the city officials are unable to give any information whatever concerning them.

In the suburban district of Jesus del Monte, and in some other portions of the city, there is on each side of the streets a shallow drain about 2 feet square, covered in some places and in other places open. This is used to drain off the surface water of the street, and at the same time is a receptacle for night soil, which is daily dumped into it, and at the present moment is in a very foul and unhealthy condition. The odors from it are extremely offensive, and it is undoubtedly a source of disease. This can be cleaned out and disinfected, but this will not prove a permanent remedy and will have to be repeated from time to time, for it would appear that the inhabitants along this street have not even cesspools in their houses, and have no other way of disposing of the refuse except through this open drain.

In the years 1894-95 an American contractor, through his attorney and engineer, made complete surveys of all that portion of the city east of Belascoain Street, and submitted an elaborate plan for the sewerage and paving of the same, and the cremation of the garbage. This plan has been before the Havana authorities for the last four years, and has received the formal approval of the Ayuntamiento in so far as its technical features are concerned. No plans have as yet been approved or even definitely formulated for paying for this, the cost of which is estimated to exceed $7,000,000. Under the old law of public works, the right to construct these sewers would have to be sold at public auction, after due advertisement, to the lowest bidder. In case the contractor who made the plans should not be the lowest bidder, he would have the right to take the work at the price named by the lowest bidder; or, if he declines to do so, the lowest bidder is obliged to pay him the value of his plans and the time and labor expended in preparing them, at a valuation to be determined by assessors. The estimated time for completion of the work is five years, although it might be completed in less under favorable circumstances.

The plan of sewerage proposed in this project is what is known as the partially separate system. Terra cotta pipes of sizes varying from 8 to 18 inches are placed in each street, and connected with each house by an iron pipe. These sewers all discharge into a collecting sewer of brick and concrete, which runs to a large works for pumping and chemical reduction, by which the offensive matters, together with the garbage of the city, will all be cremated or consumed, and the solid and inocuous residue will be towed out to sea or otherwise disposed of. Supplementary to the sewer pipes for house sewerage there will be a number of pipes in various streets for surface water, which will be conducted direct into the Gulf or the harbor.

The project also provides for new pavements in every street in this area of the city, amounting to about 500,000 square yards, of which about two-thirds is to be of granite block on concrete foundation, and one-third of asphalt. The old trap blocks on such of the streets as are now paved are to be taken up and relaid in suburban streets.

Cesspools.—For more than 300 years the people of this city have discharged all their house drainage into cesspools. These are placed sometimes under the kitchen, sometimes under the water closet, but more frequently in the patio, or open courtyard, which is usually found in the center of each house. They vary in size from 3 to 10 feet in diameter, and in depth from 4 to 8 feet. They are usually closed on top by a heavy stone with an iron ring for lifting it. The duty of cleaning these cesspools rests primarily upon the tenant, and secondly upon the landlord, and the city designates certain people who alone are authorized to clean and disinfect them and remove the contents at night. While the sanitary regulations on this subject are quite elaborate, they are seldom enforced, and the work is done in the most filthy manner, the contents being frequently dropped on the floors and halls of the house as they are being removed. Sometimes they are not cleaned for periods as long as five years. The cesspool being open at the bottom, the liquid contents drain off through the limestone or coral rock which underlies Havana, and gradually find their way to the waters of the bay or the Gulf, the capacity of absorption of this coral rock being stated to be about one inch vertical per day.

It will be several years before any system of sewerage can be completed and put in operation, and one of the first steps toward the sanitation of the city will be the appointment of a competent Board of Health to draw up health ordinances suited to this locality, and then have them enforced by the police with the utmost rigor. The present condition of the cesspools, particularly in the crowded houses of the poor, is the most fruitful source of yellow fever and other diseases in Havana.

Street Cleaning.—The streets are cleaned under contract, which has usually been let to the lowest bidder for a period of five years. The contract consists of two parts, one the cleaning of streets and the delivery of the material at the Christina Street Station of the United Railroads of Havana Province, and the other the removal of the material on that railroad to some point outside of the city limits. The last contract expired in October, 1897, and since that time the work has been done by the same contractor under a temporary contract running from week to week. The contract price per annum under the old contract was:

For cleaning	$86,212.88
For removal	35,999.60
Total	$122,212.48

The contract is of an antiquated form, such as was used in the United States 20 or 30 years ago, and provides in a vague and somewhat indefinite manner for the complete cleaning of all the streets and the removal of filth of every kind. The paved streets are fairly well cleaned about twice a week. The refuse is re-

moved in box cars to a point near Palacio Christal, about eight miles south of the city, where the cars are run off on a movable siding on property owned by the contractor, and the material is there shoveled out of the cars and left on the ground. This place has been examined by Capt. Geary, in charge of the street cleaning work, and he reports it filthy to the last degree, the stench being so strong that he was unable to remain on the spot.

During the blockade the city authorities gave the street-cleaning contractor a written order not to remove the street cleanings from the city, but to dump them in the marsh alongside of the Chavez Creek, just east of the Christina Street Station. Hundreds of tons of filth were deposited in this wet soil, creating a terrible nuisance, most dangerous to health. They still remain there. Surgeon Davis has examined the locality and recommends as the best means of abating this nuisance that these piles of foul matter be covered with chloride of potash and slowly consumed.

The habits of the inhabitants of Havana, including the rich as well as the poor, are very different from American standards in the matter of sanitation. For several months past the reconcentrados and other people of the town, as well as the soldiers who have swarmed in the streets, have been in the habit of using the public streets as open privies, and the unpaved streets were covered with enormous quantities of foul human excrement. On receiving authority from the Secretary of War to begin cleaning the city, I decided not to interfere in any way with the street-cleaning contractor, whose work on the paved streets is fairly well done, but to devote all the means at my disposal to cleaning up this excrement and generally cleaning the unpaved streets. This work has been in progress since December 3, with very satisfactory results. The work is not done by contract, but by days' labor, the laborers being hired and paid directly by the United States officers. The filth is scraped from the unpaved streets, removed in carts to barges, and thence carried out to sea and dumped in the Gulf. As fast as each street is cleaned it is thoroughly sprinkled with lime, and notices are posted on the fences and houses warning the inhabitants that this street has been cleaned at the expense of the United States, and the depositing of excrement, filth or rubbish on the same will be severely punished, in accordance with the existing city ordinances. These notices are signed by the Alcalde of the city, who has also stationed police in these streets to prevent the defiling of them. He is quite willing to coöperate in any way, and to use the police or other officials of the city to assist in this work, provided he is not called upon to expend any money. He is entirely without funds.

The temporary contract with the street-cleaning contractor is paid for from week to week, and it expired on December 31, 1898. He is quite willing to continue the work, and probably at the same rate ($2,850 per week), and it will probably be best to make temporary arrangement with him on this basis until permanent plans for street cleaning can be made. I think these had better be on the same lines as those instituted by Col. Waring in New York; that is, the cleaning of the streets by hand during the daytime and the removal of the refuse to sea in self-dumping barges. This will cost more than the present system, but it will be very much more effective.

Slaughter House.—There is only one slaughter house in the city, and it is owned by the municipality. Like all the other property and revenues of the city, it is mortgaged to the Spanish Bank as security for the loan of 1889. The agents of the bank collect the revenues in person, and the city has only a small number of employees engaged in necessary work around the buildings. The number of cattle killed is from three to four hundred per day. While the sanitary regulations concerning slaughtering are quite complete, yet they are not enforced, the excuse being that the city has no funds to enforce them.

Instead of being conducted on the same lines as the modern slaughter houses in Chicago and other cities, where nearly every portion of the refuse matter is saved and converted to a useful purpose, nothing is saved here except the meat, skins, hoofs and bones. All the semi-solid portions of the animal are dumped into an adjacent shallow creek, which is almost obstructed by them, and under the influence of moisture and a tropical sun the place is foul and unhealthy to the last degree. In the opinion of Surgeon Davis, who has thoroughly examined the locality, the chief source of infection in Havana, outside of the cesspools, is the slaughter house and the street-cleaning accumulations on the banks of Chavez Creek. The city has had under consideration for several years a project for the construction of a new slaughter house; the project has given rise to a great deal of discusion and criticism, and nothing definite has been done toward putting it into operation.

THE NEW SOUTHERN TERMINAL STATION, BOSTON.—II.

The head-house forms three sides of a court with slightly oblique angles, which surrounds the train-shed and contains all the waiting rooms, offices, and public and private apartments required for the depot uses. It is from two to five stories in height above the ground, and has walls of stone and brick masonry, steel interior columns and floor beams, and fireproof floors. As the inclosed court is larger than the train-shed, there is a space left between their adjacent walls on two sides. Towards the baggage room this forms a triangular area, used for extra baggage storage, and roofed over with beams and trusses extended to the court walls. At the end of the train-shed the space is nearly 130 feet in maximum width, and forms a promenade, called the "midway," giving access to all the tracks. It is covered by a slightly pitched roof, with skylights.

The main building has a curved front 228 feet long and nearly 100 feet high, with three entrance arches of 92 feet combined width, and an ornamental facade of columns commencing at the third floor level.

These columns are 4½ feet in diameter and 42 feet high, forming a colonnade, above which there is an entablature and parapet, with projecting pediment, carrying the facade to a height of 105 feet above the sidewalk. Above all is a clock, with a 12-foot dial and a colossal eagle. There are five stories in the main building, and two stories throughout the remainder of the Summer Street front and both the Dorchester and Cove Street wings. The arrangement and design of the building and the principal architectural features were described in "The Engineering Record" of January 2, 1897.

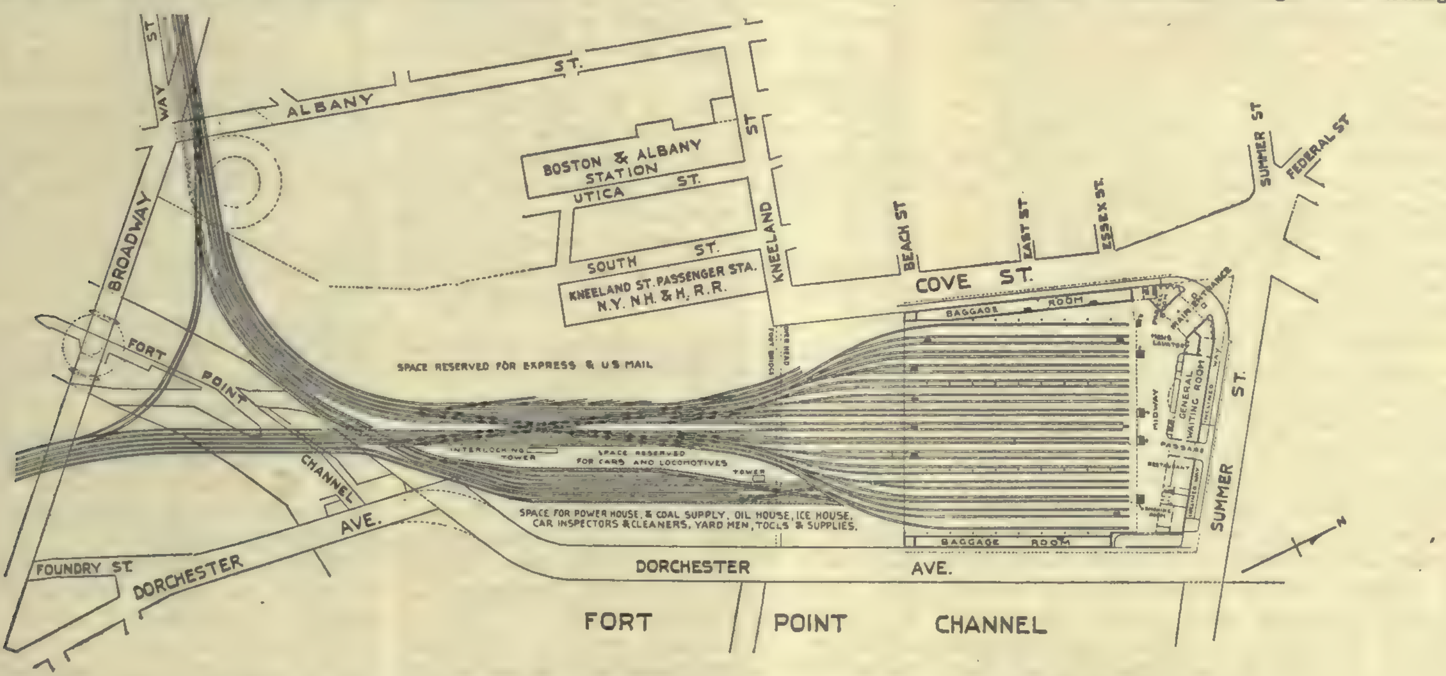


FIGURE 5.—GENERAL PLAN OF THE SOUTHERN TERMINAL STATION, BOSTON, MASS.

The present number of suburban trains is about twice as large as that of all other trains, and it is estimated that this ratio will be trebled by the adoption of electricity and other improvements in service. All suburban trains are to be loaded from the central platform between the loops, which is elevated four feet above the tracks, has a capacity of 25,000 at one time, and is reached by a gentle incline from the street and by short, easy stairs down from the main waiting room. About 700 trains a day will be transferred from the old stations to the new one, involving about 4,000 movements in 18 hours, which will probably be increased.

The design of the head-house and train-shed has been very carefully studied to facilitate the movement of crowds of passengers and handling of baggage, and provide the most comfortable and convenient waiting rooms and offices; to separate express and local traffic, and to conform to a large future increase of business. The problem of baggage handling has been solved by constructing an intercepting tunnel, which crosses under the tracks at a low level, and has elevators to raise and lower loaded trucks that may be transferred between the baggage

rooms and all trains without delay or obstruction.

A new feature in the arrangement of metropolitan terminals that has been introduced here is the operation of the trains without steam locomotives, and of separate full-length platforms for baggage.

A block plan at street level is given in Figure 5, showing the outlines of the train-shed, positions of adjacent depots and general location of yard tracks and suburban lines and subway.

The various departments of the mechanical and power plants, while each quite complete in itself, are yet more or less connected together and were all installed under one general contract.

The switching and signalling system includes a complete installation of Westinghouse electro-pneumatic interlocking apparatus for handling all trains of the four railroads to and from the main train-shed, and for handling the frequent trains of the suburban service which are to use the tracks in the depressed suburban loop. Several hundred levers will be installed for operating the switches and signals, and two brick, iron and glass towers will be built for the reception of the interlocking machines and for the use of the men who are to operate them. In each of these interlocking towers, operating models of the tracks will be placed, upon which all movements of the switches and signals will be duplicated in miniature, so that the operators will always have before them the exact arrangement of the sections of the track under their control. The switches and signals will be operated by compressed air furnished from the power house, and controlled electrically by the interlocking machines in the towers. The signals will be located in some cases on the ground level, but principally on the eight or nine signal bridges, varying in span from 50 to 120 feet.

The power house equipment will comprise ten boilers, economizers and a large mechanical draft plant. About 1,500 horse-power of Westinghouse compound engines direct-connected to Westinghouse multipolar dynamos will be installed in the engine room. The plant will be operated condensing, using salt water from Fort Point Channel, about 100 feet distant from the engine room, except when exhaust steam is required for heating or other purposes. A large switchboard providing for eighteen circuits will be installed, and a 20-ton traveling electric crane will span the engine room. The electric arc and incandescent lighting is laid out with a larger number of distributing centers than is customary in isolated plants; and complete methods of switching are to be provided, in order to meet the demands of the lighting and motor circuit, and to aid in economizing power. In the power house automatic stokers are installed, which are expected to produce practically smokeless fires and to be able to burn inferior grades of coal advantageously. Tall chimneys have been dispensed with, and forced draught for the boilers secured by the installation of two large slow-running exhaust fans discharging into a large iron stack projecting but a short distance above the roof line.

The plant for the manufacture and compression of Pintsch oil gas will include one 30-foot gasometer 15 feet high, two oil and one tar storage tanks, each seven feet in diameter and 26 feet long, one oil feed tank and one bench of 10 double furnaces. This plant will have a capacity of 120,000 cubic feet of gas daily.

The elevator equipment is to comprise nineteen electric elevators and lifts, distributed through the head-house, train-shed and baggage rooms. Five of these are for passenger service, two are for handling supplies for the restaurant and other similar uses, and the remainder are for handling baggage and express between the train-shed and suburban loop levels.

The head-house and baggage wings, which together have a total length of more than 2,000 feet, and a volume of nearly 5,000,000 cubic feet, are to be heated and ventilated with various combinations of the direct and indirect methods. Hot blast and tempered air is to be furnished by fans, which are to be driven by electric motors; while the ventilation is to be assisted by electrically driven exhaust fans located in the attics, and entirely separate means of ventilation are to be provided for the toilet rooms.

Ice for general use is to be manufactured on the premises in an ice plant, which will make 20 tons per day. This ice plant is to be conveniently located between the power house and one of the baggage wings. The restaurant and kitchen boxes and storage rooms are to be mechanically cooled by a refrigerating plant of the usual form, installed by Westinghouse, Church, Kerr & Co., and the same plant will be used for cooling the supply of drinking water for general use. The drinking water will be taken from the city mains, thoroughly filtered, and after being cooled will be constantly circulated through a water system comprising 25 drinking fountains.

An extensive system of steam and compressed air piping is to be distributed through the yards and train-sheds, and connected with about 50 stub-tracks, for warming the cars while they are standing on the tracks in cold weather, and to furnish a suitable supply of compressed air for testing the brakes prior to the departure of the trains.

For the protection of the head-house and adjacent buildings a system of fire-service mains and distributing lines connecting with the Boston high-pressure mains, and provided with a large number of outlets, will be fitted with hose and reels ready for immediate use when needed. Provision is to be made to enable special electric protective apparatus to be added as required.

Near the power house, electrically driven centrifugal pumps will be installed to remove seepage and storm water which may collect in basements and subways. The electrical pumping apparatus is to be controlled automatically by the level of the water in the sump, and a larger pump is to be installed to handle unusual quantities of water. Electrical alarms are to be provided to notify the power house attendants to start the large pump whenever the water reaches a maximum level.

There are about 14 acres of roofs, from which storm water, melting snow and ice are to be carried away by the large conductors, the freezing of which in winter would cause great inconvenience. Special provision is to be made therefore to keep them constantly open by means of a hot water and steam supply provided from the head-house. This is to be wholly separate from the heating system, and will be used only in cold weather.

A plan of the main floor of the terminal is shown in Figure 6, which comprises the head-house, train-shed and intermediate space, all under continuous roofs, which cover an area whose extent is graphically illustrated by Figure 7, which shows how there could be arranged within its boundaries 24 prominent Boston buildings. The arrangement of the 28 stub-tracks for express trains, with unobstructed platforms between each pair of tracks, is shown in Figure 6, which also shows the principal offices and public rooms on the same floor, slightly elevated above the street, and it shows in the midway five main stairways to the suburban trains, running in the subway loops below. The principal cross-sections of the main part and wings of the head-house are shown in Figure 8, and a sectional diagram of the train-shed was given in Figure 1, page 95, of the issue of January 2, 1897.

As the lowest tracks in the head-house are seven feet below very high tides in made ground near the water front, the waterproofing already described was very carefully executed, and generally the tar paper was laid on a smoothed concrete base six inches thick, under which in soft ground boards were laid. In some places the cheap concrete filling put in above the tar paper counterbalanced the upward hydrostatic pressure of 500 pounds per square foot, while in other places it was resisted by inverted concrete arches. There was about 56,000 square yards of waterproofing, with a drain pipe under the entire length of each subway line, and an inclosing cofferdam, which cost about $75,000. The submerged centrifugal electric drainage pumps have a capacity of 7,000,000 gallons in 24 hours.

All the foundation walls are of large granite blocks, set on extended concrete footings, built on rows of piles, penetrating about one foot into the concrete. The total number of piles under the entire terminal structure is about 2,600, and their working loads were proportioned in accordance with the results of a special test. On February 5, 1897, a load of 60 tons of pig iron was imposed on each of three spruce piles driven 27 feet into the ground, with a maximum penetration of four inches under the last blow of a 2,000-pound hammer, falling 10 feet with the line attached. Not more than 10 inches penetration resulted from any single blow. No settlement was produced by the test load, which was fixed at twice the working load.

A cut granite base extends around the street walls from sidewalk line to first story window sills, and above it the entire fronts of the two-story buildings are of quarry-faced stone, set in La Farge cement and backed with brick. All the third, fourth and fifth story street walls are faced inside with gray Norman brick, all the interior walls are of hard red brick, most of the lintels, sills and other trimming and the cornice, balustrade, entrance arch, main columns, entablature, parapet, etc., of the main building are of cut stone. Nearly all of the front, including all the curved portion, is built of Stony Creek granite, relieved on each side of the colonnade by dark buff mottled brick. The main entrance hall is lined with polished Stony Creek granite, and has four polished Milford granite columns 40 inches in diameter. The ceiling is of white enameled brick arches, with white marble girder casings.

White enameled brick are used for facing all walls in the subway, emigrants' rooms, minor entrances, upper part of midway, and in the court opposite the train-shed. The inside of baggage rooms and the inside of buildings above the midway roof are faced with red brick. The general waiting room, staircases, and elevator shafts and lower part of midway walls are faced with enameled cream-colored brick. The women's waiting room and smoking room walls are faced with cream-white glazed tile. All of the exterior walls, except in the baggage room, are lined with four-inch hollow brick. All the lavatories and toilet room walls are faced with slate or marble slabs, one inch thick, and their partitions of marble or slate are mounted with brass fittings. In the waiting rooms, smoking rooms, barber shop, dining rooms, stairway halls, vestibules and corridors, the floors are laid with marble mosaic, made of cubes from five-eighths of an inch to one inch square, set in Portland cement concrete. The floors of the carriage concourse, of the main exit to the midway, and of the other principal entrances, of the emigrants' rooms, carriage office, cabmen's room, kitchen, serving room, depot-master's room, parcel room, boot-blacks' room, fireproof vaults, most of the lavatories, all corridors above the first story, and all cellar floors are laid with asphalt, one inch thick, on concrete All the other floors in the building have double board surfaces, the bottom planks being laid diagonal to the joints, and the upper course at right angles to the lower. In the baggage rooms the under floor is tongued and grooved spruce

plank four inches thick, above which one thickness of building paper is laid, and then the wearing surface of first quality rock maple 1⅛ inches thick and three inches wide. In other floors the lower course is of seven-eighths-inch spruce.

The openings from the main hall into the corridors in the upper story have metallic fireproof doors, with metal-covered jambs, casings, etc. All woodwork in the directors' dining room is of Mexican mahogany; elsewhere throughout the building, except in baggage room, it is of white oak. In the baggage room it is of North Carolina pine. The interior oak is finished throughout with one coat of oil, one coat of wood-filler rubbed, one coat of shellac, and two coats of furniture varnish rubbed. The mahogany has two more coats of rubbed varnish; hard pine is finished with two coats of shellac not rubbed.

All mortar is made of one part Rosendale cement and two parts of sand. Joints are filled and pointed with Portland cement which is required to develop a tensile strength of 200 pounds after 24 hours. The partitions throughout the building are in general made with grooved plank cores, with plastered surfaces. Thin partitions and those around the heating and ventilating flues are made of small channel irons and metallic laths plastered with Keene's cement. The ticket office partitions and some others are made of porous terra-cotta blocks. All interior iron columns, except those which are finished round, are cased with three-inch porous terra-cotta blocks. Other columns are covered with metal laths and three coats of Keene's cement plaster. All beams and girders projecting below the ceiling are covered with metal lath and plaster. All ceilings are made with porous terra-cotta or metallic lath, and, except in the entrances and baggage rooms, are finished with two or three coats of plaster. Cast-iron stairs are used throughout the buildings. All cornices inside the buildings are formed with metal furring and metal lath. The roofs are made of terra-cotta tile or hollow brick arches covered with five-ply composition roofing, except for the two-story buildings on Dorchester and Cove Streets, which are covered with 14 ounce copper. The entire roofs of the sidewalk and street awnings and of the skylights are made with wire glass three-eighths of an inch thick in iron frames. All the openings into the baggage rooms and the principal street openings of the building are provided with improved patent self-coiling steel shutters. The structural iron and steel was required to conform substantially to standard bridge specifications for quality and workmanship. All heating and ventilating ducts are made of galvanized iron, and the main lines are carried chiefly between the floors and false ceilings of the corridors. The plumbing system includes 171 water closets, 103 wash-basins, 158 urinals, 14 iron sinks and six bath-tubs.

Messrs. Shepley, Rutan & Coolidge were the architects, and Messrs. Norcross Brothers the general contractors for this building, which was constructed in conformity to the general plan of the resident engineer, Mr. George B. Francis, M. Am. Soc. C. E.

(To be Continued.)

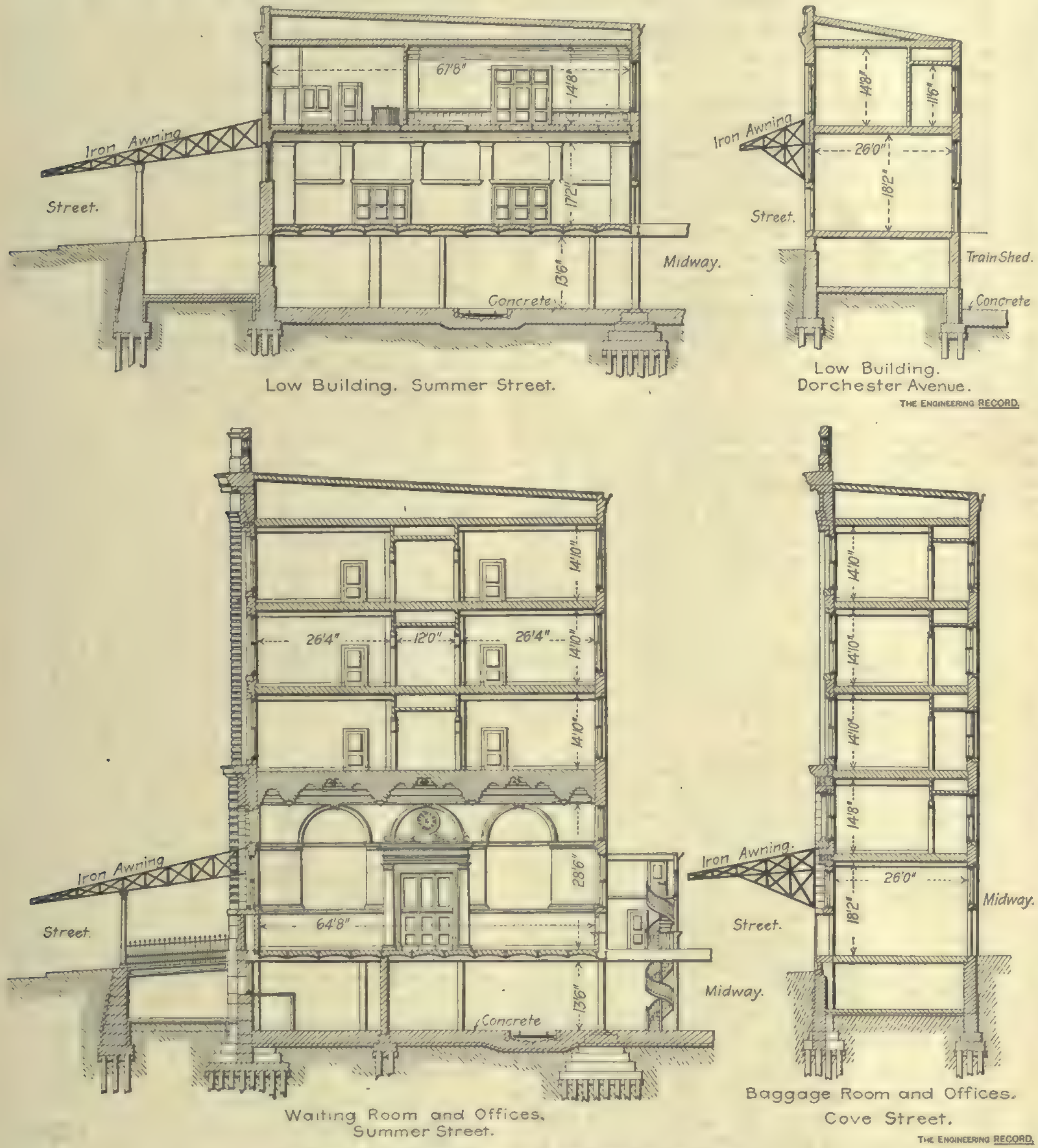


FIGURE 8.—CROSS SECTIONS OF THE HEAD HOUSE.

A New Fire-Resisting Floor Material called asbestolith has been introduced into this country from Germany, where it has been in successful use for several years. The owner of the Georgia short-fiber asbestos mines had been supplying for some time a considerable quantity of his product to Germany, without knowing the purpose to which it was put; his curiosity was recently aroused, however, and he found it was mixed with certain cementing and coloring materials and used for floors and

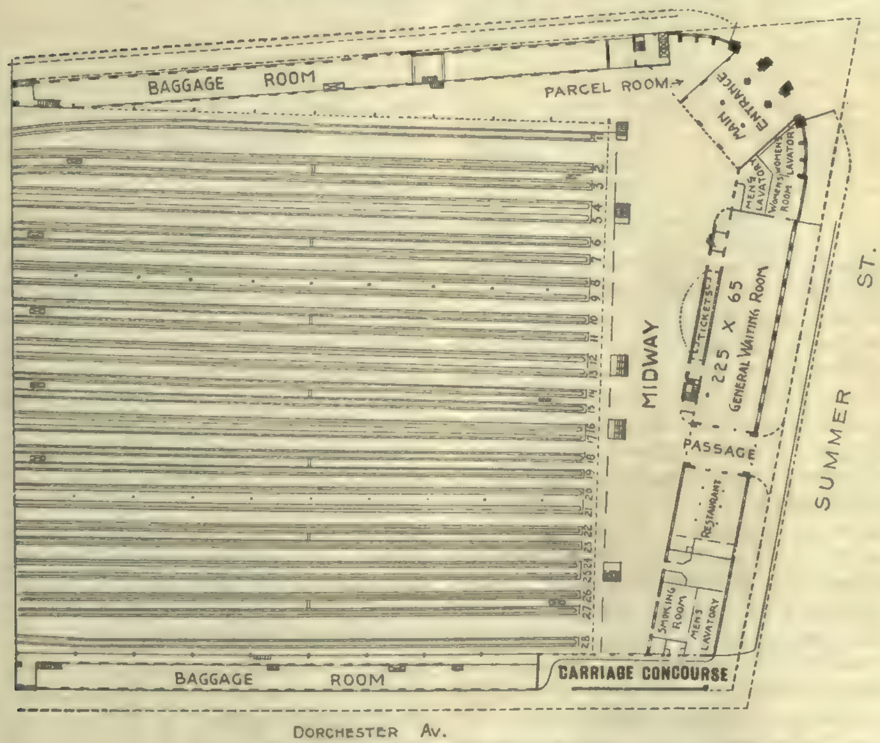


Figure 6.—Plan of the Main Floor.

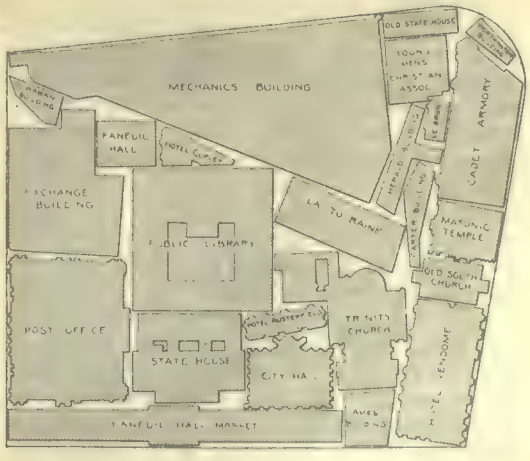


Figure 7.—The Relative Size of the Head-House.

THE HEAD HOUSE OF THE SOUTHERN TERMINAL STATION, BOSTON, MASS.

SHEPLEY, RUTAN & COOLIDGE, ARCHITECTS; GEORGE B. FRANCIS, RESIDENT ENGINEER.

walls, where light weight, durability, fire-resisting and damp-resisting properties were required. He has made arrangements to manufacture the material in this country, and has appointed Mr. J. R. Wendover, of 95 Liberty Street, as his New York representative.

WOODEN STAVE PIPE.

The Coolgardie pipe line, 328 miles long, which it is proposed to construct in Western Australia, has been taken as the basis of an interesting paper by Mr. D. C. Henny, M. Am. Soc. C. E., on the relative advantages of riveted steel plates and wood staves for such a main. The paper was read before the Technical Society of the Pacific Coast a few weeks ago, and has just appeared in the "Journal" of the Association of Engineering Societies. The Coolgardie project, it may be recalled, contemplates pumping 6,000,000 gallons of water through riveted pipe, generally 30 inches in diameter, but sometimes 28½, 27½ and 24 inches. The frictional resistance in the 30-inch pipe at the rate of discharge mentioned has been assumed as 3.103 feet per mile, the velocity being 1.888 feet per second. The difference in elevation between the terminals of the main is 1,313 feet, and the pumping plants have been located so that each forces water to some high point beyond it, from which elevation there is a gravity flow to the next station. The estimated cost of the work is $1,000,000 for pumping stations, $9,150,000 for the main, $1,500,000 for reservoirs and $850,000 for distributing pipes, or a total of $12,500,000.

The construction of the pipe line, as finally settled by Mr. C. Y. O'Connor, chief engineer, and Messrs. Deacon, Carruthers and Unwin, consulting engineers, calls for riveted steel pipe for most of the length and about 80 miles of a steel plate pipe, with rivetless dove-tailed longitudinal joints. The engineers recommended laying the pipe above ground to avoid contact with the soil, said to be strongly impregnated with alkali; building it in solid sections a little over 100 feet long, anchored in the middle and resting on proper supports; and fitting it with expansion joints to permit axial motion. The leakage, limiting pressures, life, carrying capacity and cost of such a line and one of wood staves are discussed by Mr. Henny substantially as follows:

The leakage in a pipe line 328 miles long is an important subject. So far as anticipated losses from a stave pipe are concerned, they may be due to leakage proper and evaporation from its surface when exposed. For the estimation of either only measurements of actual losses from existing pipe lines will give the needful information. The first recorded test was made by Mr. A. L. Adams, M. Am. Soc. C. E., on 2½ miles of pipe of the Astoria water-works, described in "The Engineering Record" of May 16 and 30 and July 25, 1896. This section of pipe was filled from the headworks and the gate at the lower end closed; under these conditions no appreciable leakage could be detected.

The second pipe line mentioned consists of 4.3 miles of 14-inch pipe near Los Angeles, a section of the pipe line supplying the National Soldiers' Home with water. The pipe is buried about 24 inches. At each end of the section a concrete manhole, with cross wall and steel plate weir, permitted the measurement of the flow by means of hook gauges, the weirs, the cross walls and the gauges being as nearly alike as possible. Three successive experiments were made, also by Mr. Adams, with flows gradually reduced, in order to increase the relative importance of the leakage, in the last experiment the flow being at the rate of about 32,000 gallons per day. The first two measurements showed a slight excess of flow at the lower end over that of the upper end, probably resulting from unavoidable differences in the finish of the weir plates. In the last experiment the flow measured at both ends was, as nearly as could be measured, the same, showing the pipe to be absolutely tight. The pressure in the Astoria pipe ranged from 0 to 80 feet, the thickness of the Douglas fir staves being 1⅝ inches. In the Soldiers' Home pipe the pressure varied from 0 to 65 feet, and the thickness of the redwood staves was 1⅛ inches.

The third experiment mentioned was made by Mr. Denny and included the combined losses from leakage proper and from evaporation under unusually severe conditions. A 52-inch wooden stave pipe, 968 feet in length, was built to carry the water of the Santa Ana Canal across Deep Canyon, near Redlands, Cal. The pipe has the form of a U, with the sides inclined instead of vertical. The connecting curve has a radius of 300 feet, with its lowest point subject to a water pressure of 165 feet, and is supported by a wooden trestle 50 feet high in the middle. The pipe rests on sills, both on the mountain sides and on the trestle, and is therefore entirely exposed to the hot and dry climate of Southern California. The staves are of redwood, the finished thickness being 2 inches for pressures less than 50 feet, 2.3 inches for pressures from 50 to 100 feet, and the remainder 2.6 inches.

When, upon completion early in July, 1893, it became apparent that it would be a question of months before water could be let into the pipe through the flume, it was decided to fill the pipe by pumping in order to avoid the possibly injurious lengthwise shrinkage, after completion, of the staves, which were not thoroughly dry when put in. At the lowest point connection was accordingly made with a 1-inch pipe leading up from a small pump below, which drew its supply from the creek in the canyon. Pumping continued until the creek finally dried up, the pipe being then filled to within 25 feet vertical of the ends.

The trestle, which supports only a portion of the bottom curve, had settled perceptibly as the pipe filled, and it continued to do so for some time. The effect on the pipe of this settlement was that, as the pipe off the trestle could not follow the downward movement, severe longitudinal strains were induced, which were further aggravated by the breaking of some of the sills under the pipe on the trestle. These strains manifested themselves by the slight opening of the butt joints, many of which commenced to drip. Attempts were made to stop these leaks, but, so long as settling continued, leaks would persistently reappear either where stopped before or at new points. Settlement finally ceased and all leaks were permanently stopped, but this was not until after the end of the experiment. The surface of the water in the pipe, as it gradually lowered, was measured from time to time, with the following results:

Average length of pipe filled. Feet.	Time in hours.	Daily loss, gallons. Total.	Daily loss, gallons. Per sq. ft. exterior surface.	Average pressure at bottom. Feet.
757.5	231	975	0.086	132
708.5	57	597	0.057	123
692.5	93	547	0.053	120

It was impracticable to determine separately the losses from drip and from evaporation, although it may be assumed that a large portion of the loss was due to evaporation both from the water surface at the open ends and from the surface of the pipe.

In the case of the 328-mile Coolgardie pipe, Mr. Henny estimates that the maximum leakage from its 15,000,000 square feet of surface would be 750,000 gallons a day, if the loss per square foot is taken at 0.05 gallon. If the rate is assumed as the same as that in the Astoria and Los Angeles pipes, the total loss would be very small. The engineers of the Australian line estimate the leakage as 5 per cent. of the total flow, or, 300,000 gallons a day.

The pressure which wooden stave pipe can be made to withstand safely depends upon the hardness of the saturated wood, and a working pressure of 200 feet is shown by experience to be a safe practical limit in the case of redwood and Douglas fir. If the staves are carefully selected, there will be no loss from percolation through the wood at the highest pressure when the pipe is buried.

The Coolgardie line, as now located, contains 255 miles, or about 80 per cent. of the total, on which the maximum pressure is 200 feet or less. These pressures are based on the grade lines as determined and laid down by the commission for steel pipe. The lightest gauge to be used is intended for pressures from 0 to 220 feet (for 30-inch pipe), and there was therefore no object in so locating the pipe as to reduce the pressure within these limits, which explains why, with a few exceptions, the location of the line simply parallels the railroad from Fremantle to Coolgardie. Easy accessibility, especially in an uninhabited country, is unquestionably a great advantage, but is not essential, and when stave pipe is under consideration it is customary to be governed, in making location, by the comparative cost per foot of pipe under various pressures. The practical result is generally an economical compromise between an excessively long contour line and a straight line, with heavy pressures. Such a course leads to increased length for the sake of economy, and, in a case like that at Coolgardie, it would also have the effect of greatly reducing the amount of pipe upon which the pressure would exceed the limitation set for stave pipe construction.

The commission recommended that the strength of the pipe be determined from hydrostatic pressure, with the exception of the section between the second and third pumping stations, which has been left subject to pressures from hydraulic grade only. This was done because the method followed for the other sections would have increased the already high pressures some 200 feet on about 36 miles of pipe, and it was therefore recommended that a reservoir be built at one of the intermediate summits. No reason was given why, since any small reservoir, basin or even stand-pipe, placed at hydraulic grade just upstream from a main gate, will give relief and protection against increase of pressure over that due to hydraulic grade, this method was not followed on the other sections, at least in part. With such overflows placed at every point where the pipe line approaches hydraulic grade, even assuming the distance between such points to exceed the desired standard distance between main gates, the pipe line would be divided up into sections, the maximum pressure upon which would be measured by the elevation below that of the nearest overflow upstream. It cannot be believed that the temporary waste of water at the points of overflow would present any serious obstacle. Moreover, it may be presumed that a telephone line will parallel the pipe line, so that it will be generally possible, if so desired, to have the pumps at the head of the section stopped before any gate is closed.

This matter is touched upon here because, with stave pipe, the close relation between cost and pressure renders any inexpensive method of reducing even moderate pressures highly desirable, and it is for this reason that most wooden stave pipe lines now in use have been carefully protected from unnecessary pressures. In case waste of water cannot be tolerated, the same object can in part be attained by the construction, at each summit, of a small basin into which the pipe discharges through a balanced valve operated by a drum float. The section of pipe down stream from this basin cannot be subjected to any pressure greater than that due to the depth below high water in the basin, for, even should the balanced gate fail to act, the basin would then overflow.

In considering the life of pipe lines of this sort it is necessary to distinguish the two cases of pipe buried and pipe exposed. When exposed, the steel bands of a stave pipe can be constantly inspected and repainted whenever deemed necessary, and the life of this portion

of the pipe may be considered sufficiently long to satisfy all requirements. As to the staves, it must be evident that changes of temperature and wind will cause a steady movement back and forth of the limit of saturation within the staves, thus leaving the outer skin of the wood in a condition where it would eventually decay. This decay need not necessarily result in the loosening of the bands, as the wood under the bands would be protected from evaporation; yet it would finally reach a depth where there is a permanent saturation, with a consequent steady increase of the losses from evaporation. Uncertainty as to the effect of a coating of asphalt or paint applies to this subject as well as to that of losses from evaporation.

There are short trunk lines for power purposes in the New England States, which, though built of pine, exposed, and, moreover, at times running but partly full, have seen from 20 to 40 years of service and are still in use, and from sound redwood better results might be expected.

When buried the conditions determining the life of the stave pipe are reversed. Supposing the pipe to be filled at all times, a vital condition to be strictly adhered to, the staves will remain permanently water-soaked for their full thickness and no decay can take place. But the steel bolts and iron couplings will then be in contact with the soil; nor will it be practicable to re-coat them. Hence the endurance of the pipe will then be measured by that of the metal, and will be, to a great extent, dependent upon the protective coating and the character of the soil. On this important subject experience has not been sufficiently long to warrant any definite estimate, and only general conclusions can be drawn. It is important in this connection to disabuse the mind from considering the life of steel pipe as in any way furnishing evidence on this point, for the cases are by no means parallel. The life of an iron or steel pipe is not limited by any consideration of weakened strength resulting from corrosion, but rather by the peculiar pitting action to which the plates are subject. The result is that leaks occur in some places, while at others the plate is yet perfect, and the constant recurrence of leaks finally forces abandonment of the pipe when the actual percentage of metal lost by corrosion is very small.

A forcible illustration of this difference was furnished on a compound wooden and riveted steel pipe line built in the spring of 1896 for the Hollister, Cal., Water Company. In the fall of 1897 a portion of the steel pipe, after having required an ever-increasing expense for repairing leakage through pit holes in the plate (No. 14 B. W. G.) had to be replaced, and, as this portion was near a point of junction of wooden and steel pipe, and the pressure presented no obstacle, it was decided to extend the wooden pipe and connect with the steel pipe beyond where the trouble occurred. The soil in which the wooden and the steel pipe had been buried was adobe, and, so far as could be judged, was identical for both kinds of pipe. The corrosion of the steel pipe seemed to have proceeded mainly from the outside, and it therefore became a matter of interest to note the condition of the steel bands on the wooden pipe. It was found that the asphalt coating had deteriorated, but the metal under it showed hardly any sign of corrosion, and the nuts could easily be turned on the threads. Other portions of the steel pipe (some of it No. 12 gauge) have since been replaced by cast-iron pipe; while, on the contrary, the wooden pipe is, so far as known, in practically the same condition as when first laid.

The oldest continuous stave pipe of any magnitude was built by Mr. J. T. Fanning in 1874 for the Manchester, N. H., Water-Works. The pipe is 72 inches in diameter, banded with ½x2½-inch flat iron hoops, and is buried. It has been in constant use, has required no repairs and is stated to be in good condition, so far as known.

After carefully weighing all evidence on both sides of this question, Mr. Henny concludes that, even assuming the presence of alkali in the soil, a longer life is insured—supposing the bands to be thoroughly coated—when the wooden pipe is buried than when left exposed.

As to riveted pipe, it is, as a rule, buried; the only exceptions which occur to the author being where the pipe had to be frequently moved, as in hydraulic mining and dredging, and occasional short stretches, where special conditions intervene. The life of buried steel pipe is very uncertain. In many cases even light gauge pipe has lasted remarkably well; in others it has had to be abandoned in a very short time.

Of numerous instances, one more may be quoted, showing the short life of light steel pipe laid in alkali soil. Echo Lake and West Lake, forming part of the irrigation system of the city of Los Angeles, are connected by pressure pipe. Originally a 20-inch No. 16 B. W. G. steel pipe was used, about one mile of which had to be abandoned at the end of three years, after considerable expense had been incurred in stopping leaks, which were all the more annoying because of the pipe's location near the center of the city. A No. 14 B. W. G. steel pipe was then laid, which lasted four years, and in the spring of 1895 was replaced by wooden stave pipe.

The lightest gauge for the Coolgardie steel pipe recommended by the experts is 3/16 inch, and, as previously stated, it is proposed to lay this pipe on the surface in order to lessen the danger from corrosion and to facilitate the detection of leaks. A double asphalt coating is specified, all of which may fairly be expected to insure long life for the pipe proper. While the gain in the life of the pipe, in being kept from contact with the soil, cannot be questioned, it may be asked whether this is not too dearly paid for by the necessity of providing and maintaining an enormous number of expansion joints, unless indeed some type of joint can be devised which does not depend for its tightness on rubber or other elastic material promising but a short life under severe climatic conditions and which can be repacked without interrupting the flow in the pipe.

It is interesting to note here that the much discussed question of comparative endurance of steel and iron is disposed of by the commission with the statement that they see no reason for preferring one to the other.

Mr. Henny has generally made use of the Kutter formula for computing the capacity of wooden stave pipe. He was led thereto by the consideration that experiments on new cast-iron pipe show this formula to give fairly constant values for "n" under greatly varying conditions of flow and diameter, and that wooden stave pipe offers in this respect a nearer resemblance to new cast-iron than any other kind of pipe on which a wide range of measurements is available, although it may be assumed to have a smoother interior surface. The value of "n" applicable to new cast-iron pipe was found to be 0.011, 48-inch pipe being the largest size experimented on. The variations from this value are irregular and seem to point rather to probable differences in surface finish and errors in measurement than to incorrectness of the formula itself.

In the case of wood pipe Mr. Henry concludes that for diameters from 24 to 30 inches a value of 0.010 for "n" may be fairly expected. From a commercial point of view it seems essential at times to provide a reasonable margin of safety in estimating the required diameter of a pipe line; for instance where delivery of a stipulated quantity of water is contracted for and where the attainment of even a slightly smaller flow might entail serious consequences, or, as in a case like that of Coolgardie, where the pipe line interlocks with expensive machinery designed to pump and give greatest efficiency for a certain predetermined flow. Should this flow not be attained there would be clearly waste in first cost of pumps and possibly also in subsequent cost of pumping. Hence in such cases the size of the pipe should be based upon what it is reasonably certain to carry, rather than upon what it may carry, and, in using a value of "n" = .011 for 30-inch wooden pipe with low velocities, as in Coolgardie, it is believed that an ample but not excessive margin of safety is provided. From this a value of "c" = 128 would result and a frictional resistance of 1.838 feet per mile. A most important fact in this connection is that, so far as known, the interior surface of wooden stave pipe does not become rougher with age.

The experiments on new riveted steel pipe now available tend to show that the Kutter formula does not apply to such pipe. The more simple Chezy formula, however, gives fairly satisfactory results, at least for velocities of 2½ feet per second and higher, when the value of "c" can be uniformly taken at 110. For lower velocities the value of "c" ranges within rather wide limits. While for a velocity of 1.5 feet per second the value of "c" in the 72-inch Ogden pipe was 111, it was found to be 91 in the 36-inch pipe of the East Jersey Water Company, and, for the same velocity, intermediate values have been found for intermediate sizes. The foregoing refers to new pipe only. Experiments with pipe which has been in use several years show a decided decrease of capacity. For instance, a 48-inch pipe of the East Jersey Water Company gave a value of "c" = 106 when new and = 85 when four years old for 1.5 feet per second velocity. For practically the same velocity the value of "c" in the 36-inch pipe at Rochester, when 14 years old, was found to be 80, and for a velocity of 3.3 feet per second the 24-inch pipe at Rochester, of equal size, gave a value of "c" = 78. The commission of engineers, in estimating the required diameter for the Coolgardie steel pipe, placed the value of "c" at 98. In the light of the above-mentioned experiments it seems doubtful whether sufficient allowance has been made for probable deterioration by tuberculation. If it be conceded that in the course of time the value of "c" may fall below 98, the desired flow of 6,000,000 gallons daily can no longer be maintained even by increasing the pumping pressure, as the pump mains proper constitute but the first and smaller portion of each section of pipe between stations, the remainder being gravity pipe laid with summits near hydraulic grade.

Assuming, for the values of "c," for 30-inch stave pipe, 128, as deduced above, and for 30-inch riveted pipe, 98, as adopted by the commission for the Coolgardie main, the respective frictional losses for a velocity of 1.888 feet per second would be 1.838 feet and 3.103 feet per mile, a difference of 1.265 feet per mile in favor of wood or 415 feet for a line 328 miles in length. The total pumping head, in the case of Coolgardie, was stated to be 2,605 feet, and a decrease of 415 feet would mean a reduction equal to 16 per cent. In justice to riveted pipe it should be stated that the above comparison would hold good only in case the wooden pipe were buried by reason of the necessity of providing for losses from evaporation, which would materially change the results.

Considerations of effect of pressure on cost, limiting pressure and differences in frictional losses make it essential that location should be made with special reference to the kind of pipe to be considered.

Under conditions as regards freight rates, etc., similar to those stated in the chief engineer's report as applying to the Coolgardie main pipe line, the cost of 30-inch redwood stave pipe, laid and buried, may be estimated at $1.70 per foot for pressures less than 20 feet, increasing gradually with the pressure to $3.90 per foot for 200 feet pressure. The cost of the steel pipe was estimated by the chief engineer at $5.29 throughout for all sizes and weights and inclusive of fixtures.

What would be the resulting economy in the use of wooden stave pipe for a portion or all of a main like that at Coolgardie is a question upon which Mr. Henny does not wish to venture. He states, however, that while it is true a stave pipe location generally shows a greater length of line than that for steel pipe, such additional length would result from economical considerations only, and would be the cause of a reduction rather than an increase of total cost. In a case where water is to be pumped, the cost of main pipe line is not the only point to be considered. If, owing to lesser friction in stave pipe, the total pumping head be reduced, a reduction in the first cost of pumping machinery would result, and a corresponding reduction would follow in the annual cost of pumping, which, in the Coolgardie case, is estimated by the chief engineer at over half a million dollars. Should, in a similar case, a saving of 16 per cent. in these items result, as was estimated, it is evident that there might be substantial economy in the use of stave pipe, even at a greater cost per foot than riveted pipe.

THE PROTECTION OF METAL WORK.

A lecture on the "durability of structural materials" was recently delivered before the students of engineering at the University of Wisconsin by Prof. A. H. Sabin, of Edward Smith & Company, New York City. It was largely a statement of his views on the best methods of protecting metal work, a subject of such general interest to engineers and architects that advantage is taken of the courtesy of the "Wisconsin Engineer" to print the address in these columns.

They say there are oak timbers in the roof of Westminster Hall which have been in use 1,000 years. In the village where I live there is a meeting house which has been regularly used more than 200 years, and dwelling houses built a generation before, that are still regarded as desirable residences. For all that, houses 100 years old are rare, those which are 50 are usually pretty well worn out, and very many houses and barns entirely disappear in 25. So we see that the durability of structural materials must depend in a great measure on the conditions in which they exist, and particularly on the care taken of them.

Iron, especially in the form of steel, has within a few years become a comparatively cheap and common building material; and in view of the fact that important iron structures have been almost completely destroyed by rust in as short a time as 25 years, and single members of structures have lasted from one to five years only, the question of its preservation becomes one of importance. I suppose that few bridge engineers think a steel bridge is likely to last 50 years, and if it is possible to make a steel structure last from 200 to 1,000 years it is worth while to know how to do it. As a matter of fact, we really know a good deal more about the preservation of iron than we do about the preservation of wood. The latter is subject to attacks by fungi, bacteria, various insects and other forms of animal life; the former only by chemical agencies, and in a few comparatively well-known ways.

Practically the only things which attack iron are oxygen, sulphur, and, to a limited extent, carbonic acid. Sulphur acts in the form of sulphides and sulphates, and all act in conjunction with water, which is in most cases necessary to chemical action everywhere. It certainly seems as though we ought to be able to check and prevent chemical action when it is of such simple and well-understood kinds; at all events that we should not shut our eyes to it.

The first thing to do, and it is also first in order of importance, is to prepare the surface of the metal. If this is very rusty it is practically useless to paint it; if covered only with black scale there is no doubt that advantage is derived from the use of a good paint, which in these cases affords considerable, though incomplete, protection to the metal; but if the best results are expected the whole of the scale, which is usually oxide, must be removed, so that the paint may be applied to the surface of the metal. This may be so difficult and expensive as to be unprofitable. It may be cheaper to do a less durable job and replace the structure after a time, or the structure may be a temporary one; but if the best results are sought it is necessary to clean the surface perfectly. This may be done by the sandblast or by pickling in acid, or in case the pieces are not too large by grinding the surface on an emery wheel or belt, or by scraping and filing; and when it is done the paint must be applied immediately. If there is any delay a film of oxide (probably hydrate) will form, to get rid of which all the previous work was done. When this first coat is properly applied the most difficult and costly part of the work is done.

But suppose, as is the case with most work, you do not find it practicable to secure such a perfect surface, what then? In the first place examine the surface carefully and note all the rusty places. Have a lot of scrapers made, some of them broad and flat, others narrower, some quite narrow; some of these should be bent like a hoe or rake, and some should have serrated edges, and all should be large enough so that the operator may exert a good deal of force on them; large and small chisels should also be at hand, and stiff wire brushes. With this outfit the surface should be vigorously scraped and scrubbed until the inspector is satisfied that all the scale which is at all loose has been removed, and that all rusty spots have been cleaned out as thoroughly as possible. A great part of the mill scale will resist this treatment; but it must be assumed that scale which adheres so firmly will not be dangerous if well painted, and at any rate all the dirt and grease have been scrubbed off.

Then apply a heavy coat of paint, and as soon as that is reasonably dry put on a second. Our common notions about painting metal are derived from painting wood, and are often fallacious, notably in the matter of a so-called priming coat. Suppose we are to paint a new clean piece of wood with an ordinary pigment paint. The latter consists of a solid in the form of powder mixed with half its weight or thereabouts of linseed oil or other vehicle. If this paint is spread on the wood the oil is absorbed quickly, leaving the pigment on the outside with so little cementing material that it will brush off when it gets dry. Obviously the remedy is to mix a special paint for this first coat composed of nearly all oil with a little pigment; the oil serves to fill the pores of the wood, so that the next coat of paint will be applied to an impervious surface; or for that matter the first coat may be oil alone. This first coat of very thin paint is called a priming coat. Now, when the house painter who has been carefully trained to this routine is set to painting an iron bridge, he proceeds to apply a priming coat, just as thin as possible; and, incredible as it may seem, some of the large manufacturers make what they call a priming coat for metal. The whole thing is the climax of absurdity. The first coat of paint on bridge work should be as thick as will lie smooth and dry thoroughly; and the second should be like unto it. Nothing is likely to be more wearisome to the soul of an intelligent man than this talk about a priming coat on bridge work; except when it becomes amusing, as was the case when a paint manufacturer assured an engineer of my acquaintance that his paint would soak into an iron plate a sixteenth of an inch.

The paint should be applied only in dry weather, if it is used out of doors; but if it is new work the metal should be kept under shelter, and it is better if the building in which it is should be kept warm in cold weather, until the first coat of paint is dry. Surfaces which are to be riveted together ought to receive two heavy coats of paint, and this should be reasonably dry before riveting; if it is freshly painted the hot rivet will drive the paint away from the rivet hole, but if the paint is dry no such thing will occur. When painting is done out of doors, as is commonly the case with a second coat, it is often interrupted by storms; recently I walked through a yard where such work had been going on and saw the paint buckets standing about where the driving rain could beat into them, and in one case I saw half a gallon of paint mixed with about 20 per cent. of water; this was enough to paint a very large post or girder; and when subsequent corrosion is discovered, as it is likely to be if inspection is made, the cause will be a mystery, and the blame will probably be laid on the paint manufacturer. Many workmen are careful and intelligent; they are not the ones we need inspectors for. The inspector must assume that, as was shown in this case, there is nothing too stupid or careless for the workmen to do, or too tricky and dishonest for the contractor. I do not think that as a rule contractors are dishonest; but many are, and many of the rest are ignorant, which is, in its effect, nearly as bad. What the engineer is hired for by his client is to supply the scientific knowledge needed for the work; if the contractor has it also it is an excellent thing, but that does not release the engineer from the performance of his duty. In this matter the duty of the engineer is to select the best paint, according to his judgment, and see that is is applied properly. If he thinks a particular paint is the best he ought to specify it explicitly, and for that matter do the same with all materials. I have no patience with specifications which do not specify; the contractor does not know what he is to use; the owner is not properly protected; and the engineer is likely to be involved in endless disputes.

To protect iron or steel from corrosion it is only necessary to surround it with something which shall completely keep air, water and acid gases from its surface. If the metal were to be further protected from all agencies which would destroy this protective covering, and if the coating material itself were absolutely unacted on by these external agencies, the problem would be solved. But as a matter of fact none of these desirable conditions are maintained. In the first place it may be doubted whether the preservative coating is ever quite continuous, though perhaps it may be practically so; but certainly it is liable to be removed by blows, scraping and attrition; and nothing has yet been discovered which will last forever. So we must apply the best coating material we can get, then watch it carefully, and renew it whenever it is injured; and in this way I am inclined to believe that a steel structure may very well be made to last 1,000 years.

AN EXTENSION TOWER DERRICK.

In order to avoid the time and expense involved in moving traveling, guyed, mast and boom or trolley derricks and travelers from story to story, as they set the successive tiers of beams and columns in a tall steel building, tower derricks are sometimes employed. Examples of radically different types have been illustrated in "The Engineering Record" of April 17 and June 12, 1897. The first case was in the erection of a steel-cage office building in Milwaukee, where a tower was built in advance in the center of the building, so that its two booms could command all the floor space. They were at first set near the ground, and as the framework rose were slipped up to correspond

on a vertical sliding bar. The second case was in the Baltimore City Hall, where the building, covering an entire large block, was erected by six stationary tower derricks, each having two

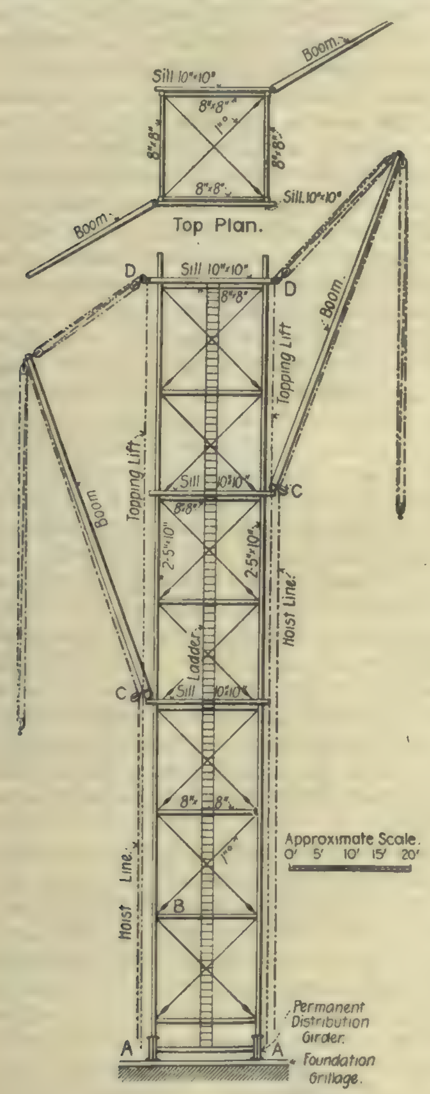


FIGURE 1.—DERRICK TOWER.

elevated booms, operated by a special hoisting engine on the ground, which was driven by a line shaft from a central power plant. The Woodbridge Building, New York, which contains the editorial rooms of "The Engineering Record," occupies the entire width of one end of a large block, and its steel-cage construction was assembled by a stationary tower derrick 150 feet high, erected in the center of the lot, so as to command every part of the building with its two booms. About a year after the completion of the Woodbridge Building, the contractors who had erected it erected a smaller tall steel office building on Maiden Lane, only a few hundred feet away, and used for the purpose a derrick that was identical with or very similar to the one used for the Woodbridge Building. From sketches and a photograph made while the derrick was in service, the accompanying illustrations have been made to approximate scale and detail, and give the correct arrangement and features of connections.

The building stands on grillages of rolled steel beams, and after these had been placed the lower panels of a light tower, about 18 feet square, were set on them. Two booms, about 60 feet long, were attached to opposite corners some distance above the ground, and handled the first tiers of steelwork without requiring very long lines. When the skeleton was built up nearly to the level of the booms the latter were used to build on a couple more panels of tower. Then one boom was unshipped and replaced higher by its companion; after which the upper boom could build on another section of the tower and set the lower boom at its own level or higher immediately, or the booms could remain at different heights till the framework reached the upper one, when the lower one had to be raised in order to shift the upper one, and so on, extending the tower indefinitely as required.

After the building was erected the tower could either be taken down by reversing the process of putting it up by its own booms, or it could be taken apart by fixed tackles suspended from the permanent framework. In either case the connections of its different members were quickly assembled or separated, and as most of the corresponding members were duplicates they were to a considerable extent interchangable, and a few marks served to identify them. Except the booms, all the pieces were light and short, making it easy for a few men to handle them, and to store and ship them. A few men could extend the tower by the use of one boom without materially interrupting the main force at work on the building.

The tower was securely anchored to the heavy foundation girders, so as to be independently stable without guying, and it was operated by a stationary hoisting engine, conveniently located on the cellar floor. All the connections were bolted, generally through iron plates, and the diagonal rods were all pin-connected and adjustable by sleeve nuts, so that the tower

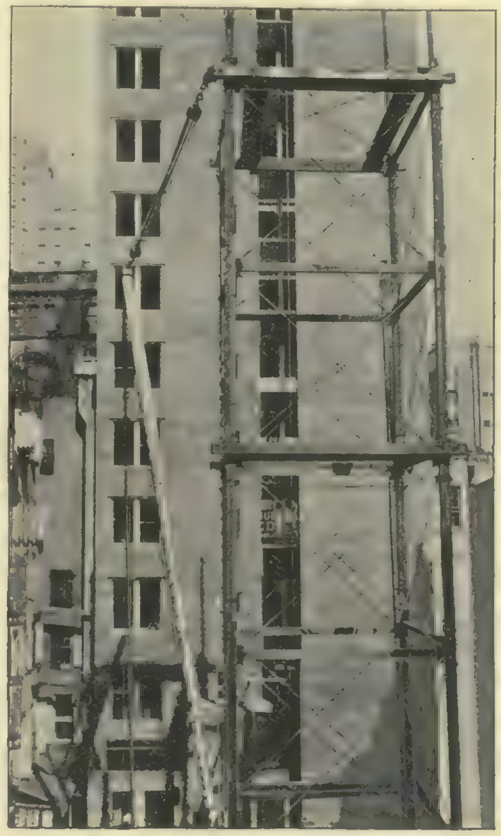


FIGURE 3.—VIEW OF TOWER.

could be straightened in any direction and everything kept snug by initial tension. All the compression members were made of wood, and all the tension rods of iron or steel. The four corner posts were 10 inches square, each made of successive lengths of 5x10-inch timbers in pairs, arranged to break joints in alternate panels just above the panel points, so that the last piece always provided a firm splice for the succeeding one. The halves of each post were fastened together by two-part flanged iron collars at intermediate points and by four-part collars receiving the pin-connections for the horizontal diagonal rods at every second panel, and were also secured by the through bolts for the connection plates. There is an 8x8-inch horizontal strut at every panel point in each side, and each end of each strut is pin-connected to a U-plate, secured to the post by two through bolts parallel to the strut. One pair of struts is set 4 inches higher than the adjacent pair and at right angles to it, so that the connection bolts shall not interfere. The vertical diagonal rods, although entering between the wings of the U-plates, are not pinned directly to them, but have forked loop ends, engaging eyebolts that piece the plates and help secure them.

The corner posts serve as masts, to which any number of booms may be attached, but only two were used on this work. Whenever it wais required to set a boom a 10x10-inch horizons it sill-piece was bolted across any face o'cur in tower at the panel points, its ends wr ng a longed by iron jaw-pieces, which gav and to vertical pins, far enough awae custom has corner of the post to give clearane total number piece of the booms, which thine to 12 or pos- similar connection was prosure of 115 pounds crosspiece two panels a/e as it is necessary to engaged a pivoted shne to get the best econ-

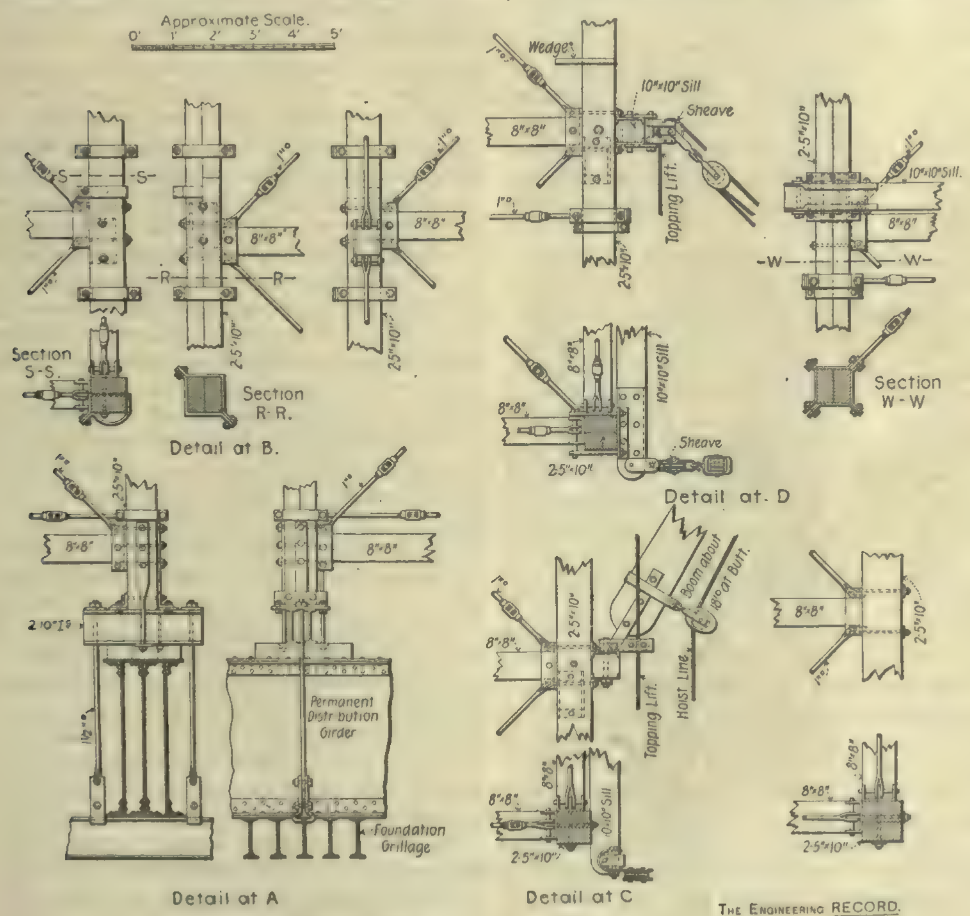


FIGURE 2.—DETAILS OF TOWER AND BOOM CONNECTIONS.

sheaves for the lines of the topping lift. The sills were set approximately at the levels of the diagonal horizontal lateral rods. Each boom was thus free to revolve through a horizontal arc of fully 270 degrees, and by the provision of five sill-pieces the two booms could be shifted independently of each other, and eight booms might have been simultaneously operated from them. Actually, however, both booms were often set from the same pair of sills, and these, with an extra one for shifting, or three in all, usually sufficed. A general elevation of the tower is shown in Figure 1, which does not differ materially from the elevations of the other three sides. The different details shown in Figure 2 are enlargements at the points indicated by the corresponding reference letters in Figure 1. A view of the upper part of the tower is shown in Figure 3, which was made from a photograph taken from the roof of an adjacent building. The sketches from which Figures 1 and 2 were made were partly taken from the roof of the building at the left of Figure 3.

Levering & Garrigues, engineers and contractors, New York, designed and constructed this derrick, and have used it for the two buildings mentioned, and for others where the conditions were suited to its operation.

CYLINDER RATIOS FOR COMPOUND ENGINES.

The question of cylinder ratios for compound engine was discussed by Mr. George I. Rockwood, M. Am. Soc. M. E., in a paper read before the Providence Association of Mechanical Engineers on December 22. Those engineers who have from time to time read in "The Engineering Record" of the remarkable success of the compound engines arranged with large cylinder ratios, advocated by Mr. Rockwood, will be interested in reading that gentleman's reasons for the position he has taken, which are given in the following paper:

The conviction that everything is now authoritatively settled about the design of the steam engine seems to have become a deeply rooted one in the minds of those who write text-books on thermodynamics and heat engines; and, in a certain general sense, this conviction may be true. The steam engine of James Watt, considered as an automatic mechanism, was not different in any essential particular from the steam engine of to-day. Even the compound engine was first proposed over a century ago. It is certain that the phenomenon of cylinder condensation was quite well understood at least three-quarters of a century ago, and the last word of theory may be found in Cotterill's treatise, "The Steam Engine Considered as a Thermodynamic Machine."

But, though it may be admitted that it is next to impossible to devise anything really new in principle connected with the steam engine, this is very far from saying that actual steam engines to be had in the market to-day are all characterized by the same features, or that they may all be bought for the same price. One has but to examine the advertisement sheets of an engineering journal to be convinced that the problem of selecting an engine of the best kind, size, proportions and speed for a given duty is at present beyond rational solution. Shall the best engine be upright or horizontal? Single or double-acting? Shall it have four valves with automatic drop cut-off, or two valves, or one positive valve? What shall be its speed? Shall jackets be used, and if so, on which cylinders? What about the real advantages of reheaters and superheaters? What shall be the boiler pressure? In most cases nowadays not one of these questions, so vital to the cost of the engine and steam plant, is necessarily answered by the conditions under which power is to be made, but its answer depends upon the opinion—or more likely the prejudice—of the purchaser. The truth is that while the modern steam engine is sufficiently complicated as a scientific and mechanical problem to account for the difficulty in estimating the relative significance of each element conducing to economy of steam, financial considerations—in other words, considerations of the net return on the total investment in the power plant—are even more fundamentally responsible for this uncertainty. Theory may show, for instance, a way to reduce a certain waste of heat by some elaboration of the steam plant, but owing to the fact that "fixed charges" and the cost of repairs, as well as of heat, are also items in the total cost of power, this particular waste must perhaps be allowed to go on until the cost of the means for reducing it has itself been cut down. The cure may be worse than the disease.

The subject of this paper suggests one of the problems in the practical design of the steam engine still pressing for recognition and solution. Although great numbers of compound Corliss and marine engines have been built within the last 25 years, it is nevertheless a fact that next to nothing was known experimentally previous to 8 or 10 years ago in regard to the most economical ratio of cylinder volumes. The ratio was, and still is, fixed within narrow limits in all compound engines, whether built in this country or in Europe. Continental manufacturers have favored a proportion varying from the ratio 1:2.75 to the ratio 1:3.25. English and American builders have generally adopted a slightly larger ratio, namely, one varying from the ratio 1:3 to the ratio 1:4. A common rule is to make the diameter of the low-pressure cylinder 2 inches less than twice the diameter of the smaller cylinder. The explanation of this rule is found in the fact that an engine so proportioned avoids more than a very slight drop in pressure from that at the end of expansion in the smaller cylinder to the pressure at cut-off in the large cylinder, with reasonable ratios of expansion in each. When "drop" occurs, it is because (at least the great engineering authorities have agreed that it is solely because) free expansion takes place; that is, a sudden enlargement of the volume of a gas without doing work against a piston, as in suddenly opening a cock in the pipe joining two cylinders, one full and the other empty of gas. Since free expansion of a working gas undeniably lowers the working pressure of that gas, any loss which such a lowering of pressure would entail may be obviated by preventing the free expansion. Hence, it is said, in a compound steam engine it is best to avoid "drop."

For 30 years this reasoning has controlled the design of the compound engine. During this time boiler pressures have been increased from an average of 80 pounds or 90 pounds to an average of 115 pounds or more without affecting the cylinder proportions generally used by engine builders. In this they have been supported by most authorities. In fact, so far as I can learn, but one authority—Carl Busley, Professor at the German Imperial Academy at Kiel—would make any change in the cylinder ratio with different boiler pressures. He gives specific ratios for various boiler pressures as follows:

Pounds per square inch....	60	90	105	120
Ratio	1:3	1:4	1:4.5	1:5

In the article on the steam engine in the "Encyclopedia Britannica," by Professor Ewing, may be seen the following statement: "Whenever a receiver is used, care should be taken that there is no unresisted expansion into it: in other words, the pressure in the receiver should be equal to that in the high-pressure cylinder at the moment of release. If the receiver pressure is less than this, there will be what is termed 'drop' in the steam pressure between the high-pressure cylinder and the receiver, which will show itself in an indicator diagram by a sudden fall at the end of the high-pressure expansion. This 'drop' is, from the thermodynamic point of view, irreversible and therefore wasteful." This statement by Professor Ewing is fairly typical of the confident language used by all of the most eminent authorities on the steam engine when discussing the practical effect of "drop." It is a noteworthy fact that at the time when it was written, 1886, no one had ever made any experiments on actual compound steam engines to determine the effect of permitting "drop" even on an engine with a fixed ratio of cylinder volume; still less had it ever occurred to anybody, so far as I know, to determine experimentally whether a gain or a loss would follow the adoption of larger cylinder ratios than that ratio which is small enough to prevent "drop" almost entirely. Since there were no experiments at hand to support the statement so positively made in the "Encyclopedia Britannica," and therefore no truly scientific basis for it to rest on, one can but wonder at its almost universal acceptance by theoretical and practical men. I am, of course, referring to the inference drawn from the last sentence quoted, to wit: "This 'drop' is, from the thermodynamic point of view, irreversible and therefore wasteful." The sentence itself is true enough, but the caution based on it is not logically connected with it, because it is too often the case that things, slightly objectionable per se, are inseparable companions of other things which are necessary or indispensable.

I have sometimes thought that the impression left on the reader of "explanations" of the effect of "drop," of the sort generally found in text-books, is that "drop" produces a lowering of potential, as it were, without any compensating effect—such as would be produced by turning a stream of water on the receiver. Certainly the drop in pressure and temperature of the receiver steam produced by sudden and violent radiation or condensation is a totally different thing from drop resulting from intermediate expansion; but one might be excused for thinking that authorities lumped both kinds of waste in the same condemnation. In D. K. Clark's "Rules, Tables and Memoranda," pages 854-855, occurs the following suggestive discussion of the influence of "drop": "That the work of expanding steam is to be calculated from the expansion upon a moving piston only is obvious enough when it is considered that the steam may expand into an intermediate receiver and into intermediate passages without doing any work on a piston, whilst at the same time the pressure falls or 'drops' as the volume is enlarged. Under these circumstances the second cylinder receives the steam at a lower pressure and in larger volume than it has when there is no intermediate expansion and fall of pressure, and there is less work done, whilst the ratio of active expansion is necessarily reduced. If the second cylinder, however, be enlarged in capacity in proportion to the enlargement of the volume of steam and the fall of pressure by intermediate expansion, the ratio of expansion and the work done in it would remain the same." These quotations, considered by themselves, would commit Clark to the common belief that "drop" produced by intermediate expansion causes a serious waste. He goes a little farther in the right direction than others have done, however, in the suggestion that the waste occasioned by "drop" may be balanced by enlarging the second cylinder; but he does not, in this immediate connection, draw attention to the fact that the loss in pressure of the receiver steam, due to the practice of taking more steam by volume from the receiver than it gets from the high-pressure cylinder, is accompanied by an increase of work in the high-pressure cylinder. That is, the back pressure in that cylinder is reduced at the same

time with the reduction of the initial pressure in the low-pressure cylinder. Hence the loss of power occasioned by receiver expansion, though it exists, is really very much less than Clark implies in the quotation, and with high boiler pressures and moderate amounts of "drop" is even, from a thermodynamic point of view, quite insignificant. Again it is not the statement of fact which the authority quoted makes that I take exception to, but his inference of the bearing of that statement on the design of the actual compound engine; and also, in this case, the fact that he here leaves unsaid that most important modifying consideration pointed out above. This is not to say, however, that Clark did not himself point this out in another place; but had he done so here he would not have left so unqualified a feeling of distrust toward free expansion. It simply illustrates the confusion of mind of authorities as well as builders with reference to this subject.

I have referred to the universality of the belief in the error in permitting "drop" in the receiver of a compound engine, and to the lack of any foundation for this belief in direct experiment on actual steam engines. I have shown also that this belief was based on considerations derived from pure theory—in fact, from the science of thermodynamics. I myself hold, as a result both of speculation and of experience, that, while the waste attributed to "drop" is a reality, and its amount may be computed if the amount of "drop" is known, such waste is not necessarily a controlling factor in determining the ratio of the cylinder volumes. Indeed, it is incomprehensible to me how the distrust of receiver expansion grew to such proportions and became all powerful in the design of compound and triple expansion steam engines. Perhaps it is the result of the idea widely held not many years ago that the real cause of "drop" was simply initial cylinder condensation and clearance in the second cylinder. The receiver space was said to be as harmful as so much extra clearance, and it is wonderful what efforts and oddities of design were put forth, especially in the design of pumping engines, to lessen the distance between the exhaust port of the small cylinder and the steam port of the larger cylinder, with a view to minimizing the alleged uneconomical influence of a large receiver volume. I believe this view is all wrong, and probably most engineers would agree with me; yet it is apparently still held in some high places. In a leading article on "Intermediate Expansion" in "The Engineer" (London) no longer ago than 1891 occurs this passage: "All intermediate receivers, port spaces, clearances, etc., mean intermediate expansion." In the same breath the writer goes on to say, "* * * the size of the intermediate receiver has no practical influence on the performance of an engine." It is pretty well demonstrated that what is ordinarily called clearance is a chief cause of preventable waste; and if the receiver is really to be classed in the same category with, and as an addition to clearance, its great size would inevitably affect the steam consumption very adversely, which, as "The Engineer" says, it does not. In the issue of December 2, 1898, "The Engineer," in a leading article on "Compression in Steam Cylinders," reverts to this same thought in these words: "Nothing has been said about compression in compound engines. There is, however, no room to think that the effect will be materially different, whatever the number of cylinders used, at all events so far as the high-pressure cylinder is concerned; both the others work with maximum clearance in the sense that the receivers become, ipso facto, part of them twice in every revolution." Yes, but only during admission, and in the usual cross-compound engine, with large reheating receiver, the fluctuation of the receiver pressure, due to the discharge of steam into the low-pressure cylinder, is hardly greater than that of the boiler supply pipe pressure, due to the discharge of steam into the high-pressure cylinder. In one case the piston of the first cylinder pushes out a cylinder full of steam into the receiver, and a somewhat larger volume is discharged therefrom into the second cylinder; but in the other case the boiler does not make steam so fast as the high-pressure cylinder withdraws it during the period of admission, but only one-third to one-fifth as fast, depending on the point of the cut-off. Both cylinders therefore work under conditions practically identical, and neither boiler nor receiver can be properly classed as additional and objectionable clearance space. Nothing but confusion can result from associating intermediate receivers in the same category with clearance spaces. It is especially incorrect to urge "that all intermediate receivers, port spaces, clearances, etc., mean intermediate expansion"—that is to say, "drop." "The Engineer" has, however, been for many years a consistent advocate of the idea that "drop" was a very small influence against the economy of a compound engine.

Quite a little has been done of late years in the way of experiment to find out the effect of "drop" in marine engines. A paper was read in 1893 before the Institution of Naval Architects of Great Britain, giving the results of a feed-water trial of a triple expansion engine with and without its intermediate cylinder. The result was very much in favor of the three cylinders, as might have been predicted under the conditions of operation. The loss due to an enormous "drop" was the cause of the inferiority of the performance of the compound engine. With a boiler pressure of 125 pounds, the M. E. P. of the first cylinder was 100 pounds. That is to say, there was next to no expansion of the steam before release in that cylinder. This paper was considered by many engineers at that time to supply incontestable evidence of the wastefulness of intermediate expansion. That is, because a drop of 100 pounds caused a loss, therefore all drop, under all circumstances, should be avoided. But this is not the only source of information on the performance of compound marine engines in which considerable "drop" is allowed. Mr. H. Crompton Ashlin, Consulting Engineer, of Liverpool, declared in a letter published in "The Engineer" dated April 3, 1893, that it has been practically known for years, to some Liverpool engineers at any rate, that high-pressure compounds can be worked at 150 pounds to 160 pounds pressure with as good results in consumption as the best triples worked at the same pressure. In a later issue Mr. Ashlin gives a short history of his efforts in this direction. His firm had at that time converted the engines in some eight steamers from the old style compounds into high-pressure compounds, the result being that, "whilst maintaining the original speed, the consumption of coal has been reduced to the same amount as would have been used if triple engines had been substituted."

Let us consider now what are the causes of "drop" and then what are the advantages which accompany its moderate use.

The causes of "drop" are of two kinds. The first kind is the one we hear the most about, namely, "intermediate expansion." When more steam by volume leaves the receiver than is put into it, per stroke (presupposing that no steam is either made or condensed in the receiver itself), the receiver pressure is bound to be less than the pressure at release in the high-pressure cylinder. This is simply saying that the pressure of a gas or vapor at constant temperature bears a fixed relation to its volume. The other causes of "drop" are cylinder condensation and clearance in the low-pressure cylinder. Suppose a receiver compound engine had neither clearance or condensation in the low-pressure cylinder. There might still be any amount of "drop" if the cut-off on that cylinder were lengthened enough. On the other hand, if the cut-off were adjusted just right to prevent any "drop" in such an engine, and then that cylinder were endued with both the usual amount of clearance and of condensation, probably at least 15 pounds of "drop" would be the immediate result. Again this even then could be prevented by making the cut-off earlier in the stroke. It is thus obvious that the point of cut-off may be a cause, or it may be a corrective, of "drop." But the point of cut-off is dependent on other considerations than its influence on the amount of "drop." As a matter of fact, it would be desirable to have the cut-off take place late in the stroke, were it not from the loss of excessive free expansion thereby involved, because this would reduce the range in temperature of the low-pressure cylinder walls, and hence would reduce the loss from initial condensation in this cylinder.

It is evident from the foregoing that, unless the best point of cut-off, estimated solely with reference to the waste by initial condensation, happens to coincide with that particular point at which "drop" would be entirely prevented, a compromise must be made between the gains on the one hand to be made by lengthening cut-off and thereby reducing condensation, and the loss on the other hand thereby incurred from free expansion. It does happen that with cylinder ratios in the neighborhood of 3:1 no such compromise need be made, because both considerations suggest the same point of cut-off; but with larger cylinder ratios, such as 5, 6 or even 7 to 1, some "drop" is inevitable, and it becomes a question just where to locate the points of cut-off in both cylinders, so as to secure a minimum net loss from clearance, intermediate expansion and initial cylinder condensation. If "drop" is accompanied by a reduction of initial condensation in the second cylinder in amount sufficient to overbalance the waste of power by intermediate expansion, it is, at least, no detriment to the coal consumption to allow that much "drop." Moreover, in stationary engine practice, few engines drive perfectly uniform loads. Nearly all light, heat and factory loads are decidedly variable, and engines most suitable for driving such loads are compound condensing engines, working with considerable "drop," because this permits a widely variable cut-off in the second cylinder without either looping at the end of expansion in the first cylinder or materially changing the receiver pressure. It is seen, therefore, that the advantages of "drop" are of both a thermal and practical nature.

Having now dealt at some length with the subject of intermediate expansion and its relation to the subject of this paper, let us proceed to consider the general theory of the compound engine. As an abstract proposition, the highest economy to be realized in an engine of any type is the result of two conditions—using a volume of steam at the highest possible pressure, expanded the utmost number of times. In practice both the pressure and the number of expansions are limited by practical circumstances; the pressure, by the increase in cost and maintenance of the boilers and piping, as the pressure is carried up, and the total ratio of expansion, by the increase in the waste due to cylinder condensation, friction and repairs. All authorities, I believe, are agreed that there is a certain minimum number of expansions allowable in any one cylinder of any type of engine. This number is between four and five. Now, as it happens that practically no "drop" will occur in the receiver of a compound engine having a cylinder ratio of about 3:1 and between four and five expansions in each cylinder, the custom has been, and it still is, to limit the total number of expansions in such an engine to 12 or possibly 15. And a steam pressure of 115 pounds is about as high a pressure as it is necessary to have with such an engine to get the best econ-

omy. A higher pressure will enable the engine to do more work, but the number of expansions would remain the same, and hence the rate of steam consumption would hardly be affected at all thereby. So, if higher pressures are to be used, with the object of improving the economy of the engine, the only way to do it, according to the received theory, is to add another cylinder in series. The average boiler pressure in use with the triple expansion engine is 150 pounds to 160 pounds. With such a pressure and with cylinder ratios of usual proportions—say 1:2.75:6.5—the number of expansions allowed in each cylinder in less than the four or five mentioned above. It is more likely to be 2.5 to 3. This is because the 150 pounds is not nearly high enough to permit the larger number without developing too little pressure at release in the low-pressure cylinder.

The triple expansion engine, or shall I say the multi-cylinder engine—how grand the name sounds!—holds a firm place in the affections of the college-bred engineer. What a complicated thing it is! How glorious to be able to say, "I comprehend it. I can design it and make it go without any 'drop.'" He longs for the time to come when, in the natural evolution of the multi-cylinder idea, he may have a chance of designing a quintuple, or even a sextuple, steam engine. Unfortunately for this vision, recent developments in the design of the steam engine for stationary work seem to have put the time of its fulfilment yet a long distance off. In the year 1891 "The Railroad and Engineering Journal" published an article written by myself with this title, "How Many Cylinders will it Pay to Introduce in the Multi-Cylinder Engine?" This was a very brief discussion of the theoretical and practical utility or uselessness of the intermediate cylinders of a multi-cylinder engine, and was written before any experimental data were available to reinforce the position taken, which was that these cylinders were of no theoretical or practical advantage as aids to the economical operation of the engine. At that time a triple expansion engine was being constructed, and the opportunity thus presented of arranging the intermediate cylinder so that the engine could be run without it was embraced, and the following year numerous tests of this engine, with and without its intermediate cylinder, appeared to show that on that engine the second of the three cylinders was of no advantage. This was with reference to the economy of producing an indicated horse-power. The friction of its piston and valve gear, not to mention the interest and fixed charges on the investment, made it a considerable loss per delivered horse-power.

Since the tests of this triple expansion engine were made, eight other large engines, built by the Wheelock Engine Company, on lines which these tests indicated to be correct, have been tested by the following engineers: Two by Professor Geo. I. Alden, A. S. M. E.; one by Francis W. Dean, A. S. M. E.; three by Geo. H. Barrus, A. S. M. E., and two by myself. In all, the same builders have built about 25,000 horse-power of these compound condensing engines, and each engine was sold under agreement to use not over 12½ pounds of dry steam per I. H. P. hour. In some cases the engines were not at first complete mechanical successes, and in one case this extended to the tightness of the valves and pistons, etc., causing a greater steam consumption than that guaranteed. In all of the other cases, however, so far as I am informed, the guarantee was surpassed. The very best performance of any mill engine which has been tested by recognized and competent experts is one of this type running at the mills of the Grosvenor Dale Company, and tested by Mr. Barrus, who published his report in "The Engineering Record," Nov. 20, 1897. The steam consumption was 11.89 pounds total per I. H. P. per hour, and the coal consumption was 1.18 pounds! The average I. H. P. developed by the engine during the test was 660. If such a result as this had been announced over the signature of Mr. Barrus or any other expert a few years ago, he would have simply forfeited his reputation for veracity for the time being. I believe, nevertheless, that a pumping engine of largest size, working with practically no clearance, with steam at a boiler pressure of 180 pounds and a cylinder ratio of 8:1 would give the horse-power on a consumption of less than 11 pounds of steam and a coal consumption of one pound per I. H. P. hour.

To appeal to the best recorded performance of any type of engine, working under every-day conditions as to tightness of valves and pistons, as to clearances, and as to the operation of the jackets, etc., as a proof of the superiority of that type as compared with all other types, while being a thoroughly practical, is also a distinctly unscientific, manner of procedure. Besides introducing possible errors or deviations from the very best result of which that type is capable, due to unknown amounts of leakage, etc., another error to which all tests are open, namely, the instrumental one, resulting from the fact that the different engines tested are situated in different parts of the world, and are tested by different experimenters whose personal equations are unknown—this error, I say, makes such a comparison of very secondary importance as a guide for the future. If some one having the opportunity would test the most economical triple expansion engine anywhere to be found, working with a boiler pressure of 160 pounds and a vacuum realized in the low-pressure cylinder of 13½ pounds, both with and without its intermediate cylinder, and have as his object to determine the heat required per brake horse-power per hour by this engine in each case, I think—but I do not, nor does any one else know—that the result would show the advantage to lie with the simpler form of engine. Such a comparative test would be a truly scientific one, and the knowledge thus obtained would be definite and compel our assent to its authority.

In the absence of such a perfect series of tests as I have outlined, we may, at least, be interested in, and allow our judgments to be influenced by, the tests made on the comparatively uneconomical and, because of its small size, low boiler pressure and poor vacuum, unrepresentative triple expansion experimental engine in the laboratories of Sibley College, Cornell University. These tests are reported and very fully discussed in a paper in Vol. xix. of the "Transactions of the American Society of Mechanical Engineers." It would be impossible to quote from the language of this paper and do justice to it within the limits of my time, and I will simply call your attention to it and quote from Mr. John H. Barr's discussion of it the figures which he presented as the water rate of this engine, run both as a triple and as a compound.

Jacketed Engine.

Triple:	I. H. P., 141.4;	water rate, 15.37
Two cylinders:	I. H. P., 152.0;	water rate, 15.58
Triple:	I. H. P., 45.6;	water rate, 17.70
Two cylinders:	I. H. P., 47.7;	water rate, 16.80

The compound does as well as the triple on heavy loads, and better on light loads. This paper, together with one by Mr. F. W. Dean, entitled, "Trials of a Recent Compound Engine with a Cylinder Ratio of 7:1," cover about all the philosophy and data that are at present known on this subject.

The answer to the question, What is the best cylinder ratio for a compound engine? depends upon the facts with regard to the loss by cylinder condensation and the loss by intermediate expansion. Little is known specifically about these facts so far as they appertain to these recent compound engines which work with high steam pressures and have very small high-pressure cylinders. As I have shown, all that we know is that high ratios and high pressures beat low ratios and low pressures; and with the exception of the analysis of Dr. Thurston of the Sibley engine tests we have no experimentally derived knowledge of the details of the saving process. This analysis, so far as it goes, bears out the view which I originally entertained of the essential incorrectness of the received theory of the action of steam in a compound and in a triple expansion engine. The deduction from that theory has been that the thing to aim at in the design of either type of engine was, besides eliminating "drop," to so proportion the cylinders as to have each cylinder do an equal proportion of work, and have the steam work through an equal range in temperature in each cylinder. Almost the first thing that was said, when the proposition to do away with the intermediate cylinder in triple expansion stationary engines was made, was that the great increase in range in temperature in the first cylinder, caused thereby, would greatly increase the loss by cylinder condensation in that cylinder. My answer to that was that even if there were more condensation thus effected in the first cylinder, this would not matter unless there was such a great increase in condensation as to exceed in quantity that in the low-pressure cylinder. The singular fact is developed by Dr. Thurston's analysis, however, that the quality of the steam at cut-off in the first cylinder of the Cornell engine when operated without its intermediate cylinder was actually better than when the range in temperature was lessened by using that cylinder, and his explanation was that this was the direct result of the sudden drop in pressure at release in the first cylinder of the compound, which did not take place in the triple. Furthermore, the improvement in the quality of the steam caused by "drop" was about equal in both the high and low-pressure cylinders, and was most noticeable with the most "drop"!

These experiments, at all events, make it perfectly plain that cylinder condensation does not depend directly and solely on the range in the temperature of the steam. The extent of the surface exposed and the amount of "drop" allowed have at least as much to do with it.

I will bring my remarks to a close by saying finally that I do not desire to see the triple expansion engine discarded absolutely, and for every purpose. I believe it is indispensable at sea for mechanical reasons; also for certain kinds of direct-acting steam pumps, working without cut-off in individual cylinders. But for stationary power plant engines the most economical engine at present practically possible, all things considered, is, in my judgment, a cross compound engine, working with a boiler pressure of 180 pounds, a vacuum of 13½ pounds, a receiver pressure of 8 pounds, and a cylinder ratio of 8:1.

VENTILATION AND HEATING OF THE MELROSE, MASS., HIGH SCHOOL.

An interesting heating and ventilating plant of recent installation is that of the new high-school building in Melrose, Mass. A hot-blast system is employed, with the now common method of securing independent room temperatures by the mixing of individual cold and hot air supplies. Heat for the building is almost entirely derived from indirect steam radiators using low-pressure steam in a gravity system of piping. Under average conditions the steam is at a pressure of about 15 pounds, and an engine is used to develop the power required to drive the blower with steam at this pressure. In the steam plant, therefore, no traps, pumps or pressure-reducing valves are necessary. The water of condensation is returned below the boiler level, and the only working parts are the engine and blower.

The high school is a three-story and base-

ment structure, planned with the modern conveniences of such buildings, and of ample proportions. The first two floors are mainly given up to classrooms, while on the top floor a large hall, a lecture room, and the laboratories for scientific classes are to be found. The first and second story ceilings are 12 feet high, the large hall on the top floor is 24 feet, and the laboratories 14 feet. The general features of the floor plans may be studied from the accompanying drawings. The basement is shown in Figure 1, and the first and top floors are given in Figures 2 and 3, respectively. There are three entrances in the front of the building, in the recess formed by the jutting ends, the center one for the visitors. At each end of the building another entrance is located, and joining one with the other is a long central corridor. The upper floors are accessible from two stairways, which rise from the front entrances. On the second floor in the front of the building three rooms extend from stairway to stairway over the master's rooms, two used as a library and reading room, and the third for the use of the teachers. The basement is divided into two parts by the blower and heating apparatus, one part being provided with various rooms for boys, and the other with similar rooms for girls.

The location of the blower and engine is shown in Figure 1. Fresh air enters directly into the blower room through three windows in the rear of the basement, with a net area of opening of 54 square feet. The blower is 10 feet in diameter and 5 feet wide, and is capable, when running at a speed of 116 revolutions per minute, of delivering 3,500,000 cubic feet of air per hour. It is belt driven from a 15x8-inch engine. The blower discharges at the bottom and upward at a slight angle, as shown in Figure 4. The heating surface is of pin radiators and is mounted on I-beams, 7 feet from the floor. There is a total of 2,400 square feet, divided into five sections, and this is considered sufficient to heat the air supply to 60° Fahrenheit when the outside temperature is 10° below zero. As shown in Figure 1, two large ducts carry the air from the blower, and two dampers, controlling the temperature of each of these, are located at the outlets of the blower, one near the ceiling of the basement to regulate the amount of hot air, and the other to intercept the desired amount of cold air. At all times the dampers are so regulated and so much of the heating surface is used as to maintain the air in the ducts at a temperature of 60°, in the effort to minimize the loss of heat by radiation. The warm air is carried by the ducts, which are suspended from the basement ceiling, to the various flues located in the interior building walls and connecting with individual rooms. Switch dampers are fitted at junctions in the ducts to divert the proper proportion of air in their respective branches. At the base of each of the fresh air flues additional heating surface is placed, so as to heat the air supply from 60 to 110°. It is delivered to the rooms at this temperature, passing directly from the flues through openings about 9 feet above the floor, protected with wire guards. None of the fresh-air openings are provided with dampers, except the two supplying the assembly hall, Figure 3. These discharge also at a level of 9 feet, one each side of the platform, and by closing the dampers while the room is unused, no heat need be lost.

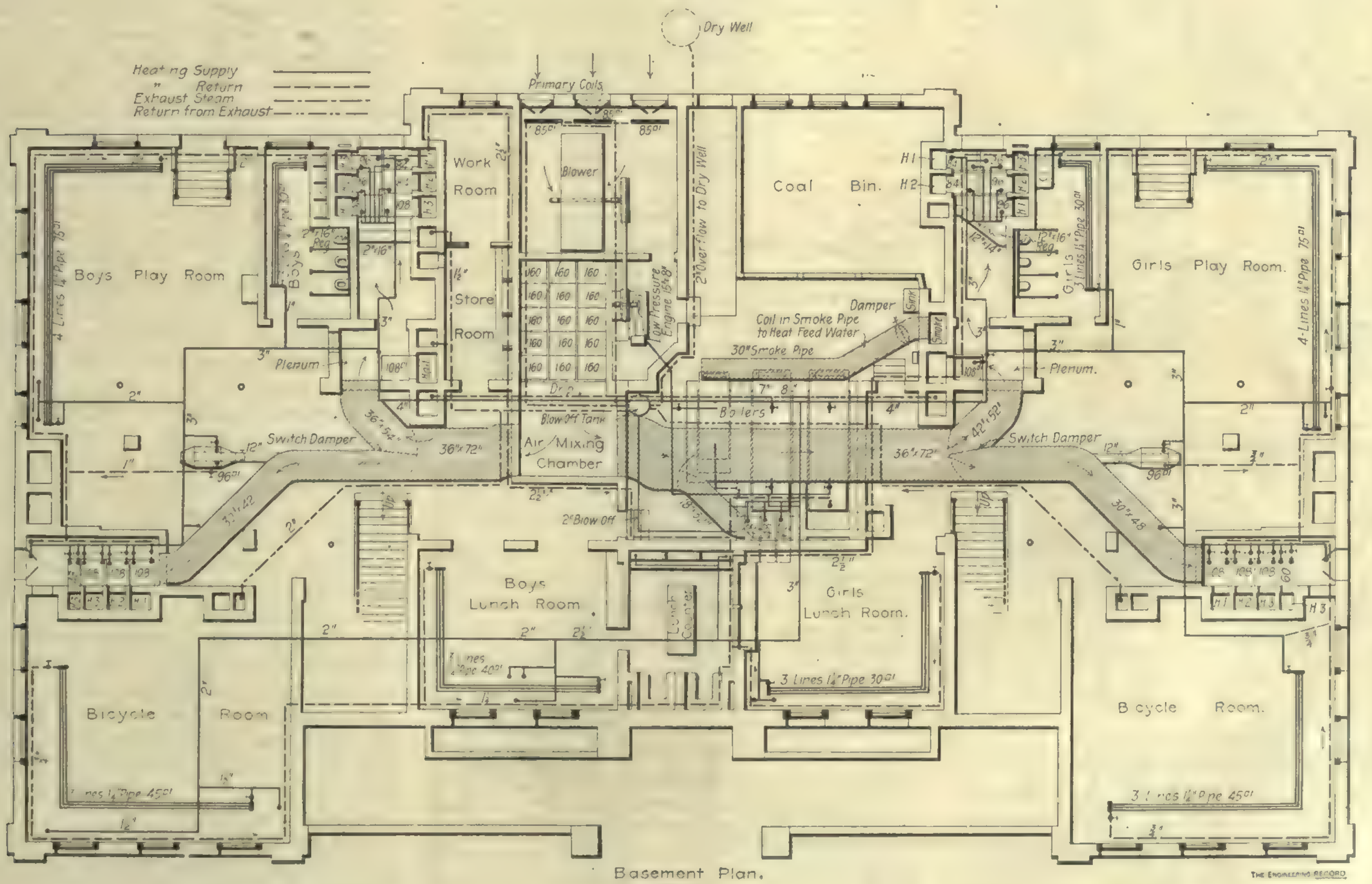
A typical method of mixing the air as it enters the fresh-air flues is shown in Figure 5. The basement duct carries the air, which, it will be remembered, is at a temperature of 60°, to a point below the heating surface, so that part may pass directly into the fresh-air flue, while the rest first becomes heated by the auxiliary radiators. Two dampers regulate the mixing, as shown in the cut. Figure 6 shows another auxiliary stack, which is a section at a plenum chamber, from which flues lead to the floors above. The mixing dampers in this case are mounted on vertical axes.

A movement of air out of the building is effected by ventilating flues, which, in general, continue in the lines of the fresh-air flues, rising to the roof, where they are capped with ventilating hoods. A draft to accelerate the outflow of the vitiated air is obtained in the flues by the aspirating effect of additional heating surface, 24 square feet in radiators being placed in each exit flue. Vent outlets in the rooms are located at the floor, protected with wire guards, and all are provided with dampers which may be closed when the rooms are unoccupied and it is therefore no longer necessary to maintain a continual change of the air. A section of the base of a ventilating flue is shown in Figure 7. The radiators for inducing the desired draft in the outflowing air are tilted to occupy the whole flue depth and are supplied from steam pipes placed within the flues. The hinged damper, already mentioned, is curved to reduce the friction caused by the change in direction of the air as it passes from the room. The cloak rooms are also provided with ventilating flues leading from wall openings fitted with registers, but in most cases these are near the ceilings.

Besides heating by a warm-air supply, direct radiators are installed in cloak rooms, corridors, toilet rooms, chemical and physical laboratories, and in those rooms of the building for which an air supply is unessential. In the basement coils of 1¼-inch pipe are hung from the ceiling, as shown in Figure 1, and they are designed to heat the basement rooms to a temperature of 65° in zero weather. Valves are placed in each coil to control the steam as the outside temperature may require.

Foot warmers, which are located at each end of the first floor corridor, are shown in Figure 8. Warm air is carried from the basement ducts in a circular pipe 12 inches in diameter to the auxiliary heating casing, where the cross-section of air flow is increased, and the velocity of air through the floor registers considerably reduced.

It has already been mentioned that the fresh air supply may be shut off from the assembly hall when the rest of the building is accepting its proper degree of ventilation, but it is also possible to heat the hall by a hot-air supply when the rest of the building is receiving no fresh air. This is effected by swinging the



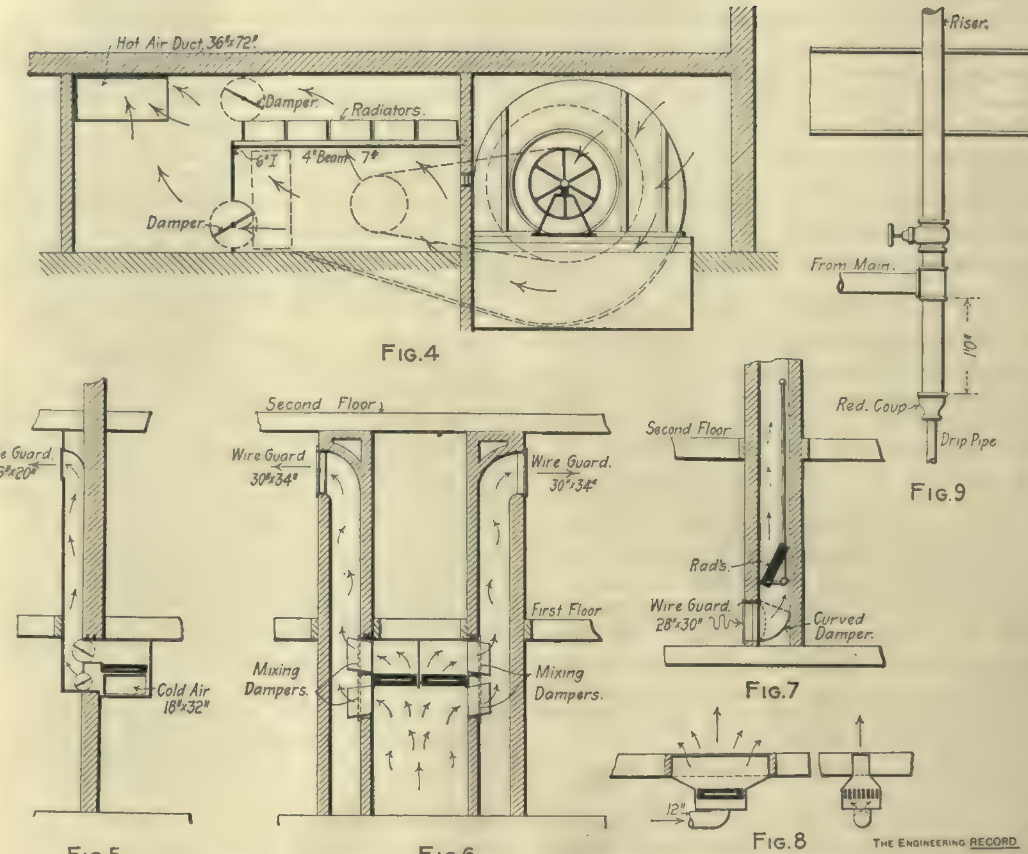
Basement Plan.
Fig. I

THE VENTILATION AND HEATING PLANT OF THE MELROSE HIGH SCHOOL.

TRISTRAM GRIFFIN, ARCHITECT; A. B. FRANKLIN, ENGINEER AND CONTRACTOR.

switch dampers in the basement ducts to an extreme position, so as to cut off at the junctions of the ducts that branch which does not supply the hall. The hall flue rises from the plenum chamber, situated beyond the main heating chamber, but starts from a separate compartment, so that by closing the doorway shown only that part is open to the fresh air duct. The plant has also been designed to deliver into the class rooms not less than 30 cubic feet of air for each occupant, and in the large hall not less than 20 cubic feet per minute.

Three horizontal tubular boilers are located in the basement, two 54 inches in diameter and 16 feet 3 inches long, intended for furnishing steam for heating purposes, and a smaller one, 42 inches in diameter and 10 feet long, to supply steam for blower engine. As shown in Figure 1, there are two connections from each of the larger boilers, so that they may be used separately or together on the 8-inch heating main crossing the boilers near the front, and either may be used to supply the engine from the rear connections, when the small boiler is not in use. A coil of 1¼-inch pipe is placed in the smoke flue to utilize some of the heat of the products of combustion, and it is designed to heat the feed water, drawn from the street mains, from a temperature of about 40° Fahrenheit to a temperature of 200°. A main damper in the flue is automatically controlled by a damper regulator.

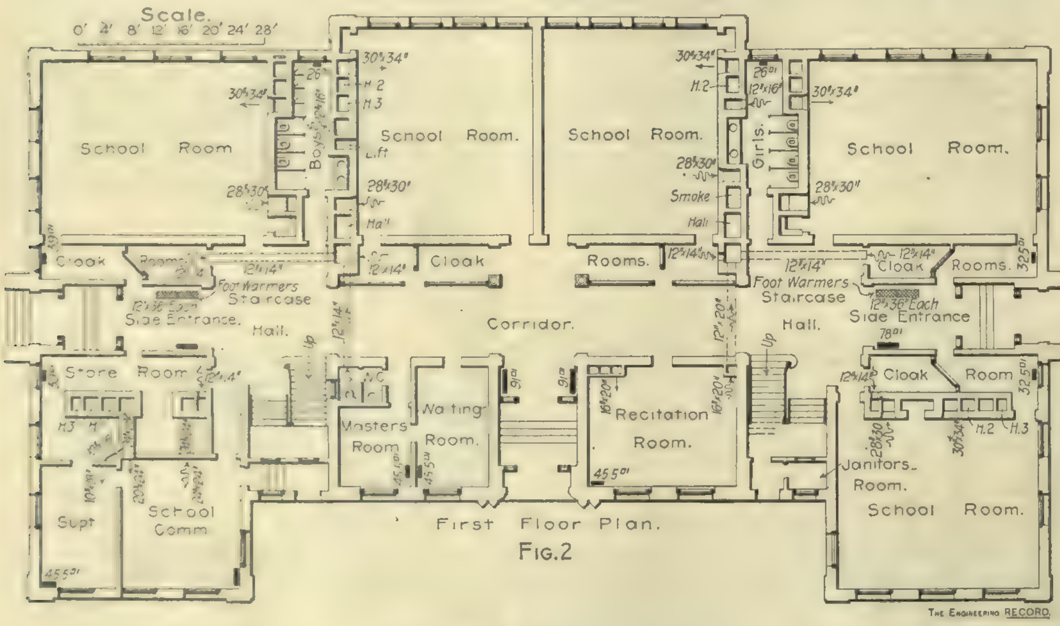


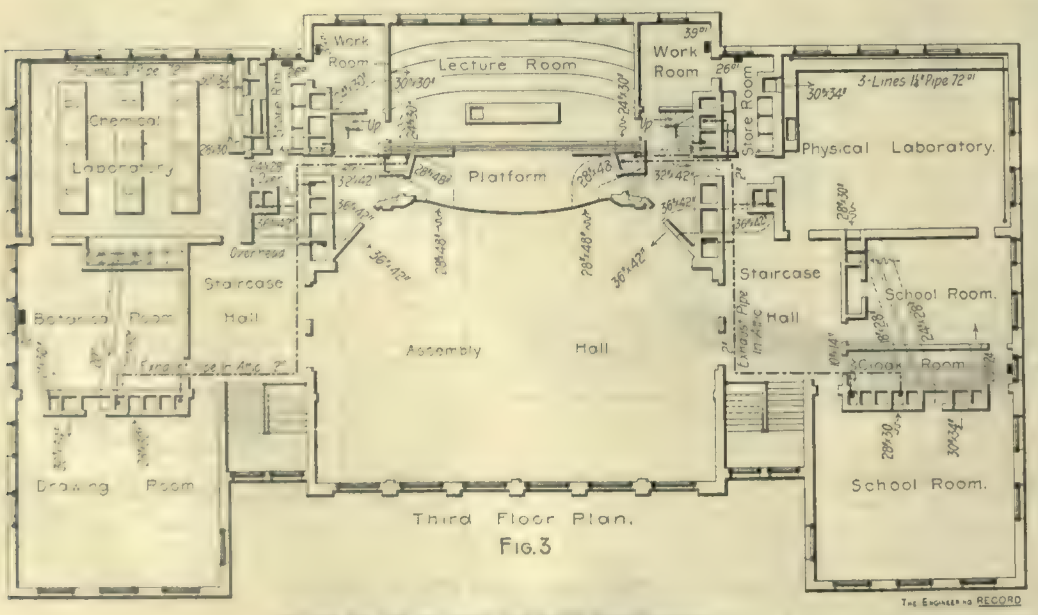
DETAILS OF THE VENTILATING PLANT, MELROSE HIGH SCHOOL

The low-pressure heating system is shown in full lines in Figure 1. The piping is hung from the ceiling joists with pipe rings and screw hooks, so graded that the water of condensation always flows in the direction of the steam, with a pitch of 1 inch in 10 feet. There are several long bends in the mains, which, together with the comparative length of the branches, made special provision for expansion unnecessary. The heating coils and radiators connect with a system of return mains, shown in Figure 1 in broken lines. The risers for the direct radiators on the floors above are provided with drips at the bottom, as shown in Figure 9. The condensation in the risers and radiators is carried back through the risers to the drip connections at their base, from which the water is returned to the boilers below the water line by the system of gravity returns. The supply of the radiators is thus on the one pipe system.

By no means the least interesting feature of the plant is the use made of the exhaust steam of the blower engine. On account of the grease it contains it is not returned to the boiler, and water is drawn, as already stated, from the street supply through the feed-water coils. Part of the exhaust steam may be discharged through three primary coils placed at the fresh-air openings in the blower room. These are designed to temper the incoming air during the spring and fall and those mild days when no other heating surface is required on the building. Of course, the danger from freezing precludes their use during the coldest weather. Most of the exhaust, however, is carried to the attic above the third floor by two risers, one in each of the two vent shafts which remove the air from the cloak rooms. Each of the risers supplies a system of exhaust steam mains in the attic, which lead to pipes dropping to each group of vent flues for the supply of the aspirating coils. The returns from the exhaust-steam system are carried in the basement, as shown, to a blow-off tank, which has an overflow pipe discharging to a drip well, and a vapor pipe rising alongside of one of the risers. The two horizontal pipes carrying the steam to the exhaust steam risers are graded up from the point where they are supplied with the engine exhaust, and at this point a drip is provided, discharging the condensed water to one of the returns emptying into the blow-off tank. One of the exhaust risers is provided with a back pressure valve, and extends above the roof as a free exhaust.

The building was erected from the plans of Mr. Tristram Griffin, of Boston, and the heating and ventilating plant was designed and installed by Mr. Albert B. Franklin, of Boston, to whom "The Engineering Record" is indebted for the data herewith presented.





FLOOR PLANS OF THE MELROSE HIGH SCHOOL.

NOTES.

A New Building which has just been completed for the Department of Mechanical Engineering and Mechanic Arts of the University of Tennessee, at Knoxville, was described in the November issue of the "University of Tennessee Record." It was designed to meet all the needs of the average technical school, besides providing for the lighting of the University. A short steel stack and a Buffalo Forge Company fan are used instead of a high brick chimney, and electrical energy is transmitted for both power and lighting. Small machines are grouped and run from a common shaft to avoid the multiplication of small motors.

The Ventilation of Railway Tunnels, according to Mr. Francis Fox, M. Inst. C. E., should be based on the principle that if not more than 20 parts of carbon dioxide is present in 10,000 parts of tunnel air, the condition may be deemed satisfactory. In the case of the Severn and Mersey tunnels it was assumed that 29 cubic feet of gas were given off per pound of coal burned; the number of pounds of fuel consumed by a locomotive per mile of tunnel, multiplied by 29, multiplied by 500, and divided by the number of minutes interval between the trains, gives the volume of air to be introduced into the tunnel per minute. In some of the London underground railway tunnels the carbon dioxide has been found to be present in as high a proportion as 86 parts per 10,000.

A Water-Works System for the University of California has been built during the past year by diverting the waters of a small creek for purposes of fire protection, irrigation and the flushing of sewers. The drainage area of the creek is about 700 acres, and with a rainfall of 24 inches per annum the quantity of water falling on this area would be over 450,000,000 gallons. The natural flow of the stream is sufficient for all uses during the entire year, except for irrigation during the months of August, September and October. For this purpose a storage reservoir is yet to be built. A concrete dam 36 feet long, three feet thick and four feet high above the bed of the creek, was built to divert the water into a chamber at one side. In reaching this chamber the water passes through a small sand filter to prevent leaves and other matter fron entering the pipe. It consists of a layer of sand placed on a floor of angle iron and birch, beneath which is the water chamber. Over the sand is laid a floor of planks. To prevent clogging, these planks are bevelled on one edge and placed an eighth of an inch apart, with the bevelled face down. In case of necessity this floor can be easily removed, as the planks are not spiked down, but are held in place by timbers at each end. During the latter part of the dry season in California all small streams are nearly dry, and often a large flow is carried in the porous strata forming the bed. To intercept this, the dam was carried eight feet below the bottom of the creek to a bed of clay. A wasteway four feet by ten feet was built to allow the escape of the water when carrying a large amount of silt and debris. At other times this is closed with 8×8-inch timbers. From the dam the water is carried by an eight-inch pipe to a circular reservoir 60 feet in diameter and 14 feet deep. This is built of concrete, and sets in the ground to a depth of 12 feet. It is covered with an ornamental frame roof. From the reservoir an eight-inch main, decreasing in size to six inches and four inches, runs down by the University buildings, with branches to various points where the water is to be used. This work was designed by and constructed under the supervision of Mr. W. F. Boardman, engineer of the Oakland Water Company, Oakland, Cal.

TRADE PUBLICATIONS.

The W. J. Clark Company, Salem, Ohio, has just prepared a pamphlet describing its "Quick as Wink" hose coupling, now attracting much attention from water-works superintendents and firemen. The coupling is made to fit hydrants and factory and house cocks, as well as hose lines, and its purpose is clearly shown by its name.

The Salem elevator buckets, made by the same company, are described in another new pamphlet of 64 pages. These were first introduced in 1880 for milling purposes, but since that time they have been standarized so as to be turned out by special machinery in a surprising variety of forms for handling mill products, grain, clay, ore, sand, broken stone, cement, clinker and similar materials. Every engineer and architect who has to use elevator or conveying machinery should write for a copy of the pamphlet.

A second illustrated edition of the lecture on mechanical draft and steam boilers, delivered at Cornell University by Walter B. Snow, of the engineering staff of the B. F. Sturtevant Co., Boston, Mass., has just been issued to meet the demand for information on this important subject. Copies may be obtained upon application to the Sturtevant Company. In its recently issued Bulletin G, the same company illustrates and describes a unique generating set, in which both the engine and the generator are entirely inclosed, although perfectly accessible through suitable doors. Such a device is of manifest utility wherever the atmosphere is laden with dust. This bulletin, containing other information of interest, will also be mailed on application.

The Lord & Burnham Company, St. James Building, New York City, has recently issued two handsome trade publications. One is a 78-page catalogue of greenhouse heating and ventilating apparatus, treating of the various hot-water heaters, pipe fittings and ventilating appliances manufactured or patented by the company. The other is a catalogue of greenhouses giving over 50 large half-tone illustrations of some of the greenhouses which it has designed and erected in various parts of the country. This is intended to show what has been done and to furnish a basis for correspondence to those who propose to erect a greenhouse.

SOCIETY AFFAIRS.

The Architectural League of New York held a meeting on the evening of January 3, and with a number of guests present at the dinner by special invitation took part in the discussion of the topic for the evening, "The Laying Out of a City." President Bruce Price asked for Mr. H. K. Bush-Brown, chairman of the Committee on Current Work, who secured the plans and speakers. Mr. George B. Post presented a plan for widening streets to secure adequate approaches to the new East River Bridge and for a site for a new City Hall, which contemplated the city's acquiring the tract of land bounded by Elm, Baxter, Duane and Worth streets. A building about 400 feet by 700 feet, with a large interior court, was to stand on a terrace within this area. Centre Street was to pass under the terrace through appropriate archways. Driveways to the city building were to approach from east and west on a three per cent. grade. By condemning this entire tract, the ground not needed for the improvement could be sold by the city at such enhanced values as to make the project a paying one. Experience in Glasgow was cited to justify the expectation. Mr. E. P. North suggested the opening of 150-foot streets to run diagonally across the city to facilitate movement of traffic from bridges to west side up-town ferries. This would permit landing of sound steamers on the east side, saving about half an hour to passengers. Mr. Charles S. Smith stated that sound steamers chose the landing place on the west side as being convenient to the dry-goods district, avoiding the long and costly haul through the city. He said the cost of cartage across the city was more than from New York to Chicago or to Liverpool. Mr. North maintained this excessive cost was due to congestion of traffic in narrow streets and to the small loads possible because of poor pavements. Mr. Jules Harter exhibited plans of several European cities. Mr. Milton Lee suggested a seven-mile improvement on North River from Seventy-second Street to Spuyten Duyvil, N. Y. A. H. Thorp presented a plan for transforming the North River front involving a 100-foot boulevard and a two-story elevated railway. The discussion indicated that the first question to be determined was the matter of defining the possible height of buildings. Mr. Post proposed a further effort to secure the needed legislation and Mr. Charles S. Smith promised the co-operation of the Chamber of Commerce and of the Fire Underwriters.

The American Society of Civil Engineers met January 4, Director James Owen presiding. A paper entitled "The Coal Hoists of the Calumet and Hecla Mining Company," by Julius Kahn, Jun. Am. Soc. C. E., was read and discussed by Messrs. George Hill, T. A. Coffin and O. J. Marstrand. The Secretary announced the death of F. H. Smith, New York. The election was announced of the following candidates: As juniors: Harris De Haven Connick, Eureka, Cal.; George Harrison Fenkell, Detroit, Mich.; John Herbert Gregory, Albany, N. Y.; Richard Prosper Gustin, Brooklyn, N. Y.; George Rommel, Jr., Wilmington, Del.; Elmer Zarbell, Chicago, Ill. As associate members: Joseph Carroll Barr, Pittsburg, Pa.; Harry Johnson Morrison, Clinton, Mass.; Gratz Brown Strickler, Broadwater, Va.

The Engineers' Club of Cincinnati elected the following officers at its eleventh annual meeting, held December 15: President, Schuyler Hazard; vice-president, Thomas B. Punshon; directors, A. O. Elzner, William C. Jewett and L. E. Bogen; secretary and treasurer, J. F. Wilson.

The Civil Engineers' Society of St. Paul, Minn., held its sixteenth annual meeting on January 2, President Estabrook in the chair and C. L. Annan, secretary. The officers of the society were re-elected and Mr. George L. Wilson chosen as representative on the Board of Managers of the Association of Engineering Societies.

The New England Water-Works Association has prepared a very attractive programme for its meeting at Tremont Temple, Boston, at 2 p. m. The papers which have been promised are as follows: "Cast Iron Pipes Used in the Metropolitan Water-Works," by Dexter Brackett. "Description of the New Steel Force Main of the New Bedford Water-Works," by George S. Rice. "Steel Pipes," by L. M. Hastings. "Description of the New Salt Water Fire System of Boston, Mass.," by Frank A. McInnes. "Wooden Stave-Pipe," by Arthur L. Adams. "Short Description of the Wooden Stave-Pipe at Manchester, N. H.," by Charles K. Walker. "Improved Wyckoff Water Pipes," by George L. Wells. "A Compilation of Recent Data Relating to the Flow of Water in Pipes of Wooden Stave, Steel Riveted and Cast-Iron," by F. F. Forbes.

PERSONAL AND OBITUARY NOTES.

Mr. Robert R. Evans has been re-elected city engineer of Haverhill, Mass.

Mr. J. C. Kingsley, of the class of 1876 of the Rensselaer Polytechnic Institute, died in San Salvador on December 23.

Mr. John J. Sullivan, of Kennedy & Sullivan, Holyoke, Mass., has been re-elected water commissioner of the city for three years.

Messrs. B. C. Ball and W. H. Corbett have opened an office at 39 Cortlandt Street, New York, as consulting and contracting engineers.

Mr. Alexander C. Humphreys, of Humphreys & Glasgow, New York and London, has been elected president of the Buffalo City Gas Company.

Mr. John W. Gates has resigned his position as president of the Illinois Steel Company to become the president of the American Steel & Wire Company, and will be succeeded by Mr. E. J. Buffington of Evanston, Ill.

Major John I. Sewell, First Volunteer Engineers, has been ordered to duty in the office of the Chief of Engineers. Captain David L. Hough, of the same regiment, has been assigned to the transport Manitoba as quartermaster.

Mr. Arthur Stanley Cochran, a graduate of Swathmore College and a practicing architect in Philadelphia, died on January 1 of pneumonia at the early age of 34. He designed several schools and churches in the vicinity of Philadelphia, and many city and suburban houses.

Mr. L. B. Youngs has been renominated by the Mayor of Seattle as superintendent of city lighting and water-works and member of the board of public works, an office he has held since 1894. Previous to that time he was a contractor in Texas, New Mexico and Washington.

The partnership which has existed for the past 20 years between George D. Mason and Zachariah Rice under the firm name of Mason & Rice, architects, 80 Griswold Street, Detroit, has been dissolved by mutual consent. The address of Mr. Mason remains, as formerly, 80 Griswold Street, and that of Mr. Rice will be 55 Fort Street W., after January 15.

Mr. Walter M. McFarland has resigned from the navy, in which he held the rank of passed assistant engineer, to join the staff of the Westinghouse Electric & Manufacturing Company. His record in the corps has been of the highest, even in that organization of picked men, and it is unfortunate for the country that its financial affairs will not allow it to compete with a private corporation for the services of such a competent officer.

John W. Chalfant, one of the best-known ironmasters of Allegheny, Pa., died there December 28. He was 71 years old, and for many years was a member of the firm of Spang, Chalfant & Company, said to have been the first to use natural gas in iron manufacture. He was president of the Isabella Furnace Company, a director of the Pittsburg Locomotive Company, and connected with a number of business and charitable organizations.

Mr. W. Dewees Wood, who died in Pittsburg January 2, was born in Philadelphia April 19, 1826. His father was the owner of sheet-iron mills in that city and at Wilmington, Del., and in them the son learned the practical details of the business. He moved to Pittsburg in 1851 and established the Wood & Gilpin mills at McKeesport to manufacture planished sheets; these mills are now owned by the W. D. Wood Company. Mr. Wood was a director of several other manufacturing and commercial corporations.

Captain Charles P. Kahler, First U. S. Volunteer Engineers, died in Baltimore December 30 from typhoid fever contracted in Puerto Rico. He was a graduate of the architectural and mechanical departments of the Maryland Institute, and was elected city surveyor of Baltimore in 1869. Afterward he was with Major George M. Wheeler in the famous survey work west of the one hundredth meridian, from which service he returned to the city commissioner's department of Baltimore in 1879. For many years he was the assistant city commissioner, and had charge of the storm-water sewers and pavements.

CONTRACTING NEWS

OF SPECIAL INTEREST TO CONTRACTORS, BUILDERS, ENGINEERS, AND MANUFACTURERS OF ENGINEERING AND BUILDING SUPPLIES.

For Proposals see page ix.

WATER.

Shawnee, Okla.—The contract for constructing water-works has been awarded to Ruemmeli & Siebert Refrigerating Machine Co., St. Louis, Mo., for $32,790. Other bids received were as follows: Kelley & Steel, $33,847; G. Jaeger, Rich Hill, Mo., $33,385.

Berkeley, Cal.—C. L. Huggins, Town Engr., writes: "The town is now boring test wells with a view to constructing a municipal water plant. If the wells prove satisfactory, a proposition to bond will be presented to the people."

Oregon, Mo.—It is stated that $3,000 bonds have been voted to extend the water and light system.

Florence, Ala.—It is stated that arrangements will be made to extend the water mains to East Florence.

Charleston, S. C.—The City Council has adopted the report of the Special Committee on Water and Light, recommending that plans and specifications be prepared for bringing into and distributing within the city water from the Edisto River.

Montgomery, Ala.—It is stated that the contract for constructing artesian wells has been awarded to the Cook Well Co., St. Louis, for $18,900.

Owatonna, Minn.—It is stated that C. F. Loweth, C. E., of St. Paul, has examined the water-works plant with a view to taking steps for an increased supply.

Vineland, N. J.—The Borough Council has been petitioned to issue $140,000 bonds for water-works, sewers and electric lights.

Williamsport, Md.—John D. Adelsberger, C. E., of Baltimore, has prepared plans for proposed improvements to the water-works and electric light plant. Estimated cost, $19,000.

Chatham, Ont.—An appropriation of $5,000 will probably be made to improve the water supply.

Shelby, Ia.—It is stated that the town will vote Jan. 10 on the issue of $4,000 water bonds.

Washington, Ind.—Articles of incorporation have been filed by the City Water Co., with a capital stock of $30,000. Directors: F. W. Gray, W. G. Maxcy, T. J. Axtell and others.

Pleasanton, Cal.—J. H. Neal, Town Clk., writes that the Board of Trustees has purchased the site of an artesian well and proposes to pump the water to a reservoir which is to be constructed, with a capacity of 200,000 gals.

Doylestown, Pa.—Wm. J. Wintyen, Supt. and Engr. of Water-Works, writes that it is proposed to increase the water supply by boring wells of a capacity of about 200,000 gals. in 24 hours.

Bigtimber, Mont.—It is stated that the Holland Irrigation Canal Co. has received a $750,000 contract from the State Arid Land Commission for the construction of a canal.

Glen Campbell, Pa.—A company has been organized with a capital stock of $15,000 to build water-works. Incorporators: H. E. and Joseph O. Clark, of Glen Campbell; John H. Patchin, of Patchinville, and others.

Jersey City, N. J.—The Street and Water Board has awarded the contract for cast-iron water pipe to Fox & Engel. See our issue of Dec. 31 for bids received.

Galeton, Pa.—The Galeton Water Co. has been incorporated, with a capital stock of $40,000. Incorporators: J. R. Collins, M. E. Northam, Frank Greco, of Austin, Pa., and others.

Florence, Colo.—Local reports state that on Dec. 29 it was voted to construct water-works.

Lockport, N. Y.—The Water Commissioners will recommend to the Common Council that an 8,000,000 gal. pump replace the 3,000,000 gal. pump now in use as a reserve pump.

Derry Church, Pa.—The Derry Water Co. has been organized with a capital of $10,000. Directors: Israel Moyer, John E. Fox, M. R. Henry and Michael Yingst.

Baltimore, Md.—Bids are wanted Jan. 11 for cast-iron water pipe and special castings for the first 6 months of 1899. William L. Kenly, Ch. Engr. Water Board.

Chicago, Ill.—Bids are wanted Jan. 10 for erecting and maintaining a temporary pumping plant at Sheridan Drive and Lawrence Ave. L. E. McGann, Commr. Pub. Wks.

Charleston, S. C.—Bids are wanted Jan. 10 for furnishing iron castings for 1899. J. B. Keckeley, Supt. of Streets.

Cincinnati, O.—Bids are wanted Jan. 28 for $15,000 Mitchell Ave. aqueduct bonds. George C. Zimmermann, Clk. Bd. County Commrs.

Topeka, Kan.—The City Engineer has been instructed to prepare detailed plans and specifications for a complete system of water-works.

Phoenix, Ariz.—The City Council has passed a resolution providing for an election to be held Jan. 24 to vote on the issue of $265,000 bonds for a water-works and sewerage system.

Clayton, N. Y.—It is stated that S. H. Snell of Lowville, N. Y., is preparing plans and specifications for the system of water-works and sewers.

Santa Barbara, Cal.—Mayor Edmund M. Burke writes that a 500 ft. extension of the city water tunnel is to be built, 2,000 ft. having been constructed.

Mammoth Spring, Ark.—It is stated that the construction of a system of water-works is under consideration.

Hartford, Mich.—At a recent special election it was voted to construct a municipal water-works plant to cost about $12,000.

Galesville, Wis.—It is stated that the City Council will soon purchase a quantity of pipe, etc., for the completion of the water-works.

Worcester, Mass.—Water Commissioner Brady estimates the total amount needed by his department during next year as $153,227; of this sum $21,000 is for labor, meters, pipes and fittings.

Whittier, Cal.—It is stated that bids are wanted Jan. 16 for $40,000 bonds. Walter E. Butler, City Clk.

Canton, O.—It is stated that bids are wanted Jan. 23 for $15,000 water-works bonds. Louis N. Ley, City Clk.

Essexville, Mich.—The Village Council has under consideration the construction of water-works.

Westerly, R. I.—Water bonds to the amount of $73,000 have been sold.

Philadelphia, Pa.—Among the appropriations for 1899 are the following: Bureau of Highways, $1,586,768.50; Bureau of Lighting, $289,190; Bureau of Street Cleaning, $903,820; Bureau of Water, $1,264,439.

Fulton, N. Y.—The Commission, consisting of ex-Judge Charles Andrews, William R. Hill, Chief Engineer and Superintendent of the Syracuse Water Department, and William Wheeler, C. E., of Boston, which was appointed by the Court to appraise the value of the property of the Fulton Water Works Co., has reported total price of same to be $172,500. A vote of the citizens will probably soon be taken on the proposition to purchase the plant at this figure.

Baltimore, Md.—Local reports state that the Board of Public Improvement has decided to report favorably upon the ordinance providing for the filtration of the city's water supply.

Somers, Conn.—Amos D. Bridge, H. Stephen Bridge, Andrew Gordon and others have applied for incorporation as a company to furnish water, light and power to Somers and the eastern part of Enfield.

Orangeburg, S. C.—Bids are wanted Jan. 25 for furnishing water-works and electric lighting material, as advertised in "The Engineering Record."

Rome, Ga.—Mayor J. J. Seay writes that a filtration plant is to be built at an estimated cost of $20,000. H. M. Smith, City Engr.

Indianapolis, Ind.—F. M. Davis, Supt. of Water-Works, writes that 60,000 ft. of cast-iron pipe, 100 hydrants and 100 water gates will be required in January.

Savannah, Ga.—The following items are included in the budget for 1899, which has been passed by the City Council: Water-works, including extensions and other improvements, $35,000; paving streets, $10,000; streets and lanes, $57,500; crematories, $6,245.

Brewton, Ala.—Mayor W. H. Strong writes that $15,000 bonds are to be sold for the purpose of improving and extending the water and light plant.

Boston, Mass.—Local reports state that the Metropolitan Water Board received the following bids for building a $150,000 stone high-service pumping station and gate-house at Spot Pond, near the Ravine Road, in Melrose: Norcross Bros., $125,924.65; McNeil Bros., $108,480; L. P. Soule & Son, $117,730; C. A. Dodge & Co., $119,511; Connery & Wentworth, $124,343.50; Woodbury & Leighton, $110,822.50; L. D. Willcutt & Son, $124,653; C. Everett Clark & Co., $134,005; Whidden & Co., $133,969; Fessenden & Libby, $233,279.50.

SEWERAGE AND SEWAGE DISPOSAL.

Denver, Colo.—Mayor McMurray has signed the bill for storm sewers on Capitol Hill.

Lakewood, O.—It is stated that the committee appointed by the Council to decide the efficiency of different sewage disposal systems has reported in favor of the Waring system.

Little Falls, N. Y.—Plans and specifications have been approved by the Board of Public Works for a sewer system on the south side of the river. Estimated cost, $15,795.

Green Bay, Wis.—It is stated that Acting City Engineer A. L. Hillis has completed plans for sewer extension.

York, Pa.—It is stated that the ordinance authorizing the loan of $250,000 for a sewerage system has been passed.

Athens, Ga.—It is proposed to extend the sewerage system. J. W. Barnett, City Engr.

Baton Rouge, La.—R. Swart, City Engr., writes that a vote will soon be taken on the proposition to construct sewers and pavements.

Milwaukee, Wis.—The Board of Public Works has estimated that $235,000 will be required during 1899 for sewerage purposes.

Oakland, Cal.—The ordinance appropriating $8,500 for the cemetery creek outlet sewer has passed the City Council.

Belleville, N. J.—The plan of building a trunk sewer to carry away sewage, and thus prevent a further pollution of the Passaic River, was indorsed at a public meeting held Dec. 30. Estimated cost, $6,000,000.

Buffalo, N. Y.—The Board of Public Works has been authorized to readvertise for bids for Emslie St. sewer.

East Orange, N. J.—It is stated that a system of sewers for surface drainage is to be built at an estimated cost of $60,000.

Hartford, Conn.—Local reports state that Samuel M. Gray, Engr., will submit plans and estimates on different sewage disposal systems about Jan. 15.

Phoenix, Ariz.—See "Water."

Fostoria, O.—Plans have been adopted for a lateral sewer in West North St.

Clayton, N. Y.—See "Water."

Okmulgee, Ind. Ter.—Bids will probably be asked about June 1 for a sewerage system to cost $4,500. H. H. Hendershot, Engr. in charge, Wichita, Kan. P. J. Byrne, Engr.

Toledo, O.—Bids are wanted Jan. 16 for sewers in sub-main sewer district No. 1 of main sewer district No. 30. Lem P. Harris, City Clk.

St. Louis, Mo.—Bids are wanted Jan. 13 for 1,090 ft. of 12-in. to 18-in. vitrified clay pipe sewers in Branch St., Sewer Dist. No. 36. Robt. E. McMath, Pres. Bd. Pub. Improvements.

Denver, Colo.—Bids are wanted Jan. 16 for Capitol Hill storm sewer, district No. 1. Samuel N. Wood, Pres. Bd. Pub. Wks.

Allegheny, Pa.—Bids are wanted Jan. 10 for lateral sewers in several streets. Robt. McAfee, Dir. Dept. Pub. Wks.

Norfolk, Conn.—The Norfolk Sewer District has petitioned for authority to issue $25,000 bonds.

Glenville, O.—An ordinance providing for the sale of $30,000 sewer bonds has been passed.

Kansas City, Mo.—Bids are wanted Jan. 14 for a sewer. Henry A. Wise, City Engr.

Brooklyn, N. Y.—Local reports state that the Board of Public Improvements will shortly be called upon to approve a general plan of sewering and draining about 16,000 acres in four wards.

Jersey City, N. J.—The figures have just been officially announced at which Edward O'Neil, 60 St. Paul Ave., was awarded a contract for 4,950 ft. of trunk sewer several weeks ago. They are as follows: Oval brick sewers, 1,400 ft. of 60-in., at $3.89; 1,200 ft. of 54-in., $3.64; 800 ft. of 42-in., $3.08; 1,550 ft. of 36-in., $2.84. The bid on about 5,000 yds. rock excavation was at $2.03.

Mt. Vernon, N. Y.—The following bids for sewer work in two districts were opened Jan. 3 by Wm. W. Hoyt, City Clk.: Qualman & Light, Mt. Vernon, N. Y., $3,513.75, $8,277; Frank Nordone, Mt. Vernon, N. Y., $2,753.60, $7,242; P. Sheridan, Mt. Vernon, N. Y., $3,133.50, $5,897; Bellew, Merritt & Co., Tuckahoe, N. Y., $5,593.47, $12,401; Cortright & Kenlon, Mt. Vernon, N. Y., $3,717.50, $7,839.85; Daniel Murray, $3,685.

East Cleveland, O.—The following bids for one of the five sections of the sewer system were opened Dec. 30 by H. B. Chapman, Village Clk.; Engrs. in charge, W. P. Rice Engineering Co., Cleveland, O. The work includes 28,000 ft. of pipe sewers from 8 to 20 in. in diameter, 45 manholes and 7 flush tanks: Ford P. Beers, Cleveland, $12,628.58; R. H. Gray, Cleveland, $13,828.50; Clement Bros. Construction Co., Cleveland, $17,954.12; Cleveland Contracting Co., Cleveland, $14,012.40; Irving Stafford, E. Cleveland, $11,615.80; Greenville Construction Co., Greenville, O., $13,281.80.

BRIDGES.

Norwalk, O.—It is stated that the Council has under consideration the construction of a steel viaduct at Linwood Ave. Estimated cost, $20,000.

Boston, Mass.—Plans are being prepared for a 4 span steel bridge to be built across Ft. Point channel.

Keokuk, Ia.—The construction of a high bridge across the Mississippi is stated to be under consideration.

Malone, N. Y.—It is stated that the Ogdensburg & Lake Champlain R.R. has under consideration the construction of a bridge over Lake Champlain.

Moundsville, W. Va.—It is stated that the Baltimore & Ohio R.R. contemplates constructing 2 iron bridges, to replace overhead structures.

Saginaw, Mich.—The Board of Public Works has been directed to prepare plans, specifications and estimate of cost for constructing a bridge over Saginaw River, at Genesee street.

Athens, Ga.—A steel and iron highway bridge, 90 ft. span and 16 ft. roadway, is to be built. J. W. Barnett, City Engr.

Troy, N. Y.—John W. McNamara, Gen. Mgr. Albany Ry. Co., writes that the contract for a $6,000 bridge to be built across the canal has been awarded to the Hilton Bridge Co.

Bridgeport, Conn.—Mayor Taylor, on Dec. 29, approved the action of aldermen voting to petition the Legislature for permission to issue $60,000 bonds for the construction of a drawbridge over Yellow Mill pond.

Syracuse, N. Y.—The construction of a steel girder bridge over Onondaga Creek at West Fayette St., is stated to be under consideration.

St. Paul, Minn.—Bids are wanted Jan. 17 for the reconstruction and repair of the 6th St. bridge. Matt Jensen, City Clk.

Boston, Mass.—Bids are wanted Jan. 16 for building abutments of bridge on Boston St., over New York, New Haven & Hartford R.R. William Jackson, City Engr.

Quebec, Que.—Bids are wanted March 1 (re-advertisement) for a combined railway and highway bridge over the St. Lawrence River, near Quebec. Ulric Barthe, Secy. Quebec Bridge Co.

Santa Barbara, Cal.—Mayor Edmund M. Burke writes that one 60-ft. bridge is to be built. Cost, $2,300.

Oshkosh, Wis.—Bids are wanted Jan. 30 for a constructing iron and wooden bridges during 1899. J. B. Cruzen, Co. Aud.

Cleveland, O.—It is stated that bids will soon be asked for the superstructure of the Center St. bridge.

Tiverton, R. I.—The New York, New Haven & Hartford R.R. has about completed plans, according to the requirements of the War Department, for a draw bridge over the Sakonnet River, between Tiverton and Portsmouth, to replace present structure.

St. Joseph, Mo.—It is stated that bids are wanted April 1 for the substructure of the Grand Ave. viaduct. H. Fernstrom, Ch. Engr. Chicago Great Western Ry., St. Paul, Minn.

Spring Lake, N. J.—It is stated that bids will soon be asked by the County Freeholders for constructing a steel and iron bridge over Wreck Pond; appropriation, $14,000. W. F. Lefferson, Chmn. Com.

Waverly, Ia.—Bids are wanted Jan. 24 by the County Auditor for a steel girder bridge across Cedar River at Bremer Ave.

Toronto, Ont.—The by-law providing for the construction of a bridge over the Don, at a probable cost of $62,500, carried at the recent election. C. H. Rust, City Engr.

Brainard, Minn.—The following bids for a bridge across the ravine on Kingwood St. were opened Dec. 19. F. A. Farrar, City Clk.: A. Everett, Brainard, $3,995; C. B. Rowley, Brainard, *$3,965; Wm. S. Hewett, Minneapolis, $3,875.

*Contract awarded.

PAVING AND ROADMAKING.

Petersburg, Va.—G. B. Gill, City Aud., writes that street improvements and extensions, to cost about $50,000, are under consideration.

Moberly, Mo.—The proposition to pave several streets with brick is under consideration. N. E. Walker, City Clk.

Camden, N. J.—Contracts for paving several streets have been awarded to the Vulcanite Paving Co., Philadelphia, Pa., at $1.55 per sq. yd., and for paving on three streets to Aaron Ward, of Camden, at $1.55. Probable cost of work, $200,000.

Athens, Ga.—The proposition to issue paving bonds is under consideration.

Charlottesville, Va.—It is proposed to construct about 4,000 sq. yds. of brick pavement. A. C. Rucker, City Engr.

Baton Rouge, La.—See "Sewerage and Sewage Disposal."

New York, N. Y.—The Board of Estimate and Apportionment has allowed $15,000 for paths in the new Botanical Garden.

Boulder, Colo.—The citizens have under consideration a plan to pave Pearl St. temporarily with macadam, which can be used next year as a foundation for asphalt.

Newport News, Va.—Mayor A. A. Moss writes that in a few weeks a vote will probably be taken on the issue of bonds for street paving, market house and a garbage plant.

Paterson, N. J.—The Street Committee of the Board of Aldermen recommends several streets for permanent improvement next year.

Elyria, O.—It is stated that plans for road improvements now contemplated embrace about 105 miles. Road Commissioners: F. D. Warren, S. B. Day and S. B. Dudley.

Springfield, Mass.—Plans are being prepared for a boulevard, having a roadway 100 ft. in width, from South Main St. to Forest Park.

Cleveland, O.—President McBride, of the Park Board, states that half of the $500,000 park bonds authorized by the City Council will be spent on the proposed boulevard approach from the viaduct to Edgewater Park.

Cambridge, Mass.—Superintendent of Streets Brown recommends in his annual report that during the next few years a sufficient appropriation be made to reconstruct from 8 to 10 miles of streets annually.

White Plains, N. Y.—A committee has been appointed to consider the matter of road improvements. It has been suggested that $160,000 bonds be issued for the purpose of improving the streets.

Savannah, Ga.—See "Water."

Northampton, Mass.—In the annual report of the Superintendent of Streets a recommendation is made for an appropriation of $5,000 for the construction of Thorpe Hill Road.

Syracuse, N. Y.—It is stated that plans for this year include 12 miles of pavement. Cost estimated at $700,000.

Cumberland, R. I.—An appropriation of $3,500 has been voted for lighting purposes.

Chicago, Ill.—The Board of Local Improvements has ordered brick pavement in 19 streets.

Jacksonville, Fla.—The contract for paving Main St. has been awarded to W. M. Lasely of Chattanooga, Tenn., at $1.47 per sq. yd.; total, $31,503.57.

Bryan, Tex.—The Council has passed an ordinance authorizing the issue of $15,000 street improvement bonds.

Sea Cliff (L. I.), N. Y.—It is stated that bids are wanted Jan. 11 by the Village Treasurer for $8,000 street improvement bonds.

Louisville, Ky.—Bids received Dec. 29 for paving several avenues with asphalt have been rejected; new bids will be received about Jan. 13. Chas. F. Grianger, Chmn. Bd. Pub. Wks.

Schenectady, N. Y.—The Common Council has voted to borrow $8,265 for paving Summit Ave. and $5,022 for improving Mynderse St.

Dallas, Tex.—The total estimated cost of paving Elm St. is $25,000.

Eau Claire, Wis.—An ordinance has been passed providing for brick pavement on several streets.

Fortuna, Cal.—It is stated that bids are wanted Jan. 10 for constructing a portion of the Bridgeville and Trinity Road. O. D. Stern, Clk.

Jersey City, N. J.—Bids are wanted Jan. 10 for 4,500 sq. yds. of asphalt paving on Clendenny Ave. Geo. T. Bouton, Clk. Bd. Street & Water Commrs.

Kokomo, Ind.—Bids are wanted Jan. 30 for 11,000 yds. brick paving and 5,000 ft. of curbing. Charles R. Ford, City Clk.

Middletown, Conn.—The Street Committee has been granted an appropriation of $26,000.

Philadelphia, Pa.—See "Water."

Atlantic City, N. J.—Bids are wanted Jan. 16 for improving certain avenues, as advertised in "The Engineering Record."

Atlantic City, N. J.—It is stated that the following bids were opened Dec. 27 for paving cross avenues. The City Surveyor's estimate of work to be done is 21,340 sq. yds. of macadam roadway, 5,025 sq. yds. of vitrified block pavement, 13,840 lin. ft. of straight curbing, 512 ft. curved curbing, 100 lin. ft. stone curbing reset: Delaware River Quarry & Construction Co., total bid, $35,936.15; detailed bids, per sq. yd. of macadam paving, 79 cts.; per sq. yd. block paving (gutters), $2.26; concrete, $4.50; straight curbing, 47 cts.; curved curbing, $1.25; curbing reset, 10 cts. Thomas J. McGovern, $36,662.60. James B. Reilly & Co., $36,829.83. Alcatraz Paving Co., $37,177.30.

POWER PLANTS, GAS AND ELECTRICITY.

Manlius, N. Y.—We are informed that bids will probably be asked March 12 for an electric light plant having a capacity of 500 to 1,000 lights. Probable cost, $2,000. Address W. J. Phillips.

Steelton, Pa.—The Steelton Electric Light Co. is stated to have received the contract for lighting the city for five years with 1,200 c. p. arc lights at $75 per light per year.

Boscobel, Wis.—C. W. Menkhausen, City Clk., writes that it was voted Dec. 29 to issue $9,000 bonds for an electric light plant.

Media, O.—See "Electric Railways."

Alpena, Mich.—It is stated that at the April election the question of issuing electric light bonds will be voted upon.

Greenville, Miss.—The Peoples' Light Co. has been incorporated; capital, $15,000. Incorporators: Harley Metcalfe, Geo. Wheatley and others.

Dayton, O.—It is stated that an election will be held in April to vote on issuing bonds for a municipal lighting plant.

Lisbon, O.—It is reported that an electric plant will be established in connection with the water-works.

Glassboro, N. J.—The Clayton, Glassboro & Pitman Grove Electric Light Co. is stated to have received the contract for lighting the streets by electricity.

Dallas, Tex.—It is reported that the Dallas Electric Co. will expend about $200,000 in improving its plant.

Hull, Que.—John F. Boult, City Clk., writes that the proposition to issue $8,000 electric light bonds carried at election, held Dec. 27.

Oregon, Mo.—See "Water."

Albert Lea, Minn.—The Council is stated to have appointed a committee to ascertain the cost of an electric plant for the city.

Humboldt, Ia.—The question of granting an electric light franchise will again be voted upon, according to reports.

Fullerton, Cal.—Edgar Johnson writes that it is proposed to let a contract for the construction and operation of an electric light plant. About $2,000 has been subscribed.

Williamsport, Md.—See "Water."

Caro, Mich.—We are informed that bids will be asked early in the spring for a power house and dam to cost $40,000. F. S. Wheat, J. H. Harris and Chas. Montague, of Caro, are interested. O'Keefe & Osborn, Engrs. in Charge, Appleton, Wis.

Santa Barbara, Cal.—The construction of a complete lighting plant for the city is under consideration. Frank F. Flournoy, City Engr.

Cleveland, O.—A charter has been granted to the Washington Lighting Co., of Ohio, with principal office at this place. Capital subscribed, $500, with the privilege of increasing the same to $600,000. Incorporators: Geo. W. Turner and Chas. Perillat, of Boston, Mass.; L. M. Loomis, of Cleveland, O., and others.

Franklin, Ind.—H. C. Strickler & Son, of this city, are said to have petitioned the Council for permission to establish an incandescent electric light system.

Baltimore, Md.—It is stated that the plans are about completed and bids will be received Jan. 25 for a full system of subways between Saratoga and Pratt Sts. and Greene St. and Jones Falls. The conduits will be vitrified clay, carrying a cluster of 4 ducts about 4 in. sq. each, in sections 3½ ft. long. Mr. Phelps, Chf. Engr. of Subways.

New York, N. Y.—See "Government Work."

Fostoria, O.—The Council has passed an ordinance granting permission to the City Heat & Light Co. to lay, construct, maintain and operate mains and pipes for conducting gas through the city.

Bessemer, Ala.—It is stated that the Bessemer Electric Light Co. will improve its system. Aaron K. Stiles, of Streator, Ill., Pres.

Jersey City, N. J.—The Union Gas Improvement Co. has received the contract for gas lighting for 1899 at $28 per lamp per year.

Dillsboro, Ind.—It is reported that the question of electric lighting will be submitted to a vote of the people.

Saxton, Pa.—The question of municipal lighting will, it is stated, be presented to the voters in February.

Richmond, Va.—It is reported that bids will be received about Feb. 1 for an electric plant; probable cost, $700,000. Smith & Fisher, Des. Engrs., care of James River Construction Co., Richmond.

Philadelphia, Pa.—See "Water."

Cleveland, O.—It is stated that bids are wanted Jan. 28 for furnishing and maintaining 7,750 incandescent gas lamps for one year. Geo. R. Warden, Dir. Dept. Pub. Wks.

Sea Island City, N. J.—Bids are wanted Jan. 23 for lighting the borough with electricity. James Chapman, Borough Clk.

Minneapolis, Minn.—It is stated that bids are wanted Jan. 13 by the City Clerk for electric, gas and gasoline lighting.

Prescott, Ont.—It is reported that bids will soon be received for an electric light plant. J. W. White, Corporation Clk.

Brewton, Ala.—See "Water."

Laconia, N. H.—Bids are wanted for 100 arc lights of 2,000 c. p., also 1,200 c. p. lights, also 300 Welsbach lights, all-night lighting. Term of contract, 5 years. S. C. Frye, City Clk.

Orangeburg, S. C.—See "Water."

Topeka, Kan.—The following bids for material and machinery for the improvement of the electric light plant were opened Dec. 29 by S. S. McFadden, City Clk.: W. M. Thompson Co., Sioux City, Ia., simple engine—Corliss, shafting, pulleys and belt, normal capacity 486 h. p., $7,045; J. B. Ehrsam & Sons, Enterprise, Kan., same, $7,146.

Camden, N. J.—The following bids for lighting the streets with electricity for five years were opened Dec. 29 by Chas. C. Southard, Chm. Lighting Com. *a*, arc lights, overhead; *b*, arc, underground; *c*, incandescent, overhead; *d*, incandescent, underground. Price given per night: *Camden Lighting and Heating Co., Camden, N. J., *a*, 33 cts.; *b*, 45 cts.; *c*, 5½ cts.; *d*, 8 cts. William Moore & C. E. Wilson, Philadelphia, Pa., *a*, 30 cts.; *b*, 50 cts.; *c*, 6 cts.; *d*, 10 cts.

*Contract awarded.

Lawton, Mich.—The General Electric Co., of Chicago, is stated to have received the contract for the lighting apparatus for the electric light plant; the contract for the power plant is stated to have been given to the Wray Austen Machinery Co., of Detroit; estimated cost, $5,000.

ELECTRIC RAILWAYS.

Media, Pa.—The Cleveland, Wadsworth & Southern St. Ry. Co. is stated to have petitioned for a franchise for an electric railway and to furnish power.

Alexandria, Ind.—The matter of constructing an electric railway from this place to Hartford City is under consideration. L. Grover of Anderson, R. H. Hannah of Alexandria and others are interested.

New Britain, Conn.—The Central Ry. & Electric Co. is stated to be considering an extension of its line. A. M. Young, Pres.

Easton, Pa.—A committee is stated to have been appointed to secure right of way, etc., for a trolley road between this place and Nazareth. Frank Huth of Nazareth, Chm. Com.; H. D. Maxwell of Easton, Secy.

Irwin, Pa.—The Greensburg, Jeannette & Pittsburg Electric R.R. Co. is stated to have applied for a right of way through Irwin, to extend its line to North Irwin and Lorimer. W. F. Sadler, Pres.

Kenosha, Wis.—John C. Wegner of Milwaukee is stated to have applied for a franchise.

Los Angeles, Cal.—It is stated that bids will probably soon be asked for a franchise for an electric railway on Eleventh St.

Vancouver, B. C.—The British Columbia Electric Ry. Co. is stated to have received an 11 year lease for a double track line over Davie St. to English Bay. J. Bentzen, Mgr.

Plainfield, N. J.—The Plainfield St. Ry. Co. is stated to have received a franchise to extend its line.

Indianapolis, Ind.—George J. Marott, Horace F. Wood and Dr. R. C. Light have petitioned the County Commissioners for a franchise for an electric railway system between Indianapolis and Logansport.

Holbrook, Mass.—The Holbrook & Weymouth Ry. Co. is stated to have received a franchise.

Liberty, Mo.—The Council is stated to have granted Chas. L. Leitch, County Surveyor, Liberty, and Chas. L. Dougherty, an attorney, a franchise for an electric line.

Lynchburg, Va.—The Virginia Paving Brick Co., of Lynchburg, is stated to have received the contract for rebuilding the street railway of the Lynchburg Electric Light & Ry. Co.; contract price said to be $70,000.

Alton, Ill.—It is reported that the Alton Ry. & Illuminating Co. will expend about $200,000 on improvements, including a new city heating system.

Lorain, O.—It is stated that a survey is being made for an electric railway between this city and North Amherst. Capitalists interested in the quarries of Amherst will build the road.

Akron, O.—The Akron, Bedford & Cleveland Electric Ry. Co. is reported to be surveying a line from a point above Cuyahoga Falls to Hudson, O., 8 miles.

Pasadena, Cal.—It is stated that bids are wanted Jan. 17 by the City Clerk for the purchase of a franchise to construct and operate a single-track street railway. The Los Angeles Terminal Ry. Co. has applied for the franchise.

Denver, Colo.—The Denver City Traction Co. has been incorporated; capital, $1,450,000. Directors: Samuel Perry, Chas. B. Whitehead and others.

Rockford, Ill.—We are informed that the contract is about to be let for the construction of 28 miles of electric railway, estimated to cost $400,000. E. M. Hopkins, 1141 Monadnock Bldg., Chicago, is interested. J. B. Butolet, Engr. in Charge, Leafriver, Ill.

East St. Louis, Ill.—A company is stated to have been organized to build an electric railway from East St. Louis to Alton. Chas. E. Carroll of St. Louis, Pres.; August Holthaus of St. Louis, Secy.

Kansas City, Mo.—Plans are said to be completed for the conversion of the line of the Brooklyn Ave. Co. to electricity and also for several miles of extensions.

RAILROADS.

Davis, W. Va.—It is stated that the Bismarck & Potomac R.R. Co. will build a railroad from Davis to Harpers Ferry. Directors: Saml. B. Shank and D. P. Herr, of Lancaster, Pa.; Powell Evans, of Philadelphia, and others.

Los Angeles, Cal.—The Southern Pacific R.R. Co. has purchased the Los Angeles & Pasadena R.R. and will, it is stated, make extensive improvements.

Saugatuck, Mich.—The Saugatuck & South Haven Railroad Co. has been incorporated to build a gauge road between Saugatuck and South Haven, a distance of about 22 miles; capital, $176,000. Joseph Johnson, Benton Harbor, is one of the incorporators.

Dallas, Tex.—The Dallas Terminal Ry. & Union Depot Co. is said to be considering the matter of extending its line to Ft. Worth, a distance of about 32 miles.

Charleston, W. Va.—A charter has been granted to the Arbuckle & Wolf Creek R.R. Co. to construct a railroad in Fayette County; capital, $100,000. Incorporators: J. M. Richards of Oak Hill, J. A. Franklin of New Orleans, and others. Principal office to be at this place.

Columbia, Mo.—The citizens are stated to have voted to grant a bonus to Chas. Wiggins, E. M. Kidder and Daniel B. Ely, of St. Louis, representing the Missouri Midland R.R. Co., to aid in constructing a standard gauge railroad between this city and the Missouri, Kansas & Texas.

Denison, Tex.—The business men of this section are reported to have subscribed $40,000 to build the Denison & Bonham Ry. John Scuttion, of St. Louis, is said to be interested.

Springfield, Ill.—A charter has been granted to the St. Louis, Peoria & Northern R.R. Co.; capital, $25,000,000. Incorporators: J. B. Cavanaugh, Chicago; Huston D. Adcock, West Springs, Ill.; L. J. Buckley, St. Louis, Mo., and others. Principal office in Springfield.

NEW DEPOTS.

Oakland, Cal.—It is stated that the Southern Pacific Co. will erect a union freight depot at West Oakland. C. P. Huntington, of New York, Pres.; Wm. Hood, of San Francisco, Ch. Engr.

Atlanta, Ga.—The railroads are stated to have engaged Grant Wilkins of Atlanta to prepare plans for the union depot; plans to be completed by March.

Boston, Mass.—The Boston & Albany Ry. Co. is to build a new freight house 417 ft. x 87 ft. Estimated cost, $20,000.

PUBLIC BUILDINGS.

Bridgeport, Conn.—Mayor Taylor on Dec. 29 approved the action of the Aldermen in voting to petition the Legislature to grant power to issue $300,000 bonds for new municipal buildings. He also favors action by the Council toward securing power to issue about $100,000 bonds for new schools.

Canton, S. D.—It is stated that bids will soon be received for a court house; probable cost, $25,000.

Cleveland, O.—The Cleveland Gesangverein is stated to have decided to ask for competitive plans for a building which they propose to erect in the near future. Paul Schmidt is said to be interested.

St. Bernard, O.—It is stated that a $30,000 addition will be erected to St. Clement's Church.

San Antonio, Tex.—Alfred Giles of San Antonio is completing plans for a 5 story fireproof building for the San Antonio Loan & Trust Co. Bids will be called for at once.

Champaign, Ill.—It is stated that the Trustees of the University of Illinois will ask for an appropriation of $150,000 to erect a building for the Department of Agriculture.

Newport News, Va.—See "Paving and Roadmaking."

Milwaukee, Wis.—The plans of E. R. Liebert, 107 Wisconsin St., are stated to have been accepted for remodeling the courthouse.

Whitehall, N. Y.—Andrew Douglas of Binghamton is stated to have received the contract for erecting the armory at $34,893. Seymour Taylor of Glens Falls received the contract for electric wiring at $1,250.

South Bend, Ind.—The City Council adopted a resolution Dec. 26 that a committee of five, including the Mayor, be appointed to procure plans and specifications for a new city hall and enter into such contracts as may be necessary to secure the erection of such a building.

Groton, Mass.—It is stated that the Groton school has been presented with $75,000 for a new chapel.

Washington, D. C.—The District Commissioners are stated to have decided to reject all bids received for constructing an isolating building on the ground of Providence Hospital, and to invite new bids after the plans have been revised. See our issue of Dec. 3 for list of bids.

Exeter, N. H.—Architect Casey, of New York, is stated to have submitted plans for a new alumni hall to be added to the equipment of the Phillips Exeter Academy; estimated cost, $35,000.

Everett, Mass.—A $12,000 engine house is to be erected here.

Brooklyn, N. Y.—A 15-story fireproof hotel is to be erected on Fulton St. and Myrtle Ave. for John F. Morrissey, Jr.; probable cost, $500,000.

Toronto, Ont.—At the election held Jan. 2 it was voted to improve St. Lawrence Market at an estimated cost of $150,000. C. H. Rust, City Engr.

El Paso, Tex.—Bids are wanted Jan. 12 for a city hall. Estimated cost, $25,000. Maydwell & McClintock, Archts.

New Orleans, La.—Bids are wanted Jan. 23 for erecting the Wm. T. Richards memorial hospital. Edwin Marks, Secy. Bd. of Administrators of the Charity Hospital.

Lexington, Ky.—Bids are wanted Jan. 17 for a brick boiler house and building. Mrs. L. E. Yandell, Pres. Bd. of Trustees of the Kentucky House of Reform, 11 Cheapside.

Belgrade, Minn.—Bids are wanted Jan. 16 for a church. Rev. Anton Miks, St. Peter, Minn.

Clarion, Pa.—Chas. M. Robinson, of Altoona, is stated to have been selected to prepare plans for a new home for the poor and insane of Clarion County.

Philadelphia, Pa.—It is reported that plans are under consideration for a $400,000 edifice for the First Baptist Church.

Garner, Ia.—Gross Bros. are stated to have received the contract for the court-house at $24,990.

New Haven, Conn.—The Board of Charities & Corrections are stated to have voted Dec. 27 to ask for bids for a new heating plant at Springside Home, and also for a new workshop.

Evansville, Ind.—It is stated that bids are wanted Jan. 20 for rebuilding the St. George Hotel; estimated cost, $65,000. Harris & Shopbell, Archts.

Owatonna, Minn.—It is stated that bids are wanted Feb. 1 (change of date) for a public library. B. E. Darby, Secy. Bd. of Directors.

Everett, Mass.—The city is considering the question of building a new city hall and a 12-room school house.

Oshkosh, Wis.—Bids the wanted Jan. 30 for a library. Casper Fluor, Chmn. Bd. Pub. Wks.

FIRES.

Port Dalhousie, Ont.—The factory of the Toronto Rubber Co. is reported to have been destroyed by fire Jan. 2; loss, about $100,000.

NEW INDUSTRIAL PLANTS.

The King Morse Canning Co., Broadway and Sansome Streets, San Francisco, will put up 100x150-ft. and 125x200-ft. buildings at San Leandro and probably install two 16x54-in. boilers.

Mr. Paulus Gast, of the Gast Wine Co., 919 North Sixth St., St. Louis, is interested in a company which expects to put up a brewery of 125 to 150 barrels a day. Plans are now being drawn and it is expected that construction will begin about March.

The Kelley Milling Co., Leavenworth, Kan., will erect a flour mill of 1,500 barrels daily capacity at Kansas City, Mo. The company states the matter is not far advanced because of trouble over the title to the real estate bought for the plant.

Geo. Giles & Co., Ocala, Fla., will move its cotton ginning plant from Marti City to Ocala and enlarge its capacity.

Mr. E. B. Hornady, Ellaville, Ga., writes that residents of this city have started a subscription to put up a cotton mill or induce some outside party to build one.

BUSINESS NOTES.

Mr. M. J. Martinez, M. Am. Soc. M. E., has received the appointment as resident agent at Havana, Cuba, for the Aultman & Taylor Machinery Company, Mansfield, O., manufacturers of the "Cahall" vertical and the "Cahall" horizontal water tube boilers. Business will be conducted under the style of Mr. M. J. Martinez, Consulting and Contracting Engineer.

The General Electric Company announces that Mr. W. J. Clark, author of the book on "Commercial Cuba," recently reviewed in this journal, has accepted the office of general manager of its foreign department, with headquarters in New York.

A new church, known as the Pawtucketville Church, at Lowell, Mass., is being erected in accordance with plans made by Architect J. Merrill Brown, of Boston. Over the interior auditorium will be placed heavy steel trusses, having a clear span supporting the roof framing and ceiling. J. H. Connell & Co., Lowell, are the general contractors for the work, and the Berlin Iron Bridge Co., of East Berlin, Conn., furnish and erect the steel work.

The Chicago Pneumatic Tool Company states that its business for last month was four times greater than that of the same period of 1897, and the result of the year as a whole was most gratifying. The use of pneumatic tools is rapidly widening, a fact recognized by the Navy Department in ordering equipments for its principal yards. The company's new hand riveters for ship builders, bridge and structural works have proved even a greater success than was anticipated, and its standard riveters, hammers and drills have been adopted in many large establishments in England and on the Continent.

The Cambria Steel Company, which has leased the works of the Cambria Iron Company at Johnstown, Pa., has consolidated its New York offices, heretofore at 100 Broadway and 33 Wall St., at the Empire Building, 71 Broadway. Mr. H. L. Waterman has been appointed general sales agent for New York and vicinity, in charge of the office. He will give special attention to structural steel, blooms, billets and slabs. Mr. W. A. Washburne will give attention to rails and track fastenings, and Mr. L. R. Pomeroy to axles and forgings. Mr. Thomas F. Russell, 102 Chambers St., New York, will sell the special products of the Gautier department, as heretofore.

BUILDING INTELLIGENCE.

NEW YORK, N. Y.

133-135 Broome st, br store and flat; cost, $30,000; o, Julius & Max Weinstein; a, G F Pelham.

126 Eldridge st, br store and flat; cost, $23,000; o, E R Poerschke; a, Kurtzer & Rohl.

127 to 131 Broome st, store and flat; cost, $50,000; o, Jacob Fischer; a, Horenburger & Straub.

S s 75th st, 253 e 1st ave, 2 br stores and flats; cost, $56,000 all; o, Adolph Wiedhopf; a, Edw Wenz.

S s 92d st, 80 e 2d ave, br store and flat; cost, $20,000; o, F J Schnugg; a, M Johnson.

E s 5th ave, 75 s 115th st, br store and flat; cost, $22,000; o, Wm Cummings, Jr, and Robt Ferguson; a, G F Pelham.

Central Park West, 25 n 98th st, 2 br flats; cost $150,000 all; o, Jno K McAfee; a, G F Pelham.

S s 113th st, 100 w Boulevard, br flat; cost, $55,000; o and a, Louis & John Brandt.

N s 120th st, 100 w 7th ave, br flat; $24,000; o, Wm G Webber; a, G F Pelham.

W s Wales ave, 312 s Westchester ave, 2 br flats; cost $28,000 all; o, Michael J Whelan; a, W C Dickerson.

MISCELLANEOUS.

Canton, O.—Bucher st, near Liberty st, fire engine house; cost $10,000; o, City of Canton, O; a, Robert Ostermayer.

Denver, Colo.—15th and Wenatta sts, br warehouse, 40x200; cost, $11,500; o, Geo L Oddy; a, Varion & Sterner.

Southbridge, Mass. — 3 story br parochial school; a, Chickering & O'Connell, of Springfield, Mass.

PROPOSALS OPEN.

Bids Close.		See Eng. Record.
	WATER-WORKS.	
Jan. 10.	Castings, Charleston, S. C.	Jan. 7
Jan. 10.	Chicago, Ill.	Jan. 7
Jan. 11	Pipe, etc., Baltimore, Md	Jan. 7
Jan. 11.	Vailsburgh, N. J	Dec. 31
	Adv., Eng. RECORD, Dec. 31.	
Jan. 11.	Boilers, South Bend, Ind	Dec. 31
Jan. 13.	Goshen, Ind	Dec. 31
Jan. 16.	Bonds, Whittier, Cal	Jan. 7
Jan. 17.	Bonds, Bozeman, Mont	Dec. 31
Jan. 19.	Florence, Colo	Jan. 7
	Adv., Eng. RECORD, Jan. 7.	
Jan. 18.	Winchester, Ind	Dec. 24
Jan. 21.	Cheboygan, Mich	Dec. 31
	Adv., Eng. RECORD, Dec. 31, Jan. 7.	
Jan. 23.	Canton, O	Jan. 7
Jan. 24.	Canby, Minn	Dec. 31
Jan. 24.	Bonds, Wamego, Kan	Dec. 31
Jan. 25.	Phœnix, A. T	Dec. 24
Jan. 25.	Bonds, McConnelsville, O.	Dec. 31
Jan. 25.	Orangeburg, S. C.	Jan. 7
	Adv., Eng. RECORD, Jan. 7.	

Jan. 26. Washington, D. C........................Dec. 31
Adv., Eng. RECORD, Dec. 31, Jan. 7.
Jan. 27. Cylinders, etc., Cleveland, O. ..... Dec. 31
Jan. 28. Bonds, Cincinnati, O. ....Jan. 7
Jan. —. Bonds, Little Falls, Minn. ....Dec. 24
Feb. 1. Tuskegee, Ala ....Dec. 31
Feb. 6. Bonds, Berea, O......................Dec. 31
Feb. 13. Bonds, Reno, Nev.....................Dec. 24
Mar. 15. Belem, Para, Brazil..................Nov. 26

SEWERAGE AND SEWAGE DISPOSAL.

Jan. 10. Bonds, Grass Valley, Cal............Dec. 3
Jan. 10. Allegheny, Pa.......................Jan. 7
Jan. 11. Buffalo, N. Y.......................Dec. 31
Jan. 13. St. Louis, Mo.......................Jan. 7
Jan. 14. East Cleveland, O...................Dec. 24
Jan. 14. Kansas City, Mo ....Jan. 7
Jan. 15. New York City.......................Dec. 3
Jan. 16. Elizabeth, N. J.....................Dec. 24
Jan. 16. Denver, Colo........................Jan. 7
Jan. 16. Toledo, O...........................Jan. 7
Jan. 17. Mt. Vernon, N. Y....................Dec. 31
Jan. 18. Aiken, S. C.........................Dec. 17
Jan. 23. Sewer pipe, etc., New London, Conn. Dec. 24
Jan. 25. Phœnix, A. T ....Dec. 24

BRIDGES.

Jan. 10. Corydon, Ia. ....Dec. 31
Jan. 10. Hastings, Neb.......................Dec. 24
Jan. 11. Oskaloosa, Ia.......................Jan. 7
Jan. 16. Boston, Mass........................Jan. 7
Jan. 17. St. Paul, Minn......................Jan. 7
Jan. 17. Plans, Binghamton, N. Y.............Dec. 24
Jan. 24. St. Thomas, Ont.....................Dec. 24
Jan. 24. Waverly, Ia ....Jan. 7
Jan. 31. Bonds, Jackson, Miss................Dec. 24
Jan. --. Hastings, Neb.......................Dec. 10
Feb. 20. Chicago, Ill ....Dec. 31
Adv., Eng. RECORD, Dec. 31.
Mar. 1. Quebec, Que ....Jan. 7
Apr. 1. Substructure, St. Joseph, Mo.........Jan. 7
—— Spring Lake, N. J............................Jan. 7

PAVING AND ROADMAKING.

Jan. 9. Houston, Tex.........................Dec. 17
Adv., Eng. RECORD, Dec. 17, 24.
Jan. 9. Brighton, N. Y.......................Dec. 31
Jan. 10. Oskaloosa, Ia ....Dec. 31
Jan. 10. Jersey City, N. J...................Jan. 7

Jan. 10. Fortuna, Cal........................Jan. 7
Jan. 11. Bonds, Sea Cliff (L. I.), N. Y.......Jan. 7
Jan. 12. Louisville, Ky......................Jan. 7
Jan. 16. Atlantic City, N. J.................Jan. 7
Adv., Eng. RECORD, Jan. 7.
Jan. 17. Cincinnati, O.......................Dec. 24
Jan. 30. Kokomo, Ind.........................Jan. 7
Feb. 27. Yonkers, N. Y.......................Dec. 8

POWER, GAS AND ELECTRICITY

Jan. 12. Annapolis, Md.......................Dec. 17
Jan. 13. Minneapolis, Minn...................Jan. 7
Jan. 14. New York, N. Y......................Jan. 7
Jan. 16. Duluth, Minn........................Dec. 10
Jan. 17. Mt. Vernon, Ind ....Dec. 31
Jan. 18. Winchester, Ind.....................Dec. 24
Jan. 20. Belding, Mich.......................Dec. 31
Jan. 23. Sea Island City, N. J...............Jan. 7
Jan. 25. Baltimore, Md.......................Jan. 7
Jan. 25. Orangeburg, S. C....................Jan. 7
Adv., Eng. RECORD, Jan. 7.
Jan. 28. Gas lamps, Cleveland, O.............Jan. 7
Jan. —. Bonds, Little Falls, Minn...........Dec. 24
Feb. 1. Tuskegee, Ala........................Dec. 31
Feb. 1. Menahgo, Minn........................Dec. 31
Mar. 1. Sault Ste. Marie, Mich...............Dec. 24
Mar. 31. Telephone, Shanghai, China..........Nov. 19
Feb. 1. Richmond, Va.........................Jan. 7
—— Pleasantville, O.............................Dec. 24

GOVERNMENT WORK.

Jan. 10. Cement, Duluth, Minn................Dec. 17
Adv., Eng. RECORD, Dec. 17 to Jan. 7.
Jan. 10. Pumping engine, Charleston, S. C. ..Dec. 31
Jan. 12. Cement, St. Paul, Minn..............Dec. 17
Adv., Eng. RECORD, Dec. 17 to Jan. 7.
Jan. 12. Sea wall, Annapolis, Md.............Dec. 24
Jan. 14. St. Louis, Mo.......................Dec. 24
Adv., Eng. RECORD, Dec. 24 to Jan. 7.
Jan. 14. Extending light system, New York, N. Y ....Jan. 7
Jan. 16. St. Augustine, Fla..................Dec. 31
Adv., ENG. RECORD, Dec. 31, Jan. 7.
Jan. 19. Akron, O ....Dec. 24
Adv., Eng. RECORD, Dec. 24, 31.
Jan. 19. Pottsville, Pa......................Dec. 24
Adv., Eng. RECORD, Dec. 24, 31.
Jan. 20. Wharves, etc., Washington, D. C. ...Dec. 24
Jan. 20. Fog signals, St. Joseph, Mich ......Dec. 31
Jan. 20. Revetment work, Houghton, Mich.......Jan. 7

Jan. 23. Stone, etc., New London, Conn ....Dec. 24
Jan. 24. Batteries, Fort Monroe, Va..........Dec. 24
Jan. 30. Beacons, Mobile, Ala................Jan. 7
Jan. 31. Dry dock, Boston, Mass..............Dec. 31
Feb. 1. Duluth, Minn.........................Jan. 7
Adv., Eng. RECORD, Jan. 7.
Feb. 3. Dredging, Duluth, Minn ....Jan. 7

BUILDINGS.

Jan. 9. School, Wilmington, Del..............Dec. 3
Jan. 10. Plans, Des Moines, Ia...............Dec. 24
Jan. 10. Phœnix, Ariz........................Dec. 3
Jan. 10. Plans, etc., Boone, Ia..............Dec. 17
Jan. 12. El Paso, Tex........................Jan. 7
Jan. 12. School, Washington, Pa..............Jan. 7
Jan. 16. Belgrade, Minn......................Jan. 7
Jan. 17. Lexington, Ky.......................Jan. 7
Jan. 18. Plans, Mineola, N. Y................Dec. 24
Jan. 20. Evansville, Ind ....Jan. 7
Jan. 21. Washington, D. C....................Dec. 24
Jan. 23. New Orleans, La.....................Jan. 7
Jan. 24. School bonds, Mt. Vernon, N. Y......Jan. 7
Jan. 25. Dormitory, etc., Phœnix, A. T. .....Dec. 24
Jan. 30. Oshkosh, Wis........................Jan. 7
Jan. 31. School bonds, Jackson, Miss. ....Dec. 24
Jan. —. Superstructure, Newport, R. I ......Nov. 19
Feb. 1. School, Peoria, Ill...................Dec. 3
Feb. 1. Owatonna, Minn.......................Jan. 7
Feb. 10. Keyser, W. Va.......................Nov. 5
Feb. 16. School, Ellendale, N. D.............Jan. 7
Feb. 25. Douglass, Ga........................Dec. 31

MISCELLANEOUS

Jan. 9. Elec. Ry. franchise, Baltimore, Md..Dec. 24
Jan. 11. Street cleaning, Indianapolis, Ind. .Jan. 7
Jan. 12. Street cleaning, Philadelphia, Pa. .Jan. 7
Jan. 14. Philadelphia, Pa....................Nov. 19
Jan. 15. Street cleaning, Indianapolis, Ind...Dec. 17
Jan. 16. Engineer's supplies, etc., Brooklyn, N. Y........Jan. 7
Jan. 17. El. Rys., Pasadena, Cal.............Jan. 7
Jan. 18. Garbage dis., San Francisco, Cal. ..Dec. 31
Jan. 19. Docks, etc., Cleveland, O...........Dec. 24
Jan. 20. Wharfs, etc., Honolulu..............Dec. 31
Jan. 24. Tunnel, London, England.............Nov. 5
Jan. 24. Garbage disposal, Chicago, Ill......Jan. 7
Jan. 26. Washington, D. C....................Dec. 31
Adv., Eng. RECORD, Dec. 31.
Feb. 1. Crane, Townsville, Australia. ....Dec. 17
Mar. 15. El. Ry., Shanghai, China............Nov. 19

NEW SCHOOLS.

Salina, Kan.—The proposition to issue $10,000 school bonds is stated to have been carried.

Montgomery, Ala.—It is reported that $50,000 in bonds will be issued for the enlargement and erection of schools.

Canton, O.—The Board of Education has decided to erect a $15,000 school. A. O. Slentz, Supt. School Bldgs.

Philadelphia, Pa.—Chas. McCaul, 10 N. 11th St., has received the contract for the new Law School for the University of Pennsylvania. Cost, over $300,000. Cope & Stewartson, 320 Walnut St., Archts.

Spring Grove, Minn.—The citizens are stated to have voted to erect a $10,000 school.

Rockford, Ill.—The question of erecting a $24,000 school in the 3d Ward is stated to be under consideration.

Lorain, O.—The School Board is stated to have accepted plans for a $15,000 school.

Bridgeport, Conn.—See "Public Buildings."

Homestead, Pa.—At the February election the citizens will be asked to vote on issuing $40,000 bonds for a new school.

Washington, Pa.—Bids are wanted Jan. 12 for a brick school in Canton Township. McCollins & Ely, Archts.

Ellendale, N. D.—It is stated that bids will be received by the Industrial School Board Feb. 16 (readvertisement) for a school.

Everett, Mass.—See "Public Buildings."

Mt. Vernon, N. Y.—It is stated that bids are wanted Jan. 24 by the Board of Education for $50,000 school bonds.

Washington, D. C.—The citizens of Columbia Heights have decided to ask the District Commissioners for an appropriation of $100,000 for schools.

New Castle, Pa.—It is stated that a $40,000 school is to be erected.

Kansas City, Kan.—The citizens have voted to issue $75,000 bonds for a new high school.

Barre, Mass.—The plans of Andrews, Jaques & Rantoul of Boston are stated to have been accepted for the $25,000 high school.

STREET CLEANING AND GARBAGE DISPOSAL.

Chicago, Ill.—Bids are wanted Jan. 24 for the collection and disposal of garbage for 1899. L. E. McGann, Commr. Pub. Wks.

Indianapolis, Ind.—Bids are wanted Jan. 11 for sweeping and cleaning the improved streets for 1899. M. A. Downing, Chmn. Bd. Pub. Wks.

Philadelphia, Pa.—The following contracts have been awarded for cleaning streets, removal of ashes, etc., during 1899: First and second districts to C. H. Vare, Betz Bldg., $83,700, $144,898; third district to Daniel Dooley, 4835 Lancaster Ave., $43,900; fourth district to David McMahon, Germantown, $134,750. Contracts for the fifth and sixth districts have been readvertised and new bids will be received Jan. 12. Thomas M. Thompson, Dir. Dept. of Pub. Wks.

Philadelphia, Pa.—See "Water."

Bridgeport, Conn.—The Board of Health has decided to ask the Board of Apportionment for a special appropriation of $14,000 for the purchase of a garbage crematory.

Camden, N. J.—The contract for repairing the garbage crematory plant has been awarded to Burt & O'Hara. See our issue of Dec. 24 for bids received.

Oakland, Cal.—J. W. Northrup has presented to the City Council an application for a 50-year franchise involving the exclusive right to collect and cremate all garbage, refuse, etc.

Atlantic City, N. J.—The Sanitary Committee has decided to reject all bids for the removal and collection of garbage. New bids were to have been opened Jan. 3.

Newport News, Va.—See "Paving and Roadmaking."

GOVERNMENT WORK.

New York, N. Y.—We are informed that contracts for two storehouses at the Navy Yard have been awarded by the Bureau of Yards and Docks, Navy Dept., Washington, D. C., to W. C. Triest, C. E., 39 Cortlandt St., New York City, for $75,000 and $64,526.

New York, N. Y.—Bids are wanted Jan. 14 (readvertisement) for extending the electric light system at the Navy Yard. Mordecai T. Endicott, Ch. Bureau Yards and Docks, Navy Dept.

Mobile, Ala.—Bids are wanted Jan. 30 for the erection of 6 day beacons on Florida Reefs, Fla. Lieut.-Col. A. N. Damrell, Corps of Engrs., U. S. A.

Houghton, Mich.—It is stated that bids are wanted Jan. 20 for 8,000 ft. of revetment work. Maj. Clinton B. Sears, Corps of Engrs., U. S. A., Duluth, Minn.

Duluth, Minn.—Bids are wanted Feb. 3 for dredging in Portage Lake ship canals, Keweenaw Point, Mich. Maj. Clinton B. Sears, Corps of Engrs., U. S. A.

Duluth, Minn.—Bids are wanted Feb. 1 at the U. S. Engineer Office for building substructure for north pier, Duluth Ship Canal, as advertised in "The Engineering Record."

San Francisco, Cal.—The following bids were opened Dec. 29 by the Superv. Archt., Treas. Dept., Washington, D. C., for a boiler plant, pumps, modification of power plant and heating apparatus at the U. S. Appraiser's Building: T. J. Moynihan, $13,700; Fulton Engine & Shipping Wks., $9,500; G. H. Fay & Co., $8,750; P. F. Dundon, $9,737; The Risdon Iron & Locomotive Wks., $20,750. Bidders all of San Francisco.

ECUADOR, CAROLINE ISLANDS AND PORTO RICO.

Coal Sheds and Piers.—According to the Brooklyn Eagle, the Navy Department proposes to let contracts at once for the construction of coal sheds at Guam Island, capable of storing 10,000 tons of coal; also for building piers.

Railways.—The New York "Times" states that American capitalists have been granted concessions by the Ecuadorean Government, including the right to build a railway 300 miles in length. The Directors of the company are Peter Cooper Hewitt, Archer Harman, Chas. H. Sherrill of New York City and others.

Railway and Electric Plant.—The Baltimore Sun states that the San Juan & Rio Predas Railway Co. contemplates extending its railway to Canguas, a distance of 24 miles; also constructing an electric plant in connection with same. J. G. White & Co. are interested.

MISCELLANEOUS.

Brooklyn, N. Y.—Bids are wanted Jan 16 for engineers' and plumbers' supplies John W. Keller, Pres. Dept. Public Charities, New York, N. Y.

Cleveland, O.—The ordinance permitting the expenditure of $500,000 for park purposes has passed the City Council.

Montreal, Que.—Local reports state that the Harbor Board has awarded the contract for a steel hull dredge to Carrier, Lane & Co. for $44,000.

Tuscola, Ill.—It is stated that J. E. Rogers & Co., of Tuscola, Ill., have received the contract for a drainage canal in Bourbon Township. Estimated cost, $10,000.

Toronto, Ont.—E. J. Castle, Secretary for City Engineer, writes that the by-law, providing for esplanade cribbing, Block D, at a probable cost of $40,000, carried at the recent election.

Rochester, N. Y.—The Park Board has asked for an appropriation of $40,000 for this year.

Providence, R. I.—The following bids for furnishing and delivering cement as needed in the sewer, water, highway and bridge departments, during 1899, were opened Dec. 28, by Robert E. Smith, Commissioner of Public Works, as advertised in "The Engineering Record:" *a*, Rosendale cement, per cask of net wght. of 300 lbs.; *b*, Portland cement, per cask of net wght. of 375 lbs.: James C. Goff,* *a*, 85c.; *b*, $2.20. Manchester & Hudson, *a*, 83c.; *b*, $2.24. Bidders both of Providence.

*Contract awarded.

Los Angeles, Cal.—Local reports state that the following bids were received by the City Council: *a*, 3d St. tunnel; *b*, Broadway tunnel: George Rheinschild, *a*, $92,990; *b*, $74,000. C. Leonardt, *a*, $96,000. Chas. Stansbury, *a*, $104,600; *b*, $82,500. Edwards & Byerly, *a*, $88,900; *b*, $66,900. French & Reed, *a*, $97,800; *b*, $87,500. Conrad Scherer & W. E. Thornton, *a*, $101,375; *b*, $82,735. A. A. & C. A. McDonald, *a*, $94,900. A. M. Chaffey, *a*, $89,797; *b*, $70,400. Alcatraz Paving Co., *a*, $111,103; *b*, $74,948. C. L. Powell, *a*, $88,449. Robert Dewar, *a*, $93,333. J. B. Johnson, *a*, $95,860. Mathus & Haupt, *b*, $74,993. Johnson & Gardner, *b*, $74,874. Ramish & Marsh, *b*, $70,990.

THE ENGINEERING RECORD.
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TABLE OF LEADING ARTICLES.

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MUNICIPAL ARCHITECTURE IN BOSTON.

On August 24, 1895, an editorial notice was printed in these columns concerning the civic architecture of Boston. Prior to the revision of the city charter, about that time, a city architect was a regular officer of that municipality; the office was abolished and since then plans have been drawn for the Department of Public Buildings by architects in private practice. The office of city architect was held for five years by Mr. Edmund M. Wheelwright, and the duties of that position were discharged in a particularly efficient manner under his direction. In noticing the change in policy at Boston, it was stated by "The Engineering Record" in the number mentioned: "If a city architect could always be a Mr. Wheelwright nothing more could be desired than that official. Again, a mayor with good taste and judgment, whose final approval is requisite for all plans, would undoubtedly leave excellent results behind him, but experience has shown often enough, and too often, that such mayors are not always in office. It may be accepted as a fundamental principle in this as in all other matters that the official who has to make a certain class of decisions should have had the training and experience to enable him to do so. A consulting architect, as advocated by Mr. Wheelwright, if properly appointed, would undoubtedly be as safe an official as it would be possible to intrust such duties with. Such a city officer could discharge his duties without prejudice to a rational system of competition in the design of city buildings; indeed, by insuring proper specifications and by prescribing reasonable conditions he could save his city from many difficulties and embarrassing complications into which at least one great architectural competition has fallen from the lack of competent direction. In the case of any great emergency the consulting architect could be transformed into a commission by one other appointment, these two to appoint a third to complete the commission. The whole subject is one about which gather some difficulties, and it is probable that Boston has not reached the final solution, yet its future experience will be watched with much interest."

In the message of the Hon. Josiah Quincy, mayor of Boston, recently presented to the city council, will be found the following interesting communication concerning the condition of affairs which resulted from the abolition of the office of city architect:

"At the beginning of the year the Architectural Division was transferred from the Public Buildings Department to the Engineering Department, and the position of consulting architect to the mayor, which was established by me three years ago, was united with that of chief of this division. The connection of this work with the engineering department is clearly the most suitable one, if it is not to be given an independent standing, and the service of the division has proved useful and valuable in many ways—such as in the preparation of studies and estimates for proposed new buildings, and of plans for alterations and repairs and for steam heating and ventilating. The examination of all plans requiring the approval of the mayor, including those of new school buildings, by a consulting architect, has proved of great utility and value to the city.

"While I would not favor the revival of the office of city architect as it formerly existed, experience has satisfied me that there are considerable drawbacks to the plan of securing outside architectural services prescribed by chapter 449 of the acts of 1895, and that the city loses a good deal by scattering its work among so many different architects, and having it done to a great extent without continuity or harmony. I have recently taken up this subject with a committee of the Boston Society of Architects appointed to consider it, and it now appears to me that a scheme of organization for an architectural department can be formulated which will be free from most of the dangers and drawbacks existing under the old system, and which will secure the advantages of a continuous department, of a proper professional character, without being exposed to the political and administrative difficulties formerly experienced. The plan which has most commended itself to the members of this committee and to myself is that of establishing an architectural department under a board of three or five practicing architects, who would only give such portion of their time to the city as might be required. These architects might be appointed partly by the president of the school committee, acting on behalf of that body—on account of the large amount of building work in connection with schools—and partly by the mayor, subject in each case to confirmation by the art commission; the latter provision is deemed an absolutely essential one to insure the maintenance of a sufficiently high profesional standard and to remove the choice beyond the sphere of political influences.

"The designing and erecting of all school buildings would be done by one of the members of the board named on behalf of the school committee, the work being divided in some manner between them, probably by territorial districts, and the same duty in relation to all other municipal buildings would be divided between the two members of the board appointed by the mayor; plans of school buildings to be subject to the approval of the school committee and of the mayor, and all plans for any other municipal buildings to be subject to the approval of the mayor, as at present. All plans would come before the full board of architects for approval, and in this manner the same advantages would be secured, with competent men constituting the board, which were realized in such a striking manner through the work of the board of architects which passed upon the plans of the buildings for the Chicago fair. It seems to me that under this plan a continuity and harmony of purpose, and a combined professional judgment, would be introduced in a manner which is now impossible, and that there would be the greatest assurance possible under any system that the architectural work of the city would be of the best obtainable character. The advantage of having the same architect, if thoroughly competent, work year after year upon one class of buildings, such as school houses, seems obvious, and the combined judgment of the board would take the place, in an even more effective manner, of the important service now performed by the consulting architect, while the expense to the city need not be any greater than under the present system. The importance of securing the best possible architectural work upon new municipal buildings can hardly be exaggerated, and any change of organization which promises to secure the highest character of professional service will, I believe, be likely to receive the approval of the Legislature."

A SIDE LIGHT ON HYDRANT RENTALS.

No one who follows the decisions concerning the business of water purveying which are made by the state and federal courts can fail to be impressed with the depth and frequency of the legal pitfalls which await the builders of private water-works. It is generally acknowledged that irrigation laws are in a formative condition; the best codes are not yet fully determined, and the whole subject is still in a haze of uncertainty, which is satisfactory to no one but the clientless lawyer. It would seem, however, that the legal conditions of such a long-established business as the supply of water to communities should be well settled by this time; yet hardly a month passes in which a decision is not rendered by some high court, which conveys the impression that a good-looking, well-drawn franchise may prove after all little better than a gold brick to the trusting investor.

For example, reference may be made to a recent decision of the Supreme Court of Nebraska in the suit brought by the Lincoln Land Company against the village of Grant, which is printed in a recent number of the "Northwestern Reporter." About ten years ago the board of trustees of this village adopted an ordinance authorizing the plaintiff to construct and maintain a system of water-works in the town, and to use the streets for a term of 25 years as a site for its mains. The ordinance further provided that the company should furnish the village the use of 15 hydrants free of cost for 4½ years immediately following the completion of the system, and that for the 20½ years next ensuing the village should pay the company an annual rental of $60 apiece for not less than 15 hydrants. The plant was built and free hydrant rental furnished for the 4½ years, as provided in the ordinance. During the following year the village used the 15 hydrants, but when a bill for $900 was presented, according to the agreement, the company was told it might whistle for the money, for the board of trustees would not pay it. The company naturally brought suit for the sum, and carried it to the Supreme Court, which has explained a feature of the Nebraska law of hydrant rentals investors will do well to notice.

The Supreme Court decides that the village was authorized by its charter to make such a contract, although in some States, such as Illinois, such a period is longer than the law allows. The question is, therefore, whether the power was exercised lawfully. The village charter states: "Ordinances shall contain no subject which shall not be clearly expressed in their titles." The ordinance in this case was entitled: "An ordinance authorizing the Lincoln Land Company to construct and maintain a system of water-works, and use the streets, alleys, avenues and public grounds for laying their pipes and mains, in the town of Grant, in Perkins County, Nebraska." This title, the court says, has no hint of hydrant rental in it. It neither specifically nor by general terms gives notice that the ordinance contains a contract binding the city to anything in the future. It is held to be "sharply restrictive, and not at all calculated to arouse aldermanic suspicion that there might be a contract concealed in the folds of the measure." The

title was not an index to the contract, which was therefore decided to be void.

It was admitted that the village had used the hydrants for a year, and that this service was worth the $900 charged for it; and it is satisfactory to learn farther on in the decision that while the contract was void, the service rendered in good faith must be paid for by the village. The principle on which this opinion is reached is stated as follows in an opinion by the Supreme Court of California: "The city is not exempted from the common obligation to do justice which binds individuals. Such obligation rests upon all persons, whether natural or artificial. If the city obtain the money of another by mistake, or without authority of law, it is her duty to refund it, from this general obligation. If she obtain other property which does not belong to her, it is her duty to restore it, or, if used, to render an equivalent therefor, from the like obligation. The legal liability springs from the moral duty to make restitution, and we do not appreciate the morality which denies in such cases any rights to the individual whose money or other property has been thus appropriated. The law countenances no such wretched ethics. Its command always is to do justice."

The Supreme Court of the United States has also ruled on this principle in the following language: "A contract made by a corporation, which is unlawful and void because beyond the scope of its corporate powers, does not by being carried into execution become lawful and valid; but the proper remedy of the party aggrieved is by disaffirming the contract, and suing to recover, as on a quantum meruit, the value of what the defendant has actually received the benefit."

In the case of the village of Grant, the judgment against the company was accordingly reversed and the case remanded for further proceedings along the line indicated. It will be seen, however, that such a decision is really a very barren victory. A water company generally has to do business for five years at least to reach a point where it meets all its expenses, to say nothing of any profit, and if it begins its further existence with no hope of any contract with the village for fire protection, which, in a small plant, largely determines the size and cost of the works, it has prospects of trouble ahead. A company building a plant in the belief it has a quarter-century contract for hydrant rental which finds itself deprived of this source of revenue is not in a pleasant situation.

THE NEW SOUTHERN TERMINAL STATION, BOSTON.—III.

The U-shaped head-house encloses a large train-shed occupied wholly by the 28 stub tracks and their platforms. Beyond it there are houses for the power plant, express service, etc. The specifications and drawings were very complete.

The main structure of the train-shed, not including the adjacent connecting roofs, is 566 feet wide and 600 feet long, with a single roof supported by transverse trusses in three spans of 169, 228, and 169 feet respectively. Each set of three trusses in the same transverse plane is 60 feet from the adjacent set to which it is connected by 24 main purlins in the longitudinal planes through the vertical posts of the trusses. They are also connected by the vertical longitudinal trusses in each side of the monitor which covers the three center panels of the roof from end to end, and are braced by diagonal rods in the planes of the rafters in the end and alternate intermediate panels. The main purlins support I-beam jack rafters 7½ feet apart. The lower chords of the main trusses are braced by approximately horizontal trusses in the panels at the gable ends. A transverse monitor 15 feet wide is set over each main truss and reaches from one panel above the eaves to one panel below the central longitudinal monitor. The three panels at each end of each center truss are made as cantilever arms of the adjacent side trusses and support the center portion with expansion bearings. The columns are set in four longitudinal rows of 11 each. The two outer rows are braced with continuous lines of horizontal struts which virtually constitute deep longitudinal girders with vertical wall pieces and diagonal rods. The two interior rows are braced longitudinally with struts and diagonals forming trussed bents in the end and alternate panels. Diagrams of the principal plans and elevations are shown in Figures 9 and 11.

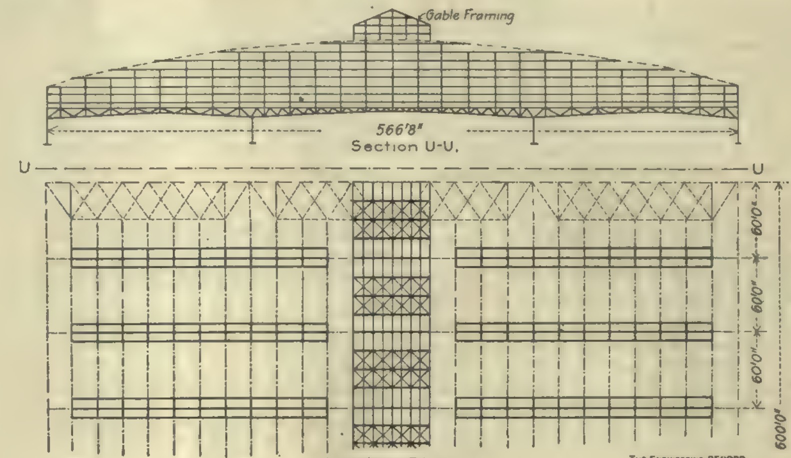


FIG. 11

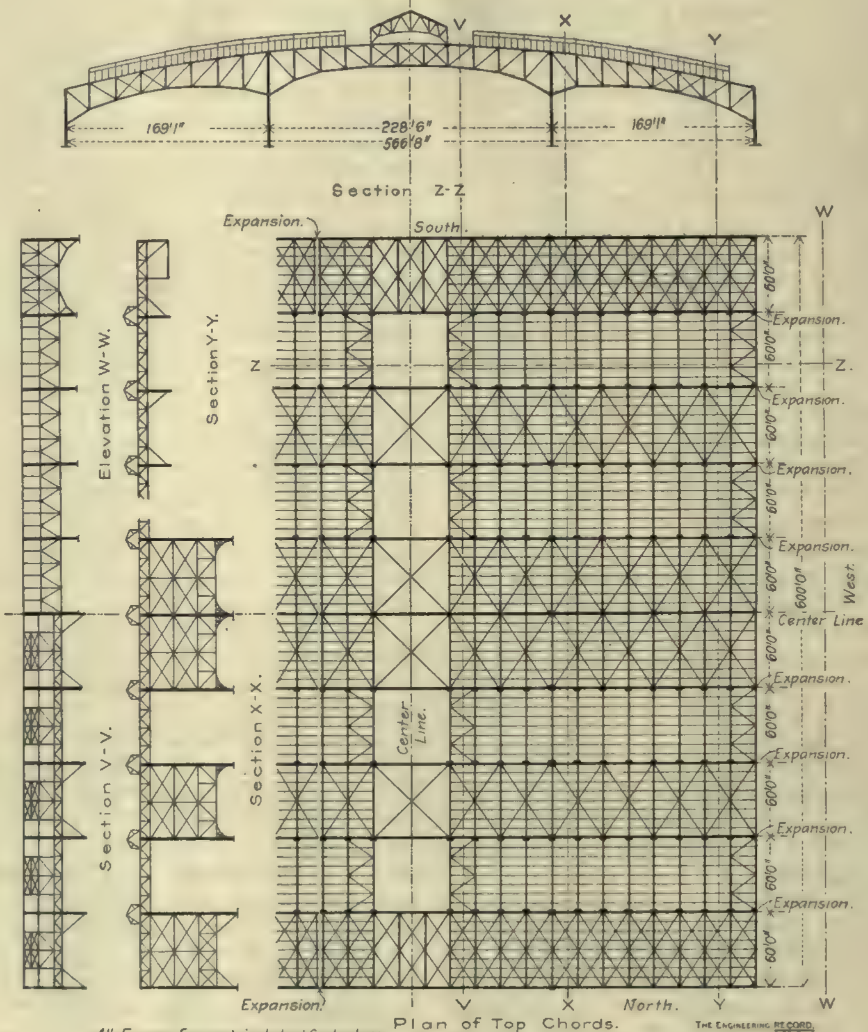


FIG. 9

TRAINSHED DIAGRAMS OF THE NEW BOSTON TERMINAL.

The main intermediate trusses are made with pin connections at all panel points except at the lower chord connections to the interior columns, which are also riveted as indicated in Figure 10, from which the strains may be approximated by dividing the sectional areas by the following allowed unit strains in pounds per square inch; Bearing on outside plates, 15,000; bearing on plates having rivets in double shear, 18,000; shear on rivets, 10,000; tension on plates and shapes, 15,000; tension on bars, 16,000. The top chord is of uniform inverted-trough section throughout, 21 inches wide and having two 18-inch webs. The variations in cross section are made chiefly by increasing the thicknesses of the web plates which are as follows; commencing at the outer end of the side truss, ⅝, ½, 11/16, 11/16, 9/16, ⅝, ⅝, ⅝, ⅝, ⅝, ⅝, 7/16, 7/16 and at the center panel 7/16 inch. From U1 to U5 the top chord angles are all ½ inch thick, elsewhere they are all ⅝ inch thick. In U1 U2 and from U10 to U13 the 21-inch top plate is ½ inch thick; from U2 to U4, it is ⅝ inch thick; U4 to U5 it is 9/16 inch thick and elsewhere it is ⅝ inch thick. The double, treble, and quadruple webs of the bottom chord are arranged as indicated in Figure 12, which also shows the knee brace at the outside column connection. The vertical posts have an H-shaped cross-section made up of one web plate and four flange angles reinforced where necessary by flange plates. The posts have horizontal shelf brackets and web bolts to receive the ends of the lower chords of the purlins, which have top chords connected to horizontal angle clips riveted to the webs of the main-truss top chords. Typical plans of the connections of the diagonal rods and struts to the top chords of the middle and

side trusses of a panel of the lateral bracing are shown in Figure 13.

The purlins are simple triangular riveted longitudinal trusses 7 feet 10 inches deep and 60 feet long, made up with two 4x4x⅜-inch angles for the top chord, two 3½x3x5/16-inch angles for the bottom chords and pairs of 2½x2½x 5/16-inch angles for the web members, all riveted together back to back with washers. The top lateral rods have long clevises pin-connected to plates which are shop riveted to the purlins and field riveted to the top chords of the trusses. The interior columns are made of pairs of built channels latticed together with riveted connection plates for struts and diagonal rod pins. The exterior columns are made with very wide web plates in the planes of the trusses so as to form vertical plate girders resisting the bending moments.

On two sides of the train-shed wedge-shaped spaces separate it from the head-house walls, and these are roofed by trusses, rafters and purlins arranged and dimensioned as shown in a part plan which with some diagrams of the midway roof trusses is given in Figure 14, which is typical of the rest of that portion of the structure.

The train-shed floor over the subway is made of riveted rectangular troughs of two sizes one of which is shown in Figure 15. The maximum lengths of the troughs was 30½ feet. They were shop riveted in sections 5 or 6 feet wide and field riveted to the webs of plate girders which rested across the tops of short columns. These troughs were filled with broken stone ballast so that tracks can be located in any desired position upon it.

The train-shed and midway roofs are covered with 2-inch tongued and grooved Georgia hard pine in widths of 8 inches, free from knots and shakes, with square butt joints over the rafters, laid smooth side down and fastened with wire nails to surfaced hard pine spiking pieces which are bolted to the rafters. All ventilators, window frames, sash and mouldings are of prime hard pine, put together with large brass screws. All railings and walks are surfaced spruce of clear seasoned stock. The wooden sheathing on the ends of the train-shed is 2-inch tongued and grooved Georgia hard pine 8 inches wide, laid smooth side in. All the midway roofs except the tops of monitors, all of the connecting roofs, all of the monitor roofs on the main train-shed, all of the flashings and counter flashings for the composition roofs around the monitors and other vertical walls, all of the cornices on the main and monitor roofs, all the timber sheathing at the ends of the train-shed and monitors, including all of the exterior main parts of the window frames in the ends and sides of the train-shed and sides of the monitors are covered with 16-ounce rolled copper. The wooden sheathing of all coppered roofs is covered with tar paper, lapped.

The sheathing of the main train-shed roof and tops of midway monitor roofs is covered with two thicknesses of Warren's composite roofing felt, manilla side down, secured on the lower edge of each sheet by nails driven through tin blanks, 2½ feet apart. Over this is laid two thicknesses of Warren's natural asphalt roofing felt, each sheet mopped under its full width with Warren's natural asphalt roofing cement and nailed on the upper edge. Over the entire surface of the felt thus laid is spread a continuous and even coating of Warren's natural asphalt roofing cement, covered immediately with well-screened, dry, white Long Island gravel.

The train-shed roof is designed to carry a total dead load of 60 pounds per square foot. The roof steel weighs about 23 pounds per square foot, and the coverings about 10 pounds.

The window sashes are rigidly fastened to the window frames except where especially arranged for opening. All glazing is asbestos covered wire glass not less than ⅜ inch in thickness. It is set in putty and then fastened with strips of wood on a setting of putty, the strips being held to the sash by brass screws. All glass is set vertically and permanent foot

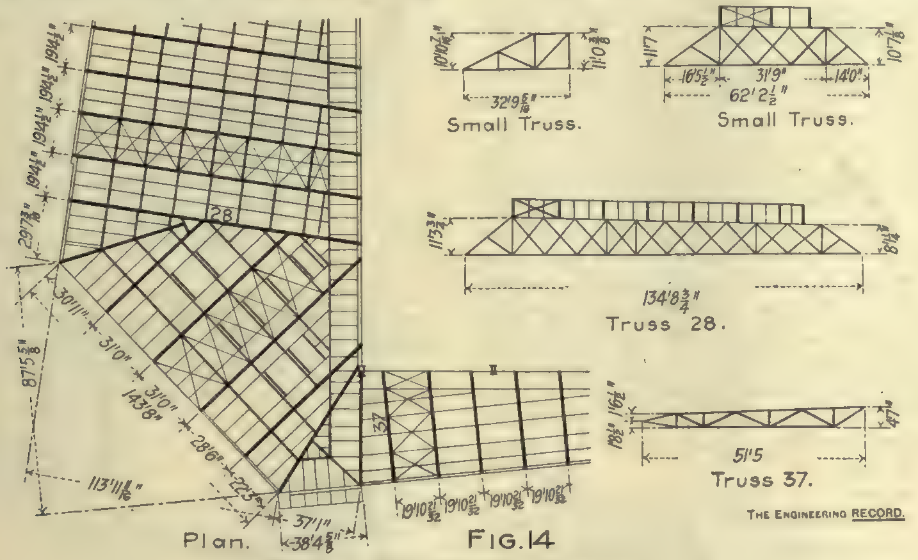
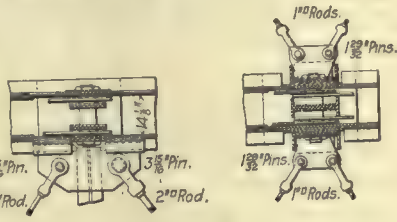


FIG. 14

SCHEME OF STEELWORK OF THE MIDWAY.



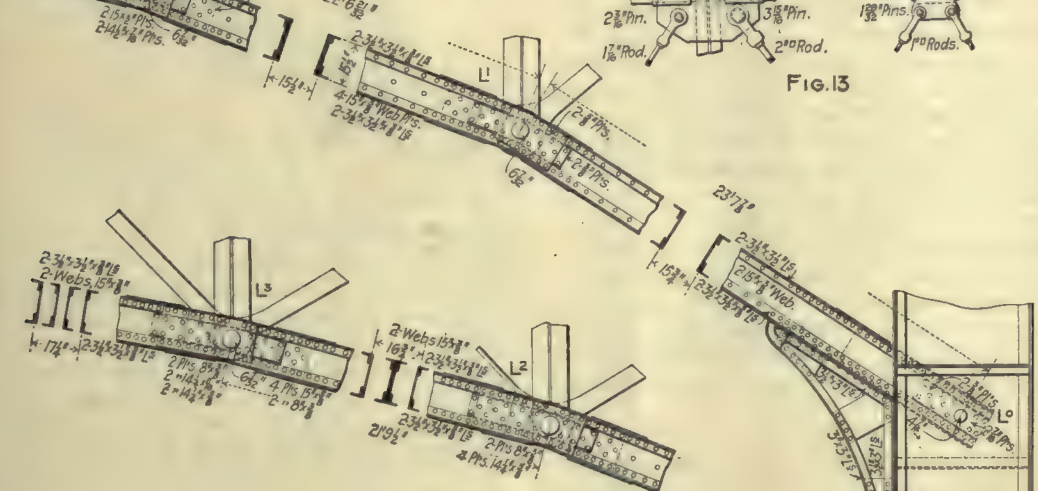


FIG. 12

DETAILS OF THE ROOF TRUSSES.

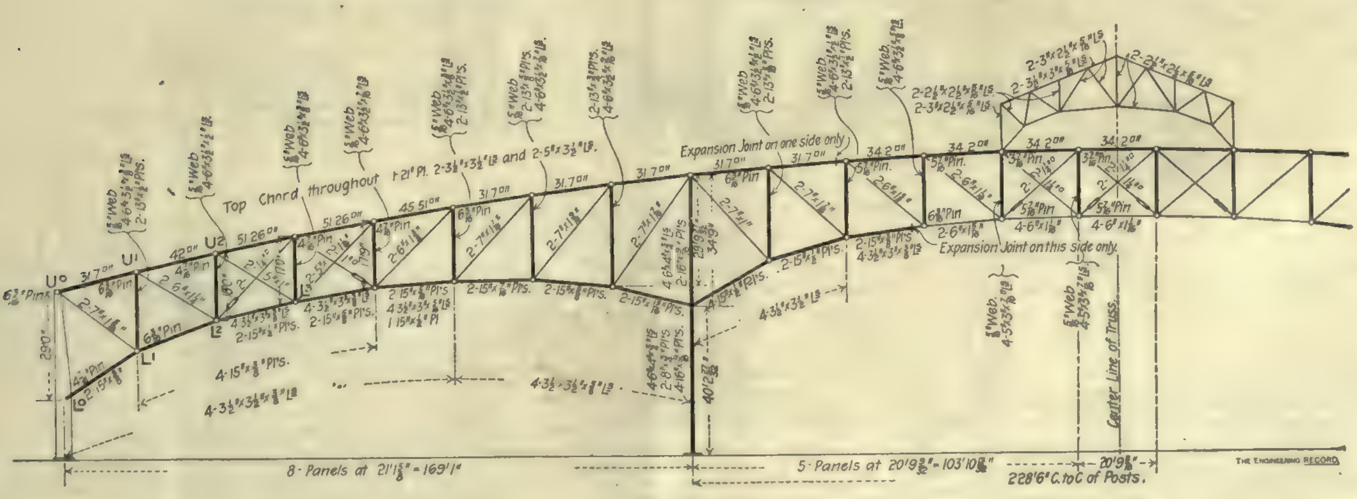


FIG. 10

THE TRAINSHED OF THE NEW SOUTHERN TERMINAL STATION, BOSTON.

SHEPLEY, RUTAN & COOLIDGE, ARCHITECTS; GEORGE B. FRANCIS, RESIDENT ENGINEER; THE PENNSYLVANIA STEEL COMPANY, BUILDERS.

walks are arranged so that every pane is accessible from them for washing.

Before laying the midway floor arches and the track ballast the portions of the steel in the midway floor not exposed in the subway and the solid steel track flooring was swabbed with one coat of mineral pitch and oil, put on at a temperature of about 350 degrees Fahrenheit, and mixed in the proportion of about 85 parts of Trinidad asphalt and 15 parts of crude black oil when applied in warm weather, or of about 65 parts of the mineral pitch and 35 parts of the oil when applied in cold weather, varying the proportions within these limits to suit the temperature. In warm weather the swabbing on vertical and inclined surfaces was done only a little in advance of the arch work, on account of the tendency of the mixture to crawl under a hot sun. The mineral pitch was either refined Trinidad asphalt which contains no oil, or paving cement which is the same with an addition of about 15 per cent. of oil, which was considered as a part of the above-named oil percentage.

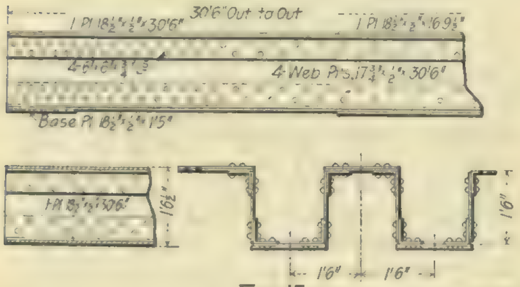


FIG.15
THE TRACK FLOORING.

White enamel first-quality face bricks were used for the first ring in arches, and straight, light, hard bricks, grouted, for the second ring. The floor was leveled up to the under side of the asphalt top with a concrete made of one part Portland cement, five parts sand or fine cinders, and ten parts of coarse cinders or gravel and finished with two inches of Trinidad asphalt.

Mr. George B. Francis, M. Am. Soc. C. E., was the resident engineer for the Boston Terminal Company, and Messrs. Shepley, Rutan & Coolidge were the architects for the head-house. Norcross Brothers were the general structural contractors and Westinghouse, Church, Kerr & Company were general contractors for the mechanical and power installations. Among the principal sub-contracts that for the steel work of the train-shed was awarded to the Pennsylvania Steel Co.; that for 70,000 barrels of Alpha Portland cement was awarded to Mr. James A. Davis & Company, Boston; that for pile driving was awarded to Mr. Frederick P. Mayo, Boston; for plumbing to D. M. Quay & Company, of the same city.

(To be Continued.)

THE CLINTON, MASS., SEWAGE DISPOSAL SYSTEM.

In "The Engineering Record" of April 9, 1898, there was an article on the Wachusett reservoir and aqueduct of the Massachusetts metropolitan water supply in which reference was made to the fact that works were to be built to purify the sewage of the town of Clinton before turning it into the Nashua River. These works are now under construction and consist of an intercepting sewer, a reservoir and pumping station and filter beds. The intercepting sewer is about 5,400 feet long and varies in size from a 20-inch pipe to a 30-inch circular brick sewer. In some places near the river part of the 20-inch pipe had to be laid in embankment. Figure 1 shows a case where this was necessary, and where a retaining wall had to be built to prevent the embankment from sliding into the river. Figure 2 shows the plan and section of two manholes and the connection between an old 30-inch brick sewer and the new sewer at a grade somewhat lower.

The reservoir is covered, and with the exception of the piers supporting the roof, is built entirely of concrete. It is circular with an inside diameter of 100 feet and is about 13 feet high. The roof is supported by means of concrete arches and brick piers as shown in Figure 3. The bottom and roof are each 12 inches thick. The side walls are 2 feet thick at the top and 3 feet 6 inches thick at the bottom, with the inside face vertical. Portland cement concrete masonry was used in building the reservoir, pump-wells, screen chamber and the foundations of the pumping engine. This concrete was mixed in the proportions of 4 parts of clean gravel stones, 2½ parts of sand, and 1 part of Portland cement. The gravel stones were not more than 2 inches and very few less than ¼ inch in their greatest diameter. The mixing was done by hand to the satisfaction of the engineer in charge. It was laid in layers and so thoroughly rammed that the water flushed to the surface and all interstices were entirely filled with mortar. In stopping work the unfinished layers were left in steps, and, in joining new work to old, precautions were taken to secure a perfect bond at the joints by cleaning off and wetting the work already in place. Special care was taken to make the interior surfaces smooth and to insure the complete filling of the interstices between the stones. When voids or irregularities were found on the interior faces of the work they were pointed, immediately after the removal of the forms or lagging, with neat cement or cement and sand as directed by the engineer. After the concrete had been placed in the bottom and immediately after the removal of the lagging or centers, pointing having been done, a skim coating of neat Portland

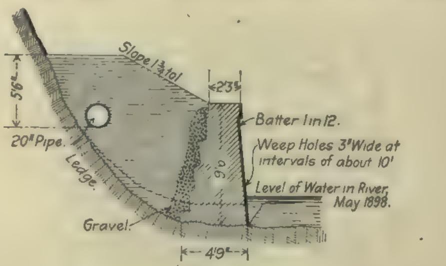


FIG.1

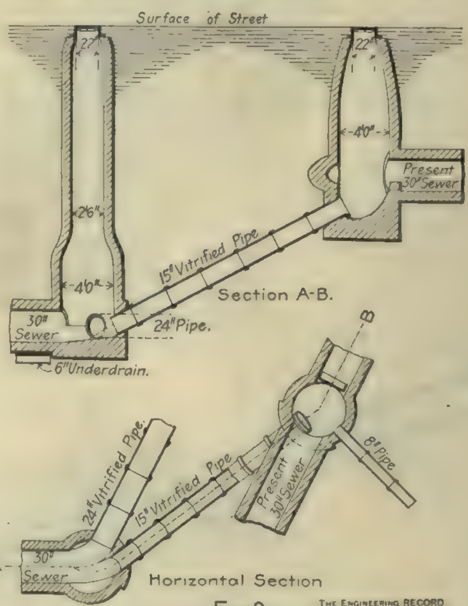


FIG.2
DETAILS OF SEWER CONSTRUCTION.

cement equal in thickness and finish to a plasterer's finish coat was applied.

At the site of the reservoir and pumping station, 18 wash drill borings, having an aggregate depth of 646 feet, were taken. These borings showed that there was about 10 feet of clean gravel overlaying very fine sand. The bottom of the reservoir is about 5 feet, and that of the pump wells about 9 feet, below the top of this

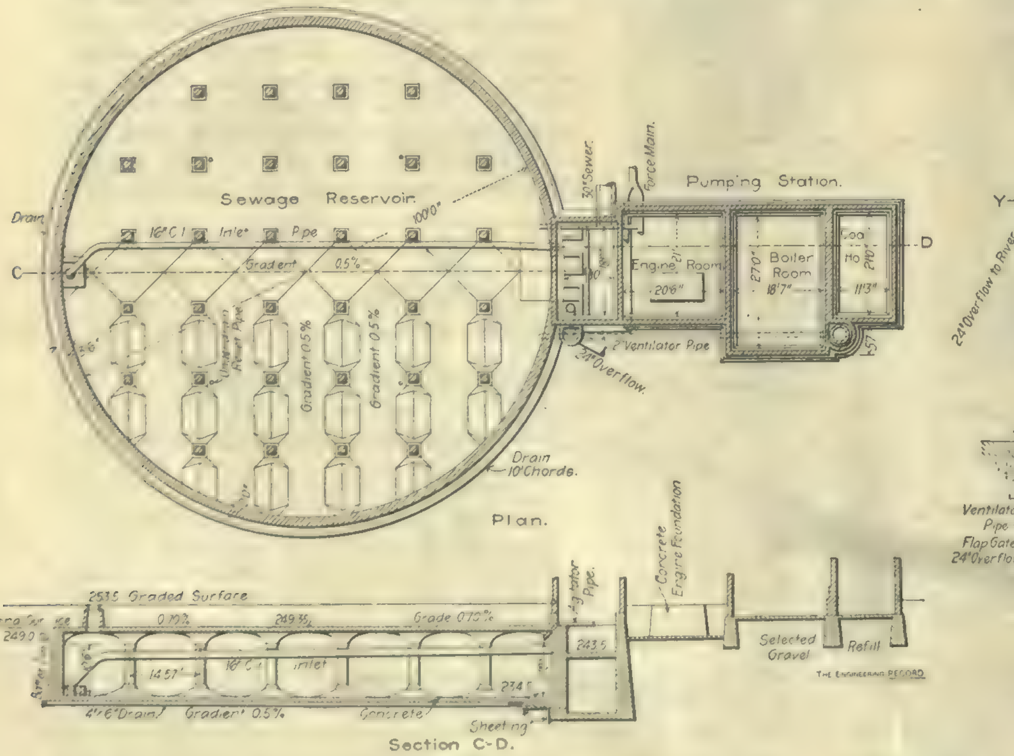


FIG.3

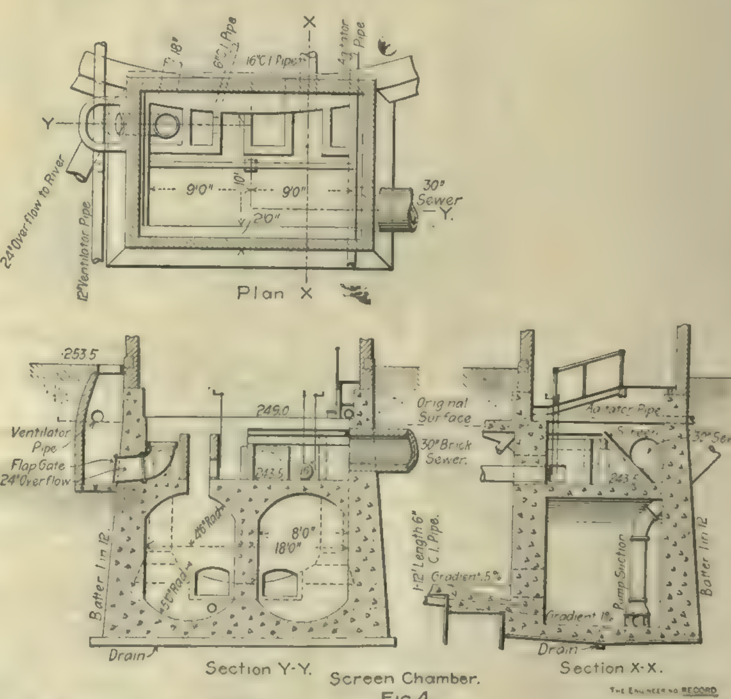


FIG.4

SEWAGE RESERVOIR, CLINTON SEWAGE DISPOSAL SYSTEM.
F. P. STEARNS, CHIEF ENGINEER; T. F. RICHARDSON, RESIDENT ENGINEER.

sand. The reservoir is situated about 100 feet from the bank of Nashua River, the surface of the ground being about 4 feet above the river and the bottom of the pump wells about 15 feet below.

The excavation for the pump-wells was made first. After their masonry had been raised 2 feet above the inside of the bottom, a trench was excavated for the outside wall of the reservoir, starting at the pump-well and thoroughly supporting the material at the sides by close sheeting and bracing. Care was taken to have all sheeting tight and driven far enough below the bottom of the excavation to prevent the admission of sand. The removal of the earth inside the reservoir was not continued until the wall had reached a height of 5 feet. As the reservoir is situated so near the bank of the river it was thought best to make the bottom extra strong against upward pressure, and to load the reservoir with a sufficient amount of earth to prevent it from floating when empty. Suitable overflows which empty into the reservoir are provided to the underdrains so that the bottom of the reservoir will not be subject to more than 14 feet head of water. In times of freshet the water in the river has been 19 feet above the bottom of the reservoir. The sewage can be turned into the far side of the basin, and thus have an opportunity for a large amount of sedimentation, or directly into the pump-well with only a small amount of sedimentation. The gates and screens for doing this are concentrated in a small room between the reservoir and engine room as shown in Figure 3. Figure 4 shows a plan and sections of the screen chamber and the arrangement of inlet and outlet pipes and gates and the overflow into the river. From the pumping station the sewage is forced through an 18-inch iron main across the river and to the top of a hill which is about 49 feet above the bottom of the reservoir, from which it flows through a 24-inch vitrified pipe to the filter beds.

There are 25 of these beds having a total area of about 23½ acres. They are arranged in four rows separated by embankments. In two of these embankments are carried the 18-inch pipes which distribute the sewage to the different beds. Much care was taken in selecting the location of these beds, 24 borings and 287 test pits being made covering a much larger area than that finally selected. The test pits were dug 200 feet apart at first, but when the most favorable area had been located, intermediate pits were dug so that, on the area selected for filter beds, they were 100 feet apart. The pits varied in depth from 8 to 12 feet. Careful measurements were made at each to determine the depth of the soil and the thickness of the various strata of sand and gravel, samples of the sands and gravels being taken and preserved. These samples were afterwards rated, by comparison with other samples whose rates were known, to determine the quantity of water, in gallons per acre per 24 hours, which would pass through them with a head equal to the depth of material. The rates thus obtained varied between 10,000,000 and 110,000,000 gallons per acre averaging 30,000,000 or 40,000,000 gallons. The filter beds were very carefully prepared, the black and yellow surface earth and sub-soil being removed in most cases. They were thoroughly cleared of all bushes and trees, and stumps and roots of a greater diameter than 1 inch were grubbed out. All stones more than 3 inches in diameter were removed. All of the beds were graded and leveled to true and even surfaces, the material from the high parts being used to fill the low parts.

The embankments were built in horizontal layers about 6 inches thick, each being thoroughly rammed and rolled. Where the inlet pipes discharge on the filter beds concrete aprons were built to distribute the flow. These were semicircular in plan, with a radius of 7½ feet, and built of Portland cement concrete of the same proportions as that used in the reservoir. They were laid in alternate blocks in such order that each block was allowed to set before the adjoining one was laid. Wearing surfaces of mortar ½ inch thick made of 1 part of Portland cement and 1½ parts of sand were applied within one hour after the concrete had been placed and were troweled hard and smooth on top. The embankment is protected by a concrete wall and dry stone paving similar to that used at the outlet of the underdrains.

Under the centers of the two lower rows of beds were laid underdrains 6 and 8 inches in diameter uniting at the outlet. The trenches for these were dug to such depths and widths as to give suitable room for placing gravel around them. When fine material was encountered it was removed to a depth of 6 inches below the bottom of the pipe and a width of 2 feet and the trench filled with coarse material. The pipe was carefully bedded with a thorough bearing at all points and laid accurately to line and grade. Screened gravel was placed around each joint, with a minimum thickness of 4 inches in all directions. This gravel was free from sand and clay and at least one-half of it by measure ranged in size from ⅛ to ½ inch; none was over 1 inch in greatest diameter. The trench was refilled with material in 6-inch layers and thoroughly rammed, porous sand and gravel being used for the first 2 feet directly over the pipe. At the outlet of the underdrains a concrete wall 4 feet high, 15 inches thick on top and 24 inches thick at the bottom was built. At a height of 2 feet above the bottom of this wall are the 8-inch pipes. Around the outlet a pavement of cobble and field stones was laid, the stones being laid dry and close together, thoroughly bedded and driven home with heavy rammers and the spaces between them thoroughly chinked. Figure 5 is the plan and section of a typical manhole showing the inlets to the filter beds and the aprons, retaining walls and paving around them.

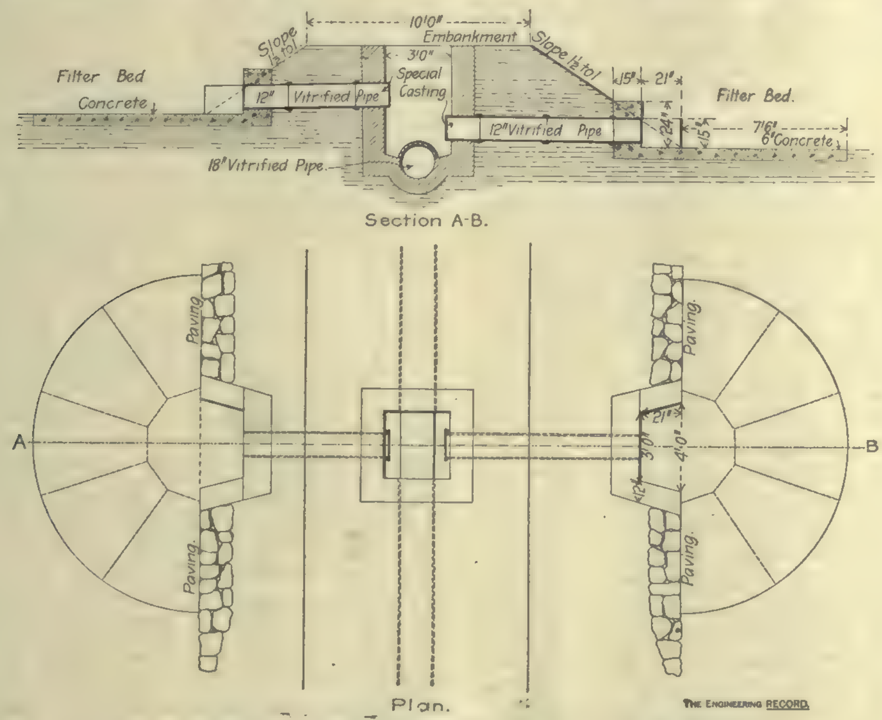


FIGURE 5.—TYPICAL MANHOLE AND INLET TO FILTERS

Mr. Frederick P. Stearns is the chief engineer of the Metropolitan Water Board and Mr. Thomas F. Richardson is the engineer of the Dam and Aqueduct Department; the preceding information was furnished by these gentlemen.

The Electrolysis Ordinance at Richmond, Va., which was hailed as little short of an inspiration when passed a few years ago, has proved to be a fizzle, as was expected by many engineers when it was first announced. The ordinance prescribes an alleged remedy for electrolysis and holds the railway companies responsible for its good results, which is absurd. There is no question of the serious danger to which water mains are exposed in the city, and it has therefore been decided to prepare another ordinance.

GENERAL ABBOT ON THE PANAMA CANAL.

Senate Document 41 of the present session of Congress is a paper by General Henry L. Abbot, Corps of Engineers, U. S. A., retired, on the advantages of the Panama route for a ship canal. He was associated with Mr. A. Fteley, president of the American Society of Civil Engineers, as representing the profession of this country on the board of fourteen engineering experts of international reputation which has assisted the reorganized canal company's technical staff in its elaborate investigation of the conditions and possibilities of this route. These examinations and studies were carried on for a number of years with several thousand employees at times, and the care and patience spent on them contrast strongly with the methods which Congress has authorized in connection with the investigation of the Nicaragua route. It is believed, therefore, that General Abbot's paper will be read with much interest, even if it is openly partisan, and it is accordingly reprinted herewith.

The delays and risks experienced in bringing the Oregon eastward from the Pacific coast at the outbreak of the war with Spain have drawn the attention of the whole country to the importance of an early construction of a ship canal across the isthmus now obstructing free communication between our Atlantic and Pacific coasts. The route by Cape Horn is entirely too long to meet present demands, either commercial or military. But, while a canal is so urgently demanded, it is equally true that it should be, in respect to facilities of transit, security of operation, and cost and time of construction, the best canal possible. The work will be a gigantic engineering feat, and no mistake in selecting the route should be made at the outset. Unfortunately, the American public has been led to believe, by the collapse of the old sea level project at Panama, that there is only one really practicable route for a canal, viz., that by Nicaragua. The elaborate investigations which have been in progress at Panama during the past eight years are little known or appreciated in America, having been conducted quietly (especially during the last four years) by the new company, with a view to determine the best and most economical solution of the problem before making public the information obtained.

The writer, being a member of the comité technique invited to assist the new Panama Canal Company in directing its investigations and forming its conclusions, has had exceptional advantages for understanding the subject in its present aspects. The comité is international in composition, and includes French, English, German, Russian, and American engineers—among them the chief engineers of the Manchester and Kiel maritime canals. It may be added that, in this respect, it reflects the view of the company that the work should be broadly international in character, a benefit to the whole world, and not simply a French construction. Last spring the writer visited the Isthmus of Panama with other engineers, and personally examined the route in detail. He has had for many months free access to the elaborate records of surveys, borings, experimental excavations, river gaugings, and researches of every kind conducted by the company, and is therefore qualified to present the subject in its true aspects, which may be found to differ widely from the popular impressions now existing in America.

When the idea of constructing a sea-level canal at Panama was definitely abandoned, there remained three important difficulties to consider: (1) The regulation of the water supply, and control of the floods of the Chagres River; (2) the serious caving which had occurred at the Culebra, and (3) the ill effects of the climate upon the health of the employees. The present conclusions as to each will be given in turn.

(1) The studies of the region of the Chagres have been most elaborate, including water levels, automatically recorded since 1883; frequent measurements of the discharge at crucial points; the collection and discussion of data respecting all the historic floods (five in number, of which one was carefully measured); rain records at points well distributed along the route of the canal, aggregating fifteen years on the Atlantic coast, thirteen years on the Pacific coast, and thirty-two years in the interior; and, finally, a collation of all this material, and the elaboration of projects perfectly providing for controlling the floods, for the supply of the summit level with water during the dry season (January, February, March, and April), and for ample hydraulic power at the dams, transmitted by electricity, for operating the locks and lighting the canal at night. It may safely be affirmed that the Chagres River is no longer an element of danger, but is rather a useful friend, whose assistance will be of great value to the canal in its operation.

(2) The question of caving in the deep central cut has been studied in the most thorough manner, involving not only many borings and pits to determine the material to be encountered, but also a tunnel excavated throughout the troublesome region along the axis of the canal, having a projected width at bottom of 32¾ feet, with slopes of about 45 degrees, and a projected elevation above sea level varying from 128 feet to 157½ feet. This work, together with a tunnel 689 feet long and 9¾ feet wide, pierced, at an elevation of 134½ feet above sea level, at the spot which had given the most trouble on the whole route, combined with the evidence afforded by the borings and pits at greater depth, leads to the conviction that at Culebra, where the deepest cutting is required, the excavation has already passed through the strata subject to caving, and that the remainder traverses an indurated argillaceous schist changing to compact rock, where no fears of yielding to pressure need be entertained. At Emperador, where the cutting required for the canal is much less, the indications are similar, except that the material at present reached is less resisting; but with proper precautions in the way of drainage, which were wholly neglected by the contractors of the old company, little or no difficulty from serious caving need be apprehended. This work of experimental excavation has been continued for more than three years, involving the removal of about 3,924,000 cubic yards. It was projected, partly, to determine the proper inclination for the side slopes, and partly to estimate the unit cost. The results are highly satisfactory; and the old bugbear of a sliding mountain divide has been proved to be imaginary.

(3) The health of the personnel formerly caused trouble, coolies and other races not well suited to hard labor under a tropical sun being employed. With negroes from the British Antilles little difficulty is now experienced. This matter was carefully investigated during the inspection last spring, American engineers and employees on the canal and the Panama Railroad being questioned, the fine hospital near Panama—where the company provides for its sick—being visited, and the views of the medical officers and of the Sisters of Charity, acting as nurses, being obtained. All agreed that the dangers resulting from the climate have been much exaggerated. The surgeon in charge of the hospital, Dr. Lacroisade, who has resided on the Isthmus since 1887, after presenting full statistics covering the sick reports for the past year of a force of about 3,800 agents and laborers under employment, said:

"Among the diseases attributable to the climate the most numerous are simple marsh fevers, which have not occasioned a single death. Two diseases only belonging to the epidemic type have appeared—the beriberi, of which there is no longer any question (it was imported with negro laborers brought from Africa as an experiment, and disappeared when they were sent back), and yellow fever. The latter, after having been absent from the Isthmus for at least six years, was imported in 1897, and continued about six months—from March to August—when it again disappeared after very light ravages (only six deaths). Thus it can not be considered that this pest is really epidemic on the Isthmus. From the other infectious epidemics, such as variola, typhoid fever, diphtheria, etc., the Isthmus appears to be almost entirely exempt. From the foregoing we may conclude that life on the Isthmus scarcely incurs more dangers than elswhere, even for Europeans, who, after the blacks of the British Antilles, appear to resist the climate best. Residence here would, then, offer nothing alarming were it not for a constant feeling of fatigue and uneasiness due to a temperature always high and an atmosphere saturated with moisture."

There appears, therefore, to be no danger of serious mortality in the construction of the canal, if due care be taken to benefit by past experience in selecting the laborers.

The three old specters barring the route being thus laid at rest, it remains to consider the present project for the canal. This has been most carefully elaborated. No less than sixteen projects (not including the older proposals) have been worked out in detail, including estimates of cost and of the time needed for construction.

The entire length of the canal is 46 miles, of which about 15 miles on the Atlantic side and 7½ miles on the Pacific side, or about one-half of the whole distance, will be at sea-level. Of this distance 18 miles, or about two-fifths of the entire route, is to-day essentially completed, so that at a moderate outlay for dredging it will be made at once serviceable. We have, therefore, only to consider the 23½ miles between Bohio, on the Atlantic side, and Miraflores, on that of the Pacific. Two excellent harbors, which will demand no outlay for protection, are available; and the Panama Railroad skirts the canal throughout its entire route to be availed of in construction. Ample quarters, in fair condition, for the increased force of laborers are already prepared at many sites. These advantages are immense where time is of so much importance.

There is another advantage, in my judgment scarcely less valuable. By careful technical studies the company has succeeded in provisionally adjusting the project so that a choice between the best three different summit-levels may be reserved, to be decided by actual experience in conducting the work upon a grand scale. These projects are designated as "Level 96¾ feet," "Level 69 feet," and "Level 32¾ feet," the figures indicating the elevation in feet of the bottom of the canal at its highest level above mean tide, which is found at practically the same absolute level in both oceans, although the tidal range at Colon is only a few inches, while at Naos it may at times reach 20 feet. A comparison of the estimated cost of construction, properly so called, has established that, as between larger excavation, on the one hand, and more locks and higher dams, etc., on the other, there will be nearly a balance of expenditure. The cost of either of the plans is estimated at about $100,000,000. It is not the same, however, when the element of time is considered. This time will vary with the amount of excavation called for in the deep cutting at Culebra and Emperador, which will largely determine the duration of the work. The deeper this cut, the longer will be the time required to complete the canal, and, consequently, the greater will be the outlay in general expenses of administration, interest on the funds to be raised, loss of revenue, etc. These are important elements of expense sometimes neglected in estimates.

Basing the rate of probable excavation chiefly upon the experience acquired by the old company in operating on a large scale, checked by that of the new company in operating under many disadvantages upon a small scale, it has been computed that there will be required to complete the project of level 96¾ feet about eight years, and longer proportionally for the other projects. But it must not be forgotten that the old company has been criticised, perhaps justly, for the mode adopted by its contractors in prosecuting the work—rapidity of execution not having been made an object to be specially sought. Also, that great improvements have been introduced during the past ten years in machines and methods. It is therefore not unreasonable to expect that with these improvements and with better stipulations in the contracts these estimates of time, at least for the higher levels, may be notably reduced, and excessive incidental expenses for interest, etc., be thus avoided. To be convinced of this, it is sufficient to consider the rapidity attained in excavating the ship canals of Manchester and Kiel, and especially the drainage channel at Chicago, where such great advances were made.

It is a great merit so to have adjusted the projects as to be able to pass readily from one to the other, if experience in the progress of the work should show this to be desirable. But how is this advantage to be secured? Simply by so adjusting the different levels as to permit the change to be made by omitting upper locks—thus calling for ten, or eight, or six locks, in the three projects, respectively.

All three projects require a dam at Bohio, transforming the Chagres River into a vast lake, of which the boundaries have been accurately determined. It will extend a distance of 13 miles to Obispo, where the canal leaves the river, and will cover an area of about 21¼ square miles. Its lowest level is fixed at 52½ feet, its normal level at 55¾ feet, and its highest level at 65½ feet above mean tide. It thus provides a reservoir to retain 196,000,000 cubic yards of flood discharge, which, with 130,000,000 more held back at Alhajuela in the Upper Chagres, will effectively control the torrential stream. Two locks will admit ships coming from the Atlantic into this lake. Thence, to

attain the summit level at elevation 96¾ feet, three locks will be required, all at Obispo, while for elevation 69 feet two will suffice, and for elevation 32¾ feet one only, or perhaps none, will be necessary. The descent to the Pacific is made for the three projects, respectively, by two locks at Paraiso, two at Pedro Miguel, and one at Miraflores, or by one lock at Paraiso, two at Pedro Miguel, and one at Miraflores, or by two locks at Pedro Miguel, with a tidal lock at Miraflores.

All of these locks have a rock foundation, and none presents extraordinary difficulties. All are double, one chamber having a serviceable length of 738 feet and a width of 82 feet, and the other (for smaller vessels) the same length, divided by a set of intermediate gates, and a width of 59 feet. The maximum lift is 29½ feet, except that provision for 32¾ feet is made at Bohio when, very rarely, and then only for a few hours, the lake may rise to maximum flood level.

With respect to alignment of the canal the following are the conditions adopted: The curves not to have a radius less than 8,200 feet, which experience has shown to be required for easy navigation; the depth to be 29½ feet, with provision at the locks for 31¼ feet should an increase ever become desirable; the cross section never to fall below about three times the midship section of the vessels which will navigate the canal; ample enlargements, at distances not exceeding 5½ miles, for ships to pass each other; bottom widths of 164 feet in Lake Bohio and 98½ feet in the central part; retaining the existing width (72¼ feet) in the Atlantic level, to be enlarged to 98½ feet after the canal is opened to navigation, 98½ feet in the Pacific level, and 164 feet in the channel extending through the bay from La Boca to Isle Naos, where the canal terminates.

Only two large dams are required—the first at Bohio, creating a lake which, besides acting as a flood regulator, will obviate the necessity of encountering strong currents where the route traverses the bed of the Chagres, a very important matter for ocean shipping; and the second at Alhajuela, in the Upper River, to assist in controlling the floods, to supply the summit level in the dry season, and to furnish hydraulic power, transmitted by electricity for operating the canal.

The dam at Bohio will be of earth revetted with stone, with a foundation bed of clay and abutting against rock banks. The extreme length of crest is 1,286 feet. The extreme height above the bed of the river is 75½ feet, and above the lowest point of the foundation 93½ feet. All details of construction, including the devices for controlling the river during the progress of the work, have been carefully elaborated, and will command the confidence of engineers. The sites for the two overflow weirs are remote from the dam, and an abundance of excellent material is found near at hand.

The dam at Alhajuela, about 10 miles from the canal, is to be of concrete masonry, founded on compact rock, and abutting against rock walls. The extreme length of crest is 936¾ feet. The extreme height above the bed of the river is 134½ feet, and above the lowest point of the foundation 164 feet. The cross section and the practical details of construction are in accordance with all the requirements of modern engineering. Good rock and sand are abundant in the immediate vicinity.

To connect this reservoir with the summit level a feeder 10 miles long, starting at 190¼ feet above sea level, is required. It traverses a rough country, and its construction will be relatively costly; but when compared with many of our irrigating canals west of the Mississippi it offers no serious difficulties.

The minor dams at Obispo, Paraiso, Pedro Miguel, and Miraflores will vary in height according to the project adopted; the first, second, and fourth will be of concrete masonry and that at Pedro Miguel of earth. None of them present difficulties worthy of note.

The regulating weirs will be of the Stoney design, which has given entire satisfaction on the Manchester Ship Canal, and all of them will be detached from the dams.

Such is a brief summary of the present condition of the studies for the Panama Canal. It remains to compare the project with that at Nicaragua. The details of the latter are so fully presented in the report of the Government commission of 1895 and accompanying documents, and are so well known in America, that a recapitulation in detail is not required here. The new commission, of which Admiral Walker is president, has as yet made no formal report; but the individual views of the three members were given in so much detail at the hearing before the Senate select committee in June last that the modifications likely to be recommended may be inferred. The essential features of the project are the following: The whole length of the route is 176½ miles. Of this distance about 67¾ miles lie in the bed of a crooked river, through which must pass the outflow of Lake Nicaragua, draining some 3,000 square miles, and about 57¼ miles in the lake itself, calling for from 10 to 14 miles of dredging in soft mud. The summit level is fixed at 110 feet above mean tide, and both of the Government commissions recognize the extreme difficulty of regulating this level so as to avoid, on the one hand, flooding a valuable district on the Pacific side of the lake, and, on the other hand, exposing rocks in the bed of the Upper San Juan, where there are several bad rapids to be drowned or excavated before a ship channel is possible.

The Nicaragua Canal Company advocates two principal dams—one at Ochoa, on the San Juan, and the other at La Flor, west of the lake—but as the latter was regarded as impracticable by the Ludlow Commission, and apparently is not favored at the projected height by the Walker Commission, it will be left out of consideration. The Ochoa dam presents serious difficulties; and although the present commission has succeeded in finding a rock bottom at great depth (Admiral Walker estimates it, approximately, at 40 or 45 feet and Professor Haupt at 60 feet below sea level, i. e., at 80 to 85 feet and 100 feet, respectively, below the deepest part of the bed of the river), no definite plan has yet been presented for modifying the loose rock and clay dam heretofore regarded as necessary. This construction is without precedent in canal engineering; and Admiral Walker says of it: "Of course, a dam of loose rock would have to be enormous in size; it would be like moving a hill into the river."

But the alternative of digging from 80 to 100 feet to reach foundations in the bed of a river which can not be temporarily diverted, and then of raising a masonry mass to a height of 150 or 170 feet above this newly discovered rock bed, is not an easy or a safe undertaking. Moreover, to hold the summit level at 110 feet enormous embankments are required in the San Francisco Basin. They are 67 in number and 6 miles in length, and some of them will rise from 60 to 85 feet above soft mud, which must be excavated to a depth of 30 feet to reach a clay foundation. The chief engineer of the company regards these embankments as "the weakest feature of the whole route," and they appear to have impressed the present commission, as they did that of which General Ludlow was president, most unfavorably. Indeed, new surveys have been ordered to attempt to radically change the existing project, with a view to reducing the height of the dam at Ochoa and of the huge embankments, at the expense of making an equally deep cut in the eastern divide and of raising a second dam at Machuca Rapids, either retaining the site at Ochoa or replacing the dam there by one at Tambour Grande below. Of this prospective change Admiral Walker says:

"We have had some parties out to find how far we would have to run embankments, and it is quite possible they may be as bad as the San Francisco embankments. * * * I think the chances are, by putting a dam at Machuca and a dam below at Ochoa, or Tambour Grande, and taking a low-level route, we may escape this heavy work and get into Greytown with considerable less expenditure of money, and with a canal that would not, perhaps, keep its superintendent awake at nights so much."

Evidently the plans of the Nicaragua Canal can not be regarded as definitely determined. But it is not only in the construction of the canal proper that serious difficulties are to be encountered. When the writer traversed the transit route in 1856, the harbor of Greytown was open to the largest steamers, and presented no difficulty. To-day, owing to the travel of sand along the coast, under the influence of the winds and waves, the port no longer exists for seagoing vessels. The jetty constructed during 1890-93 by the canal company has proved a total failure, and the problem is now presented, not in the simple form of making a new port, but of reopening an old one which nature has decided to close. American engineers have had experience in the difficulty and cost of such constructions at Fernandina, at the mouth of St. Johns River, at Brazos, and at many other points; and before undertaking a canal it would seem to be prudent to reopen the port and determine the first cost and the probable annual outlay for maintenance. A canal, access to which would be subjected to occasional interruptions from natural forces now known to be in action, would be a serious mistake; and it may be added that a study of the six charts accompanying the report of the Ludlow Commission, showing the condition of this port at five different dates between 1832 and 1895, is not reassuring.

As to the important element of the cost of the canal, there appears to be considerable difference of opinion. The chief engineer of the company estimated it, in 1895, at $69,893,660, and the Ludlow Commission, at the same date, at $133,472,893. Engineers will recognize the impossibility of exact figures in the present state of the investigations now in progress under the Walker Commission; and each of the members has carefully guarded himself from expressing a definite opinion. Admiral Walker, at his recent examination before the Senate committee, said:

"We have made no figures. It is no use to figure on the thing until we have all our data. But I do not see why that canal can not be built. I should think myself, speaking as anybody in the street might speak, that the canal could be put through for $125,000,000, and it would not surprise me if it came considerably below that."

Professor Haupt, on the same occasion, stated that he thought the canal could be built "inside of $90,000,000."

General Hains said:

"I think a canal of the dimensions that have generally been referred to—30 feet deep, with locks 650 feet long, and all the cross-sections that have been referred to as necessary in rock and earth—could be constructed for a maximum sum of about $140,000,000, with a possible reduction of $25,000,000 or $30,000,000. * * * But the trouble is that just now I am not prepared to give an opinion that would be worth anything."

Evidently in view of previous experience in such works showing that the actual cost has usually very largely exceeded even carefully prepared estimates, it would be premature to form an opinion as to the outlay that will be required for the Nicaragua Canal; but a general

idea of that demanded by the two routes may be formed from the following comparison:

COMPARISON OF THE TWO ROUTES.

Panama.	*Nicaragua.*
Two good harbors now existing.	Two harbors to be created; one of them (Greytown) presenting unusual natural difficulties.
A good railroad now existing along the entire route.	A long and difficult railroad to be constructed, which Gen. Hains considers should extend along all the route, except the lake portion, i. e., for a distance of 120 miles.
Actual construction, now well advanced (about two-fifths entire length actually completed) and remaining difficulties accurately known.	Practically nothing done in way of construction, and many of the essential elements undecided.
No constructions projected which are not justified by recognized engineering practice.	One or two dams projected wholly without precedent in canal work; and many embankments which must be permanent elements of danger.
Except the works at Bohio, no difficult excavations or constructions to be made where the annual rainfall exceeds 93 inches (only about 50 per cent. more than on our Gulf coast).	The most difficult works lie in a region where the observations of the canal company indicate the annual rainfall to be nearly 22 feet (256 inches), or nearly three times as much as at the Panama site.
Route lies wholly in Colombia, where all interests will be benefited by the canal.	Route lies on the border of Nicaragua and Costa Rica, where local jealousy already exists, which may prejudice the interests of the canal.
Distance to be lighted and supervised when the canal is completed, 46 miles.	Distance to be lighted and supervised when the canal is completed, 176 miles, or nearly four times as great as the Panama.
No active volcanoes within about 200 miles of the route of the canal, and earthquakes therefore less probable.	Active volcanoes near route; one, Omotepe, on an island in Lake Nicaragua, and another, Onose, only about 40 miles from the locks. An earthquake on April 29, 1898, at Léon, destroyed several buildings.
Cost carefully estimated on detailed plans at about one hundred million dollars.	Cost estimated by the Government commission, on data recognized as wholly insufficient, at about one hundred and thirty-three million dollars.
Concessions from Colombia (upon which whole undertaking is based) ample, satisfactory, and unquestioned.	Concessions from Nicaragua and Costa Rica (upon which whole undertaking is based) either expired, or expire next year, and officially declared by Nicaragua to be forfeited and void.

But let us assume that both canals are constructed and open to navigation, and then compare the two routes, by considering which of them would undoubtedly be selected by vessels seeking to cross the Isthmus. This is a crucial test which will reveal their relative merits:

RELATIVE ADVANTAGES OF THE TWO ROUTES.

Panama.	*Nicaragua.*
Ports both known to be good and easy of access.	Both ports artificial, to which access may be doubtful, especially on Atlantic side.
Length of route 46 miles, and time of transit 14 hours.	Length of route 176 miles, and time of transit not less than 44 hours.
Summit level probably 103 feet, and perhaps only 66 feet.	Summit level 110 feet.
Locks double from the opening of the canal, one chamber 738 by 82 feet and the other 738 by 59 feet, with intermediate gates.	Locks single (subsequently to have another chamber added); dimensions 350 by 80 feet.
Curvature gentle. Smallest radius 8,200 feet. Of the 46 miles 26¾ are straight and 15 have radii equal to or exceeding 9,850 feet.	Curvature too sharp. Smallest radius in canal proper 4,000 feet. For 68 miles the route traverses the San Juan River, where, to gain 47¼ miles as a bird flies, it is necessary to travel 67¾ miles—a loss of 43 per cent.
No troublesome winds or river currents to be encountered, even in times of flood.	Heavy trade winds and strong river currents.

It would seem from this analysis that there can be little difference of opinion as to which is the better route. But perhaps some enthusiastic advocate will say, "The Nicaragua Canal may be the more costly, may present more natural difficulties, may require more time for construction, and may be less easy of transit; but let us have an American canal, made with our own money and wholly under our own control."

Such considerations are outside the province of an engineer. But, perhaps, it may be suggested that we have already interests and responsibilities on the Isthmus, where the Panama Railroad was built and is now controlled by an American company, under American protection; that the business control of any canal must vest in its stock and bondholders in time of peace, while, in fact, in time of war—unless its neutrality be guaranteed by the great maritime powers—the transit will be controlled by the belligerent having command of the sea.

May it not, then, be wiser for our Government to extend its powerful assistance to what nature has determined as the best route, rather than to expend more time and more money for what, after all is said, must remain a distinctly inferior canal, unable to compete with its rival for the commerce of the world?

In this connection it should be added that the company has recently issued from its New York office a large pamphlet of valuable maps, views along the canal and statistics which will prove of much interest to all who wish to become better acquainted with the present condition of the work. Enquiries for the book should be addressed to Mr. Xavier Boyard or Messrs. Sullivan & Cromwell, 45 Wall Street.

LONG SPAN PLATE GIRDER BRIDGE.

A single track deck span plate girder bridge 9½ feet deep and 105 feet long has recently been put in by the Pennsylvania Company at Bridgeport, O., where it replaces a corresponding old eight-panel Pratt truss pin-connected bridge. The new girders are deep and massive, and as shown in Figure 1, are composed of 115-inch web plates 7/16 of an inch thick, and united by web splice plates 11 feet 3¾ inches apart, each riveted up with four vertical rows of shop-driven rivets. The top and bottom chords are each composed of a pair of 6x6x¾-inch angles, with staggered joints planed at the ends and spliced with vertical cover plates. There are also continuous horizontal cover plates and a pair of vertical web reinforcement plates, all 16 inches wide, in each chord, thus giving fairly uniform T-shaped chord sections of the required area, with good connections to the web and without excessively long rivets. The girders receive the track ties directly on their top chords, and are spaced 9 feet apart, and connected with horizontal bracing consisting of riveted top and bottom transverse struts, and adjustable pin-connected diagonal rods. At each panel vertical sway bracing is provided by single adjustable transverse diagonal rods 1¼ inches square with 1⅞-inch upsets and sleeve nuts and forked loop ends, which engage 3-inch pins in vertical gusset plates shop-riveted to the cross struts and field-riveted to the vertical web stiffeners on the insides of the girders. At each end of each girder a pair of vertical webs are riveted to the under side of the bottom flange to receive a 6-inch pin that takes bearing in an ordinary riveted pedestal such as is generally used for small trussed spans. At one end this pedestal is seated on a nest of expansion rollers, as shown, at the other end the rollers are omitted, and it rests directly on the abutment masonry.

This bridge was designed in accordance with the specifications of the Pennsylvania Lines West of Pittsburg, Edition of 1897. The loading specified is a uniform load of 5,000 pounds per lineal foot plus a concentrated load of 50,000 pounds in addition to the weight of the bridge. The weight of the bridge was assumed at 2,100 pounds per lineal foot.

On a length of 102 feet center to center of end bearings the following values were found for end shear and center moment:

102-foot girder.	End shear, pounds.	Center moments, foot pounds.
Uniform live load	127,500	3,251,250
Concentrated live load	25,000	637,500
Dead load	53,550	1,365,525
Total	206,050	5,524,275

Y = ratio of minimum to maximum strain = 0.26.

Unit strain for tension flange = (1 + Y) 7,000 = 8,820 pounds.

Section modulus = 5,524,275 × 12 ÷ 8,820 = 7,150.

Distance between centers of gravity of flanges = 111.6 inches.

Required net area = 7,150 ÷ 111.6 = 64.06 square inches.

Area of flange.	Square inches, gross.	Square inches, net.
2— 16 x ⅝-inch plates	20.00	15.00
2— 6 x 6 x ¾-inch Ls	16.88	15.38
4— 16 x ⅝-inch plates	40.00	35.00
Total	76.88	65.38

The lengths of the flange plates are determined by this formula:

$$l = L\sqrt{\frac{a}{A}}$$

Where l = length of plate.
Where L = length of girder.
Where a = area of plate.
Where A = area of flange.

$$102\sqrt{\frac{10}{76.88}} = 36.8 \text{ feet use 40 feet.}$$

$$102\sqrt{\frac{20}{76.88}} = 52.0 \text{ feet use 55 feet.}$$

$$102 \sqrt{\frac{30}{76.88}} = 63.7 \text{ feet use 67 feet.}$$

Unit shear on web plates = 4,000 (1 + Y) = 5,040 pounds.
206,050 ÷ 5,040 = 40.89 square inches required.
Bearing per square inch on rivets = 1.5 × 8,820 = 13,230 pounds.
Average distance between rivet lines in flanges = 99.25 inches.
206,050 ÷ 99.25 = 2,076 pounds per lineal inch.
Space ⅞-inch rivets 2⅜ inches at end of girder.

Each of the girders in the bridge was riveted up complete in the shops at Massillon, O. They were handled during construction and loaded, when finished, by four 15-ton air hoists. Each girder was loaded on four cars and shipped standing, being thoroughly braced to prevent it from tipping over. In removing the old bridge it was necessary to use a falsework bent under each panel point. The traveler used in taking down the old work was made strong enough to carry the new girders. When the old work was removed the traveler was moved over to the center of the span, where it was used in handling the new work.

In erecting the new work, the four cars with one of the main girders were run out upon the temporary trestle, and the girder was lifted from them by four sets of tackle. The cars were then run out and the first girder let down into place on one side of the track. The second girder was placed in the same manner. After this the bracing was easily put in place, and the track was transferred to the new bridge. Figure 3 shows one of the girders in place and the other suspended ready to be lowered into position. The trusses seen between the two girders belong to a different structure on an adjacent railroad. The lead lines for the tackles were run out to each end of the bridge, where they were operated by hand crabs. Each of the main girders weighs 82,900 pounds, and the bridge complete weighs 185,200 pounds, exclusive of ties, rails and guard timbers.

The general dimensions and material of the traveler are shown in Figure 2, which also indicates the arrangement and operation of the tackle by which the girders were handled. The use of pairs of tackle suspended from opposite sides of the straining beam and attached to the girder at the same point enabled it to be hoisted from the middle of the track as shown by the full line, and swung some distance laterally, so as to be lowered nearly in position on either side of the track, as shown by the dotted line, by slacking off at different rates on either of the tackles, so as to throw the strain on the other one and enable it to carry the girder vertically alone. As each set of tackles had to carry over 40,000 pounds, a special attachment was made by a long U bolt, which embraced the girder and had bearing nuts screwed up on the cross plate under the lower flange. This was connected to the tackles by a loop at the top, thus avoiding danger from the use of a sling, chain or clamp, and expediting the handling. A general view of the falsework supporting the old trusses and the track with the traveler upon it lowering one of the new girders is shown in Figure 3.

The Massillon Bridge Company, Toledo, O., Mr. A. J. Sprague, president, was the contractor for its construction and erection. Acknowledgement is made to Mr. C. S. Davis, chief engineer of the Massillon Bridge Company, for data received.

DRAFTING RULES FOR STRUCTURAL IRON WORK.—I.

In any large roof, bridge or structure of rolled or forged iron or steel there are numerous important considerations after the general design has been made, strain sheets computed, details and connections settled, and the data properly completed for the trained draftsman. There are many right ways to do the same thing, many points require special and particular attention, and innumerable details which should be treated in a given way for the best convenience and efficiency of shop tools and workmen and to conform to convenient customs and materials. Besides this it is advantageous for the workmen to be trained to do a certain thing in a certain regular way and to be expert in a uniform treatment of ordinary work. Many structural members may be standardized and constructed nearly always exactly alike except for certain regularly varying interdependent dimensions, which are readily tabulated compactly with a general sketch. Other members and pieces require allowances for excess material used in manufacture, and others require auxiliary pieces to be always provided, like nuts on pins and bolts. Besides this, great numbers of calculations are of continued recurrence and can be made once for all and tabulated with the original formula and a working range of variable quantities, so that values for ordinary cases may be selected by inspection, and a great convenience, economy of time and accuracy be effected. The larger the shops, and the greater the number of employees the more important this consideration becomes, and many of the principal bridge shops have established tables, rules, and instructions for their draftsmen, intended to cover the principal points met with. Such data are in the nature of an epitome of the practical development of the given plant and organization, and because they condense and classify just that information they are not usually accessible to the non-specialist. It is therefore a matter of considerable satisfaction to "The Engineering Record" that it is able to present the instructions for the drafting department of the Pittsburg Bridge Company, which were drawn up some time ago by its

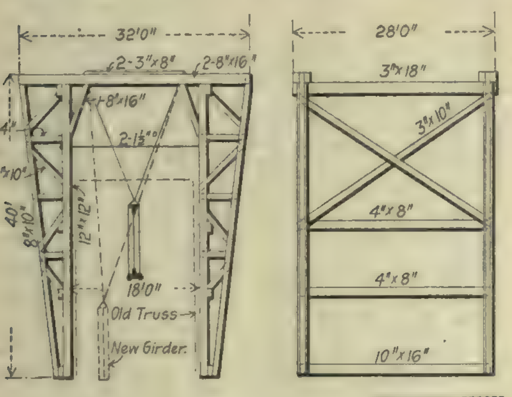
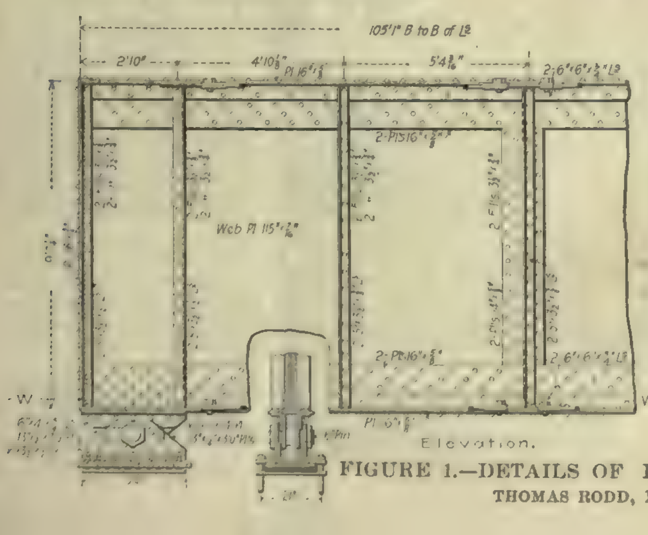


FIGURE 2.—DIAGRAM OF TRAVELER.

FIGURE 3.—VIEW OF BRIDGE AND TRAVELER DURING ERECTION.



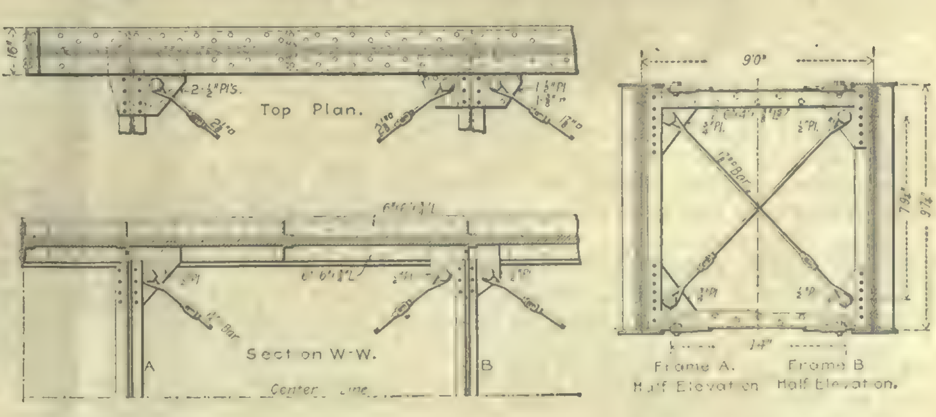


FIGURE 1.—DETAILS OF PLATE GIRDER BRIDGE FOR PENNSYLVANIA COMPANY, BRIDGEPORT, OHIO.
THOMAS RODD, M. AM. SOC. C. E., CHIEF ENGINEER; MASSILLON BRIDGE COMPANY, CONTRACTORS.

chief engineer, Mr. Walter R. Marden, Assoc. M. Am. Soc. C. E.

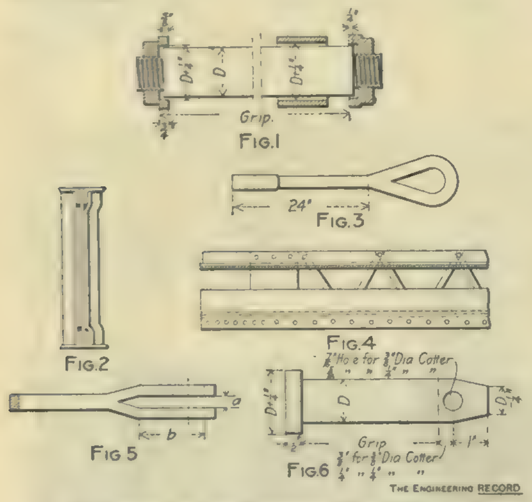
On award of contract see that the original estimate has been checked by the estimating department.

Before beginning the work obtain all data (contract, estimate, masonry plan, profile, general plan, specifications, etc.) in our possession relating thereto. Examine this data carefully with the view of referring any discrepancy, doubtful or ambiguous point to the proper authorities at the earliest opportunity, and avoiding any unnecessary delay.

Masonry Plan.—For structures of our own design a plan showing clearly how masonry is to be built or modified shall be made and a copy sent to the proper party as soon as possible.

Camber Calculations.—All truss bridges shall have an estimated camber of: $d = l^2 s \div ch$, in which d=camber in inches, l= length of span in feet, s=average unit stress in top and bottom chords in tons of 2,000 pounds per sq. in.; c=900+(8.4 times span in feet) for spans of 250 feet and under; c=3,000 for spans over 250 feet in length; h=depth of truss in feet. In general camber will be given to a truss by increasing the length of the top chord.

Camber will be given to pivot spans by shortening the top chord panel at the center of the bridge.



DRAFTING STANDARDS FOR METAL WORK.

The increase in top chord panel length will be $i = 8hd \div ln = 8ls \div cn$, in which n=number of panels in the truss; the other quantities as in the equation for camber.

The length of the bars and end post will be calculated as the hypothenuse of a right angled triangle, of which one side is the depth of the truss and the other a mean of the top and bottom chord panel lengths. No part of the camber of a bridge will be taken out in the floor unless insisted upon by the railroad company, in which case instructions are to be obtained as to how it shall be done.

Pins and Pin Nuts.—The sizes of pins to be used must be governed by the circumstances of each particular case; but it is desirable to have as few different sizes as possible in the same structure. The pin nuts used are malleable iron, recessed nuts unless otherwise specified. The distance between shoulders is ½ inch greater than the grip of pin—See Figure 1. The smallest reduced end on which recessed nuts are used is 1½ inches in diameter. In figuring lengths of pins 1/16 inch will be allowed for each space between eye bars. The grip of pin is always clear distance between nuts. Pins will be ordered ⅛ inch larger than finished diameter for pins up to and including six inches diameter, and ¼ inch larger for pins above 6 inches diameter. Wing plates when used will be placed in the reduced end when pins are over four inches in diameter.

Play in Pin Holes.—Turned pins, all pin holes in eye bars, top chords, intermediate posts, etc., will be 1/32 inch larger in diameter than the pin for highway bridges. For railroad bridges the specifications will govern the amount of play. In non-adjustable rods for highway bridges, one end of the rod only is bored so as to get the exact length, and the diameter of holes will be 1/16 inch greater than diameter of pin.

Rough pins in bored holes have 1/32 inch play.

Make holes for anchor bolts ¼ inch larger in diameter than the bolt. Cast-pin washers, when used, and filling rings, which shall be of gas pipe, will be made with the inside diameter ¼ inch larger than the pin for which they are intended.

Eye Bars.—Steel bars will be upset in all cases. Iron bars will generally be made by the top piling process; loop piling will be used for special cases only. Material for top piling will be ordered in bar lengths as far as possible. The minimum thickness for bars is ½ inch. Eye bars for the same structure should, as far as practicable, be made of uniform width, and with same size of head at each end of bar. Inquiry should be made as to number of test bars required for inspection. For eye bars with screw ends see next paragraph.

Loop Bars will be made of iron only. Material for upset ends will be ordered according to table in standard prints. Finished length of loop rods without adjustment will be given from back to back of eyes. For rods with adjustment length will be given from back of eye to end of rod. For bent rods from inner corner of bend in eye to end of rod. Sleeve nuts are kept in stock and will not be ordered. When flat bars with sleeve nut adjustment are made of either steel or iron they will be upset at the screw end and material for each bar ordered in one length accordingly.

Bolts and Rivets.—Round iron one inch in diameter and less is kept in stock; sizes larger than one inch will be ordered from the mills with the rest of the material. Bolts connecting iron-work will be made with hexagon head and nut; bolts for timber work to have square head and nut. The shop bill to always state which is required. When bolts connecting ironwork are subject to shear they will be provided with wrought iron punched washers, generally ⅝ inch thick, and the length of screw will be the thickness of nut + ¼ inch projection + ½ thickness of washer. The diameter of washers will be as follows:

½ in. bolt	1¼ in.	⅞ in. bolt	2 in.
⅝ in. bolt	1½ in.	1 in. bolt	2¼ in.
¾ in. bolt	1¾ in.	1¼ in. bolt	2¾ in.

Bolts through timber will be provided with cast washers under head and nut. Avoid as far as possible the use of different sizes of rivets in the same member.

Machine and Fitting-Shop Work.—All material which is to be faced at ends should be ordered about ¼ inch longer for each facing. This occurs in most end posts, all top chord sections, most floor beams and stringers, etc. All stiffeners on girders and other angles which are to be fitted in between flange angles should be ordered at least ⅛ inch long at each end for fitting. All plate girders of a fixed, or dead, length should have webs and flange angles ordered ½ inch long for facing (¼ inch for each end), so as to be able to set end angles without facing same. See Figure 2. When any shop work differs from general practice it should be noted on drawings. This relates to facing of edges of sheared plates, close joint at intersection of top chord with end post (general practice is ⅜ inch open), etc. When plate girders have cover plates arrange rivets so that none need to be countersunk to admit stiffeners, as flanges are riveted after webs are put in.

Blacksmith Shop Work.—Short ends of adjustable rods should be made four feet to five feet long from back of hole to end of upset. The minimum length of finished upset rod, which can be made in the machine, is 24 inches for either loop or fork. If it becomes necessary to make them shorter, order in lengths a multiple of two rods with loops, and upset at each end, to be cut in two and loops turned; or, if forked loop, two rods without forks, and upset at each end; forks to be welded on after cutting in two. See Figure 3. Angles used as crimped stiffeners should be ordered the depth of girder to allow for crimping + finish excess on each end for fitting. Order lengths for curved pieces to be taken on convex edge and an excess added.

Size of Drawings.—Drawings will generally be made on sheets with a border line 24x36 inches, leaving a ½ inch margin outside when trimming. Drawings in special cases may be made either 25½x46 inches or 27x60 inches between border lines.

Border Lines.—Border lines will consist of a single heavy line.

Title.—The title will always be placed in the lower right hand corner, as close to the border as possible.

Scale.—In truss work use 1 inch = 1 foot wherever possible; in large plate girders ¾ inch=1 foot may be used. For details of small work 1½ inch=1 foot is allowed.

Pin Connected Truss Arrangement.—In the upper left hand corner of sheet put a small diagram of the bridge, giving length of top and bottom chord panels, depth of truss, length, center to center of end pins, and width, center to center, of trusses. Also give on this diagram the shipping marks of all the different members, panel points, splices, etc. Make the skeleton for the part of the truss to be shown on as large a scale as possible. About two panels should be shown on a sheet, or as much as can be drawn without the least crowding. Leave sufficient space at top and bottom of the sheet for the several views of the chords, to be shown as described later.

Top Chords.—On the skeleton, which will be either ½, ⅝ or ¾ inch scale, draw first a side elevation of the top chord, showing the web, flange angles, edge of cover plates and tie plates on bottom, and web rivet spacing. Above the elevation draw a plan and longitudinal section combined, showing width of cover plate, rivet pitch and spacing and splices, if any. On the sectional view show the lattice and tie plates dotted, as in Figure 4, at each end of chord, if two posts are shown, and at one end if only one is shown. Make a cross section of chord, showing all pitches of rivets and giving packing at this point. Also show in this view the pin and nuts with strut and lateral connections, if they are connected with the pin. The rules for drawing top chords apply also to inclined end posts. At one side of section make a bill giving size and grip of pin and filling rings if required.

Vertical Posts.—Show posts in position in cross section of chord, and in elevation of truss, showing pin plates, etc., but giving no rivet spacing in these views, using them only to give packing and to show what cuts have to be made, if any, in flanges; and what rivets, if any, have to be countersunk or flattened. Also, on elevation of post show any hand railing or fence that may be wanted. Then at one side of elevation show each side of post with its rivet spacing and details. In the center of one of these views show a cross section giving pitch of rivets.

Bars.—Give sizes of all diagonal and chord bars, distances, center to center, of pins, diameter of pins, diameter of heads, and whether the bars are steel or iron. Give diameter of upsets on laterals and counters.

Floor Beams and Stringers.—Give extreme length, out to out, of end angles. Give extreme length, out to out, of flange angles, making depth ¼ inch greater than depth of

web plate. Give pitches of rivets in all cases; also distances between end field rivet holes.

Struts and Braces.—Give extreme length, and length between end field rivet holes in all cases, pitch of rivets in both legs of angles. If struts are bent give bevel of bend on drawing of struts. Give width, center to center, of trusses in all cases. Do not neglect connections for knee braces and sway rods, if any are required in the structure.

Truss Pins.—Rules for calculating grip and packing. In general 1/16 inch for each joint or thickness of each bar or rod is to be allowed.

Allow ¾ inch for heads of ¾ inch rivets and ⅞ inch for heads of ⅞ inch rivets, unless flattened or countersunk, in which case exact thickness of head will be shown on drawing.

In addition make ⅛ inch allowance on each side of the chords or posts when bars pack outside against edges of angles. This provides for overrun of angles, or irregularities of cut if angle or channel flange has to be notched.

Where ½, ¾ or 1 inch collars of filling rings are put between two adjacent parallel bars no allowance need be made for clearance of collar; but in other cases allow from ⅛ to ¼ inch, so as to make width of collar come in ¼ inch.

Allow ½ inch for two recessed nuts, and ¼ inch for one, in addition to above allowances. If one recessed and one standard pin nut are used no allowance need be made for the standard pin nut; but if two standard pin nuts are used add ½ inch to grip of pin and use a ⅜ inch washer on each end of pin next to nut. This does not apply to cases mentioned in next paragraph.

When a lateral rod, sway rod, strut or other connection comes on a pin which has to be turned down to receive it, make the distance from shoulder to thread equal to the exact thickness of the connection that comes on pin, and use a standard pin nut on this end. In case of bent loop or head use a washer between head and nut to make head pinch tightly against shoulder of pin. If strut connection comes between head and nut this washer may be omitted, as the bent plate on the strut answers the same purpose as the washer.

Plate Girders.—Make a diagram showing length and depth of girder, length out to out of end angles and width center to center of girders, also showing all stiffener angles, and where web and flanges splice. If girder is symmetrical about center line, draw only one-half the girder, if unsymmetrical full length must be shown. Draw the side elevation near the center of the sheet, leaving room for diagram mentioned above and a plan showing lateral bracing and rivet spacing in cover plates and flange angles. Just below this elevation draw a longitudinal section giving spacing in bottom cover plates, flange angles and shoe plates. In the lower right hand corner place the title in all cases. In case the girder is so long that the whole or half length, whichever is to be shown, cannot be drawn on one sheet in this manner, then show as much as possible in the manner given above and the rest on a second sheet so arranged as to paste together. Care must be taken to have the rivets interspace in the two legs of flange angles. Be sure all webs, flanges and cover plates are plainly marked, and give distances from center to all splices, and from center to end of all cover plates. Make rivet spacing in longitudinal direction vary by ¼ inch only, for convenience in punching. Draw out separately details of connection plates and angles where all spacing, etc., cannot be clearly shown on the piece in its true position, in detailing a plate separately. The holes through which field rivets are to be driven will be blackened. The holes for shop rivets will be shown of proper size but not blackened.

General Notes.—As far as possible make the arrangement of views uniform for similar classes of work; and put dimensions which are repeated on different members or sheets in the same relative position on each. Take care that the sizes of rivets do not exceed the maximum given in standards for the various sizes of angles, channels, etc., and that no rivets are so placed as to give trouble in driving. Wherever possible keep rivets 1½ inches from ends of plates and angles, and 1¼ inches from edges. Take care that sleeve nuts on lower laterals do not interfere with stringers in bridges where laterals pass close above or below same; or, when they pass through the web of the stringer, be sure the hole is large enough to allow the upset to pass through. When two counters run between the same points in a truss, be sure to examine them and see that the sleeve nuts do not interfere with each other; and in case they do, make the short ends of different lengths. Always find out and distinctly mark on drawings whether material is to be iron or steel; whether rivets are to be iron or steel, and whether rivet holes are to be reamed or not. When a piece is right or left always make it right on drawing and state so. In designing always strive to make pieces symmetrical about the center line, as this saves drawing out the entire piece; and it also makes only a half templet necessary to lay out the work in the shop. The foregoing applies especially to stringers, floor beams, plate girders, struts and similar pieces. When two or more men are working on the same contract, special care must be taken to see that connections and parts which they have in common correspond in all respects. Number all sheets in each contract. A sheet of erection diagrams should be always furnished for truss bridges. As a rule the scale for detail shop drawings will be 1 inch = 1 foot. Sometimes it may be advantageous to use ¾ inch, and again to show certain details to a scale of 1½ inch = 1 foot.

General Instructions Regarding Shop Bills.—Be sure to make a full description sheet. This sheet should always have full shipping directions and full specifications. Be sure to put full painting directions on description sheet, stating whether there is field painting or not. Where the specification for painting is incomplete, for instance in regard to tints, call the attention of the superintendent of the drawing department to the fact. When field painting is required and the work is to be erected by the P. B. Co., specify on shop bills the number of gallons to ship, allowing for each coat ½ gallon per ton of material. Ascertain the painting information from specifications for painting. Make a complete bill of each member, giving number of pieces required and shipping marks. When billing I beams, channels and Z bars always give depth, width of flange and thickness of web in addition to weight and number of shape. Be sure to ascertain what test bars are required before ordering eye bars. When using forked eyes give a sketch and the distances, a and b, Figure 5, in the bills. Smith work is done entirely from bills. For this reason give sketches in bill of such work. When billing counter rods, stagger the sleeve nuts if the rods are so close that nuts will interfere. When billing lower lateral rods see that sleeve nuts do not interfere with stringers. Stiffener angles for girders, beams, etc., should be ordered at least ¼ inch longer than net length to allow for fitting. For crimped stiffeners order length is the depth of girder + ¼ inch. When billing filling rings always give diameter of pin on which they go and make inside diameter ¼ inch larger. The filling rings will be made of gas pipe. In case wrought iron hexagon nuts have to be used for chord pins, a cast iron washer will be used under one nut on each pin. For top chord pin, ⅝ inch thick; for bottom chord pins, ¾ inch thick. Make inside diameter of washer ¼ inch larger than pin, and outside diameter same as long diameter of nut, rounding off to even figures; but never make outside diameter less than 1 inch larger than inside diameter; and when the length or thickness is small make outside diameter even more than 1 inch larger than inside diameter. In ordering plates that are to be cut to length in the shop allow ¼ inch for each cut, and if plates cut off exceed about 12 inches in length allow 1 inch for each cut, as such will have to be punched off. Plates ⅝ inch or over and not rectangular, having beveled ends, corners cut off, etc., are to be made sketch plates and ordered cut at the mill. Orders for field rivets are to be made giving exact number needed, diameter, grip, length, head and connection in which they are to be used. Besides this, make a summary sheet giving the number of each size to be shipped (exact number + 10 per cent.), diameter, length, kind of head. For bolts to be used in field connections of buildings order shipped the exact number required, unless that be great, when a few extra may be ordered. For field bolts of bridges add to exact number 5 per cent. for shipping number. Always keep rivets for corrugated iron with the clips, and separated from other rivets.

Allowance on Ordered Material.—Bent plates, order length to be taken on outside of bend or bends + ¼ to ½ inch.

For bent angles the order length is to be taken on longest curve.

Stiffener angles; if crimped, length = length out. to out. of flange angles of girder + ¼ inch.

Stiffener angles; if straight, length = length inside of flange angles of girder + ¼ inch.

Fillers for girders. Order length = (depth of girder) — (width of two angle legs).

Lattice. Order bars in lengths from 14 feet to 22 feet, allowing from 3 to 3½ inches more than distance center to center of rivets for each bar, depending on size of bar and rivet used. In ordering angles, plates and bars in multiple lengths allow ¼ inch for each cut. Beams, channels and Z's should not be ordered in multiple lengths. Plates over ⅝ inch thick should be ordered exact, not multiple lengths; and if they are not rectanglar make a sketch with dimensions in bill, so they can be sheared in the mill. No re-entrant cut should be given in sketch, as the mill cannot make such a cut, which will have to be punched out in the shop. All plates 12 inches wide and over, and more than 2 feet long, will be ordered exact. Plates with parallel sides, one end square and one on an angle, when short order to cut two, allowing ½ inch on total length. If over ⅝ inch thick, give sketch so plate can be sheared at the mill without any allowance. Plates over 26 inches wide cannot be sheared in the shop.

Web splices of plate girders; order web plates to make a close joint, but do not allow for planing ends unless specifications require a butt joint, when ¼ inch will be added for each plate end that is to be planed. Beams and channels which do not require to be faced will be ordered exact length. If they require to be faced, add ½ inch to finished length for mill order. Flange angles for girders and columns which require to be faced will be ordered ½ inch longer than finished length. Never use sixteenths of an inch in giving the mill order lengths of material; eighths is the least fractional part of an inch permissible. Pins of 3 inches diameter and over order in multiple lengths and allow ¼ inch for each cut in sawing. Pins under 3 inches order exact length.

General Notes for Making Shop Drawings.—Rollers.—Make reduced end on 2-inch rollers, ¾-inch diameter. Make reduced end on 3-inch rollers ⅞-inch diameter.

Counters and Laterals.—Back of hole to end of short bar for lateral rods is 4 to 5 feet. Back of hole to end of short bar for counters, 6 feet.

Pins.—Order cotter pins ¼ inch larger di-

ameter than finished diameter. Length of cotter is one inch greater than finished diameter of pin. Use ¼-inch diameter cotters for pins under 2 inches diameter. See Figure 6.

Collars, or Filling Rings and Washers.—Make inner diameter of pin collars or filling rings ¼ inch larger than nominal diameter of pin. Make inner diameter of pin washer ¼ inch larger, if cast iron, and ⅛ inch larger if a punched or bored plate, than finished diameter of pin.

Allowances.—Where nuts or clevises are used, allow bar to project ½ inch. Where slotted holes are to be drilled they should be (twice their diameter + 1/16 inch) for the length of hole.

Bed Plates.—Plane all cast bed plates top and bottom.

Crimping.—When angles are crimped place rivet hole 2 inches or more from crimp where possible.

Rivets.—In stringer and deck girder cover plates, 12 inches wide or less, use only one row of rivets through each angle. In wider plates use one or two rows, as conditions may require.

Rivet Spacing.—At ends of chords and posts use 3-inch spacing for about twice the depth of member; then a few 4½-inch spaces and 6-inch spaces to the center.

Turned Bolts.—Wherever turned bolts are used allow 3/16 inch for reaming. Punch same size hole as for rivets and use bolts ¼ inch larger than rivets.

Marking.—Take special care in marking size of pins, thus: 5¼-inch pin; hole, 5¼ + 1/32 inch. It is not necessary for the draftsman to mark why small pieces are right and left, but it is very important to state why main members are right and left. If members are not interchangeable they are either right or left or entirely different, and should have another mark.

The right and left may be determined by considering an imaginary line and placing one member on each side. If the notchings or hitches, or whatever prevents the members from being interchangeable, are in precisely the same positions relative to the imaginary line, then they are right and left; if not, they should be marked differently.

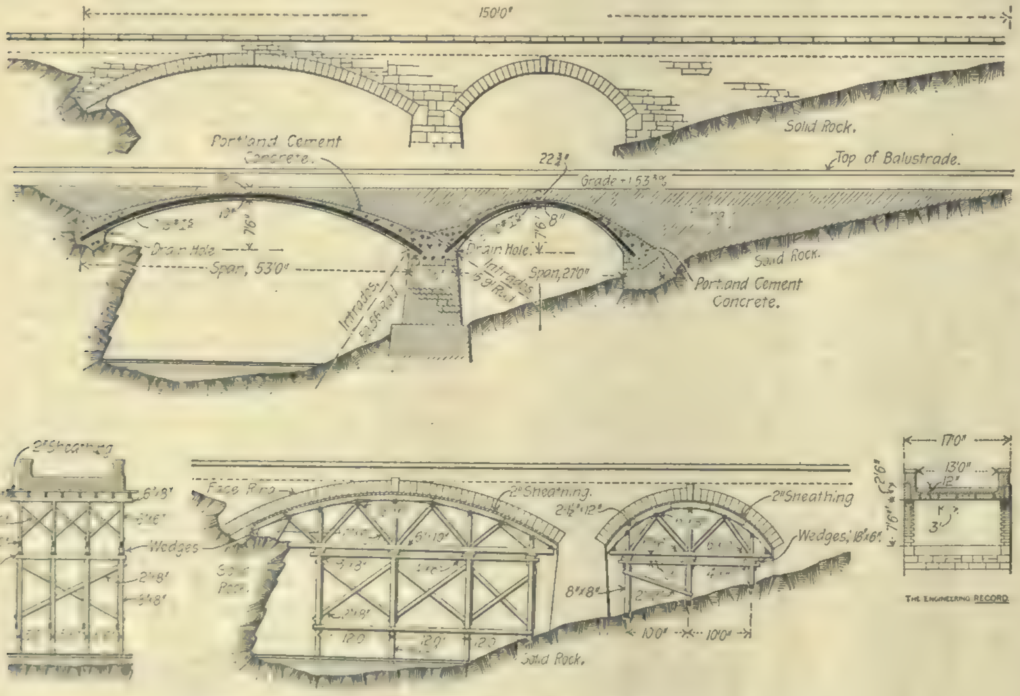
Titles for Drawings.—Titles must contain as full description of structure as possible. The information to be given in rote as follows: Name of members on drawing; number of tracks; deck or through, square or skewed span; number and length of panels; C. to C. length, depth and width of span; number of span; number and length of panels; center to center length, depth and width of span; number of spans; name, number and location of structure; for whom built; date of drawing, and name of draftsman. Place the order number and sheet number in the lower right-hand corner of sheet.

(To be Continued.)

A PRIVATE PARK ARCH BRIDGE.

The use of reinforced concrete for durable and efficient park bridge construction is illustrated in a driveway crossing of a small ravine on the estate of Mr. F. W. Vanderbilt at Hyde Park, N. Y. Here a large private park has been laid out by landscape architects, and an appropriate crossing was desired for the rocky bed of a small watercourse. A masonry structure of semi-rustic appearance was chosen, and arch spans were adapted to the local formation, which provided an excellent foundation of solid rock, needing comparatively little excavation or dressing to receive the skewbacks, piers and footings. A viaduct 150 feet long was therefore designed, to consist, as shown in the accompanying illustrations, of an earth fill about 60 feet long and 15 feet in maximum depth, enclosed between vertical retaining walls on each side, and of two Melan arches of 53 and 27 feet clear span respectively.

At one end of the bridge a little of the surface of the solid rock was removed and a recess



ARCH BRIDGE ON VANDERBILT ESTATE, HYDE PARK, N. Y.

cleaned out to receive the concrete skewback for one end of the longer span. Short piers of selected large rubble stone, carefully bedded and laid in cement mortar, were built for the other skewbacks, and timber falseworks were built in the two openings. The surface of the rock was slightly leveled where necessary, to receive the lower ends of the vertical posts of the falsework, which were secured by horizontal cross-pieces and vertical X bracing of eight-inch plank, spiked at every longitudinal and transverse panel. The tops of the posts were sawed off level a little below the springing line and capped with continuous 4 x 8 pieces laid flat across their tops from end to end of each span. These four lines of top pieces formed sills, on which the centering for the segmental arches was supported on pairs of wedges over the vertical posts. This centering consisted merely of eight lines of ordinary curved ribs, made of short sections of double plank, supported on horizontal cross beams at every joint. Half of these beams were in the planes of the falsework bents, and were supported by verticals over the tops of their posts. The intermediate beams were each supported by pairs of balanced inclined braces running to the feet of the vertical pieces and concentrating all the loads symmetrically there above the adjustment wedges. Each set of vertical and inclined pieces was also X-braced with 6 x 1½ inch plank well spiked, and the end half panels were supported by the cantilever ends of the 6 x 10-inch horizontal timbers, which received the lower ends of the verticals and braces and formed the upper wedging surface. Narrow two-inch lagging was laid on top of the falsework ribs to conform to the intrados of the arch.

Cut stone voussoirs forming end rings were set in the vertical planes of the faces of the arch, virtually making the sides of molds for the Portland cement concrete, which was from 8 to 38 inches thick for the arches, and 5¼ feet thick on top of the middle pier. The concrete was mixed in the proportion of one part cement, two parts sand and four parts stone. A thin layer of fine concrete was spread over the lagging and the five lines of curved steel I-beams set on it and blocked up 1½ inches from the surface of the intrados. Concrete was then rammed around and over the beams, and its upper surface was smoothed and finished with a coat of one-to-two cement mortar ½ inch thick. The side walls and coping were built of quarry-faced coursed stone with horizontal beds laid in cement mortar. Rolled earth was filled in over the haunches and between the side walls up to subgrade, and the roadway surface constructed on it, 12 inches above the crown of the larger arch. This bridge was designed by the Melan Arch Construction Company, and built by W. T. Hiscox & Company, both of New York.

FIREPROOF CONSTRUCTION.

By a striking coincidence the same day which witnessed in its early hours the triumph of American fireproof construction in arresting the spread of a fire started in a clothing store at Broadway and Warren Street, New York, as described in "The Engineering Record" of December 10, 1898, saw in its closing hours a meeting of the Royal Institute of British Architects to discuss a paper on fireproof construction of buildings in the United States. This was written by Mr. R. W. Gibson, at the request of Mr. H. D. Searles-Wood, honorary secretary of the Institute's science standing committee, and an abstract of portions of it is reprinted here.

The paper opens with a discussion of the development of the principles of slow-burning, fire-resisting and fireproof construction as it is known in this country to-day. Emphasis is laid on the failure to recognize at first the difference between incombustible and fireproof materials. It was afterward learned that although iron is incombustible, it is very far from being proof against injury from fire of even moderate intensity. On the other hand, "there were and still are many advocates of the use of timber in very massive scantlings who show with much truth that it takes longer to impair the strength of floors and pillars of this kind than it does those of unprotected iron. Yet very large conflagrations have proved that after all it is only a question of a limit to be passed when the massiveness of the timber becomes a horrible addition to the quantity of fuel. It may be safely asserted that the days of slow-burning wooden construction are numbered, so far as concerns large cities, although possibly rural factories, where economy of construction can be partly counterbalanced by an extra organization of fire-extinguishing machinery, and where the destruction of one building does not necessarily imperil any others, may advantageously use these methods for a long time to come."

The fireproof building of the best type is constructed with two principles in constant view,

that no combustible material enters into it, and that non-combustible material which is not fire-resisting is protected by substances which are. The structural framework of buildings also has an important influence on their fireproof properties, but as this subject was discussed fully in these columns in the recent series of articles on the development of architectural construction, it is unnecessary to follow Mr. Gibson's interesting account of the steel skeleton and steel cage types of framework and their modifications. He brings out one feature of construction, however, which is so characteristic of American practice that its origin is sometimes forgotten; it is the standard spacing of floor beams and girders, and is referred to as follows in the paper:

"The beams supporting the floors are small rolled steel I-beams, laid out to what has become a standard distance apart—viz., 4½ feet—and of what has become a standard economy of size. This size and spacing arise from the use of the terra-cotta arch, of from 8 to 10 inches thickness, which is, theoretically, good for ordinary office building loads up to a span of 5½ or 6 feet, and practically and thoroughly good and reliable up to spans of 5 feet, with sufficient factor of safety to permit of such cutting as may afterwards be necessary for the insertion of pipes, wires, etc. Many experimental tests have been made with these floor arches, with greatly varying results. They have been built with spans 7 or 8 feet, and have endured tests at these spans for very great loads; but the difficulty of securing in a building the perfect workmanship used in a test makes all such records of small value as compared with custom arising from an accumulation of experience, and such custom has decided that 4½ to 5 feet is the span of flat floor arch combining the necessary strength with desirable economy of construction under working conditions. As thus used, these arches are very economical, very adaptable, and elastic in their application, and requiring only a moderate degree of skill on the part of the workmen. They are made of hollow terra-cotta blocks, with joints inclined at a fixed angle, which is only a rough approximation to the theoretical radiation of such joints in a flat arch; but there is no practical difference in the strength, and there is a great gain in having three patterns in all the blocks—viz.: the springer, which rests on the flanges of the floor beam; the intermediate blocks, which are all cut to the same inclination; and the key-block, which, of course, has the sloped joint on both sides. The springer is made so that the lower surface forming the soffit or ceiling stands about 1½ inches below the lower flange of the iron, and covers one-half of that soffit. A variety of floor arches of late date is the end construction arch, in which the perforations of the terra-cotta are arranged in the direction of the stress in the arch instead of at right angles to it, so that a larger quantity of material is used under strain; but it is doubtful whether this is of much real advantage—it is rather the product of severe testing than of any practical need. As the floor arch determined the distance apart of the floor beams, so it next regulated the distance apart of the girders. The span of the arch is indicated by its own working strength, and the depth of the beam is indicated by the thickness of the arch, because any considerable difference would have to be made up by concrete filling upon the top of the arch, which would be more expensive than the arch material itself. Then the depth of the beam having been determined within reasonable limits, its economical span is easily ascertained. This proves to be somewhere between 14 and 18 feet, which is the working distance between the main girders, and which, being a convenient size for a single office, is also taken as the unit of room width and the space allotted in the outer walls to a pair of windows. The distances will, of course, vary according to the floor loads adapted for different purposes; those mentioned apply to buildings having floors weighing from 75 to 95 pounds dead load per foot, and supporting live loads from 75 to 150 pounds, which are the usual limits for offices."

It is unnecessary to follow Mr. Gibson's description of the construction of these floors, nor his explanation of the details of masonry walls and interior furring and partitions, as these subjects are already familiar to the readers of "The Engineering Record" through the many descriptions of notable buildings which have appeared in its columns. "The greatest need of improvements in fireproof work is the bringing up of the lower grades to the level of the higher by a system of insurance inspection, or something of the kind, which will present in tangible form to a certain class of owners the value of good work, which they do not themselves understand. There is a tendency in all building, and at all times, to put inferior work in places where it is soon covered up, and in fire-resistance we have been working on so small a margin that there is little chance of doing this without injury."

The problems presented by the trim and water-supply of high buildings are discussed as follows: "The doors and architraves should be of sheet metal, wood cores must still be tolerated; such are already upon the market, and have been used long enough to demonstrate their practicability. The window architraves and jambs should be of hard plaster, and the window frames and sashes of chemically treated fireproof wood or of metal. The borrowed lights in the internal partitions generally used to light the interior corridors should have similar sash and trim, and these and the doors should have wired glass, which is also a demonstrated success in its ability to hold together and check draughts of hot air and flame, before which ordinary glass disappears. The outside glass windows must probably be tolerated in large panes of plate and sheet glass, because the value of the light and view doubtless exceeds the price paid for it in extra risk. As to the furniture, a really first-class office pretending to be fireproof, such as that of a large bank or public department, can and should have metallic book shelving, and desks, and cabinets, letter files, etc., all non-combustible, even though they scarcely claim to be fireproof in the same way that a safe is so made. It is of great importance that such things do not add to the fuel in the critical moment when the fire is commencing. The desks and tables may have wooden tops upon metallic frames and pedestals—in other words, the wood may be reduced to such a minimum quantity that the risk is almost nothing. Of course there remain the papers, books, implements, etc.; but this risk can be taken care of by the fire hose of the building.

"Every first-class building should have, and in New York does have, a number of private fire hoses so distributed that every part of the building can be reached by one of them. They are of small diameter—about two inches—and are supplied by a large tank on the roof, and frequently by an auxiliary pump in the machinery department in the basement, in case continued use is required. As it has sometimes happened that the water has failed by reason of the main being found shut off when wanted, it is undoubtedly best that the fire main should also be the chief distributing main of the building; its extra size will be no harm, but the water will be always there ready for use. Such an apparatus has nipped in the bud many an incipient fire, and with this, and the care above mentioned as to materials, a building may really claim to be fireproof. A few buildings come almost up to this standard of protection. The use of the fireproof doors and architraves and wire glass is yet rare, but in all other respects a high standard has been reached. One may walk into a new banking room and find it difficult to discern any combustible material in sight, except the desk tops and the window sashes; even the floors are very frequently of mosaic or some ornamental cement composition or marble, although, as before remarked, the wood floor is the smallest risk. Even in ordinary fireproof buildings, where offices or apartments are rented, the halls, stairs, and corridors, and elevator shafts are entirely incombustible. Something remains to be desired in the protection of the staircases from flame at their soffits, because they are usually built of iron strings or carriages with marble treads all visible beneath, and, as will be shown later, fire may be carried to them from very distant points; still, the complete banishment of wood from these departments is of value. But it is true that the ordinary so-called fireproof building still retains too much wood; what is most needed is the bringing up of this class to the higher standard; the expense is not very great, and would no doubt be covered by saving in insurance and risk."

To American readers the most interesting part of the paper will probably be found in the concluding paragraphs discussing the loads to be provided for in these structures. This portion of the essay reads as follows:

"The New York City building law is so imperfect that its revision is now in hand; but its stipulations as to thicknesses of walls, and strains in various structures and materials, may be taken as typical of American practice of conservative tendency. Many cities have laws less exacting, and doubtless the new law for New York will tend in that direction. New York law stipulates 100 pounds per superficial foot floor load for office buildings; a few years ago it demanded 150 pounds. Most of the expert opinion to-day would agree that 75 pounds is sufficient, with the provision that any single foot of the floor should be capable of supporting a larger load, say 500 pounds, the 75 pounds referring to distributed load over the whole surface; the reason for this distinction is that an office floor is never likely to be loaded throughout with more than 75 pounds per foot, and beams and girders of this capacity are undoubtedly sufficiently strong, yet a concentrated load, such as a burglar-proof safe, may be placed occasionally upon a limited surface, and the structure should therefore be of such a nature that this point of strain may be equal to the emergency, assuming that the surrounding surface is not loaded. In other words, the weakest point of a beam or arch (viz., its center) should be capable of a center load of considerable magnitude, as well as being proportioned to the distributing load first stipulated. Difference of opinion and practice exists in regard to column loads. The New York law requires that the whole of the theoretical load, amounting in office buildings to about 180 pounds (80 pounds dead and 100 pounds live), should be accumulated floor by floor upon the columns; that is to say, the lowermost column should be capable of supporting every floor above it fully loaded. The Chicago architects, however, have calculated, and their views are gaining ground, that the assumed live load of superimposed stories may be decreased in calculating the strength of columns as the number of stories increases. The assumption is that the greater number of floors, or the quantity of floor space in question, the less likelihood of the maximum load in office buildings and dwellings being reached throughout simultaneously. The Chicago law has recognized this principle, although no particular rule as to its application seems to prevail. In some cases the uppermost story is calculated with the full live load upon the beams (of course the full dead load is included on all members), and about 86 per cent. of the live load upon the girders and

columns; then the next story with the same loads upon the floors and girders, but only 80 per cent. of the additional load upon the columns; the next story with only 75 per cent. of the load upon the columns, and so on down; so that in the case of a building of 15 or 16 stories, the lower columns in the first, second, and third stories are calculated for live loads on those stories of only three or four pounds, or in some cases nothing at all; and the foundation is accurately adjusted for the dead loads with no provision whatever for live loads, it having been found that a foundation, sufficient when new, acquires considerably greater strength to support temporary loading after having properly settled and taken its bearings. This may be a somewhat daring theory, but it provides a column in the lower story which is sufficient for the full average load for the building, say about 25 pounds per square foot of floor surface, and the material is placed in the most scientific as well as the most practical manner; but it is argued by many authorities, especially in New York, that municipal regulation of buildings is unable to completely control their uses after they are finished, and that although a building may be erected for offices or apartments, parts of it are likely to be converted to the use of light storage or light manufacture or to other purposes, and a considerable margin should be provided to cover such contingencies. Some buildings have been designed with the live load calculated at 70 pounds per foot on the beams, 60 pounds per foot on the girders, 40 pounds per foot on the columns, and nothing upon the footings; the dead load being, of course, included to its full amount, about 90 pounds throughout.

"The building by the writer, before referred to [the Onondaga County Savings Bank, Syracuse, N. Y., see "The Engineering Record" of November 5, 1898], was designed and calculated as follows:

Load on all beams = total dead load + 70 lbs. per ft. live load.
Load on all girders = total dead load + 60 lbs. per ft. live load.
Load on columns of three upper stories = total dead load + 60 lbs. per ft. live load.
Load on columns of remaining stories = total dead load + 40 lbs. per ft live load.
Load on foundations = total dead load + 20 lbs. per ft. live load.

"There is no doubt that the New York building law will permit of a decreasing percentage of the floor load upon the columns of many-storied buildings—and possibly a decreasing but never vanishing proportion will be the basis of the rule: as, for example, a reduction by five per cent. at each story of the total live load brought down from superimposed stories, the percentage being reckoned in each case upon the total, and not upon the original, floor loads; and, of course, as before stated, the full dead load being included on every member throughout.

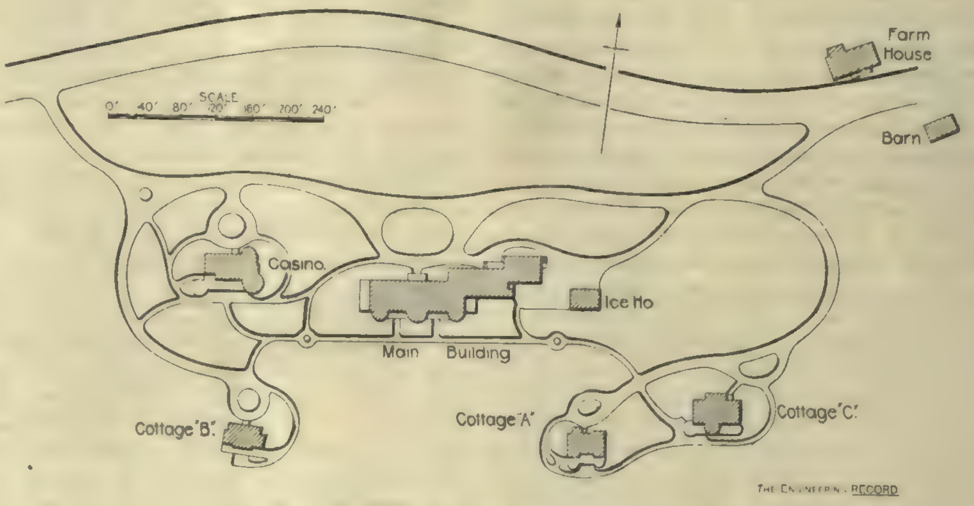
"Another reason for abundant provision of strength in fireproof office building is the custom of building fireproof partitions, counters and heavy desks upon the floors without special regard to their positions over beams or girders. A floor is rented by a bank, for example, and is loaded with a marble counter and steel fittings weighing possibly over 300 pounds per lineal foot, or perhaps a partition with a very narrow base. These things cannot be prevented, and therefore should be provided for; their place cannot be anticipated, so the only provision is a general stiffness of the floor, which, however, need not be carried to the columns, except as already averaged.

"As to the load on foundations, practice varies very much. The enormous pier loads showing considerable inequalities require an exact adjustment of their superficial area to the load to be supported, or else the building will be racked and cracked by unequal settlements. In Chicago settlements of four inches are not at all extraordinary; in New York one inch is quite frequent. If two piers are made with equal size base courses, and one is loaded with 500 tons and the other with 250 tons, the more heavily loaded pier will settle more proportionately than the lighter loaded one, and the building will be out of level, and will show cracks. This has actually occurred by reason of municipal regulations as well as because of too theoretical a view in calculations. Long since the days when it was recognized that the foundation must be proportioned to the load, buildings have been erected where one pier supported 520 tons of dead load, and another pier 500 theoretical tons, of which 200 were dead load and 300 live load, an arrangement which taught the lesson that a live load which was continuously absent would have no effect upon the building, and provision for it would be injurious. As a fact, such columns and piers have been found standing from one to three inches higher than their calculated settlement. From this position arose a custom of disregarding the dead load, by the experience, before mentioned, that a foundation, after it reached a certain age, would bear temporarily and within limits increased loads without any further settlement. Many Chicago buildings are so calculated with their dead loads equally balanced and with no provision at all for live loads, and in most cases it has worked well; but there is always the risk of a greater load being imposed, which would cause serious damage; in fact, it happened on one occasion that a warehouse had to be emptied most expeditiously because the column foundations were sinking into the Chicago mud with dangerous speed.

"The better practice undoubtedly is, to proportion the foundations to the true average load which they will have to bear, and which will be found to amount to 15 or 20 pounds per superficial foot in offices and dwellings—sometimes something must be added to cover heavy decorations and finishings, such as marble wainscotings; but generally 20 pounds will provide for this, and when added to the dead loads will not make the column foundations too large for their work. The character of the soil will, in some cases, permit without injury considerable variation in the load per foot upon the base course, but on all soft or compressible soils the problem is a very serious one when from 10 to 20 fireproof floors are built upon them. Superfluous strength in the columns is not injurious, it is simply uneconomical; but superfluous strength in the foundation base course is positively a danger to the building. The only safe practice, therefore, is that which arrives most correctly at the actual load to be supported, and proportions the work accordingly."

THE LOOMIS SANITARIUM.

It has been recognized for years that the peculiar disease of the city is consumption, yet it is only recently that the physician, sanitary engineer and hospital architect have joined forces to resist its increasing inroads on public health by supplying the conveniences needed to treat patients who have little or no money. Only five years ago the conditions in New York were such that a lady reported she had tried in vain to secure admission to a hospital for a young working girl dying in a miserable room of a tenement house. Another lady offered at once to give $1,000 toward a hospital for such patients, and out of this small beginning grew what is known as the Loomis Hospital, where incurable consumptives are received. It was named after the late Dr. Alfred L. Loomis, eminent alike as a specialist in pulmonary diseases and a man of broad-gauge philanthropy, who was associated in the charitable work of the Women's Auxiliary of the Hospital Saturday and Sunday Association. He had long recognized the value of the climate of Sullivan



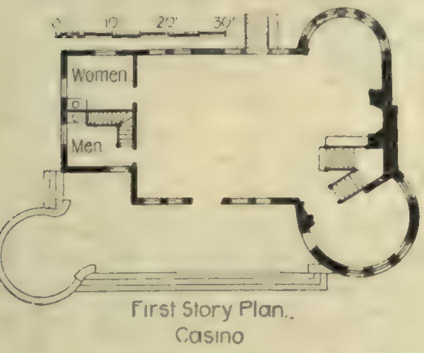
THE GROUNDS OF THE LOOMIS SANITARIUM.

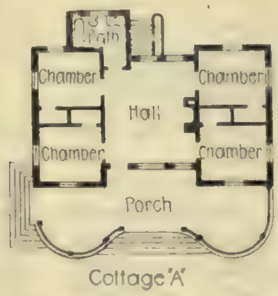
THE LOOMIS SANITARIUM FOR CONSUMPTIVES, LIBERTY, N. Y.

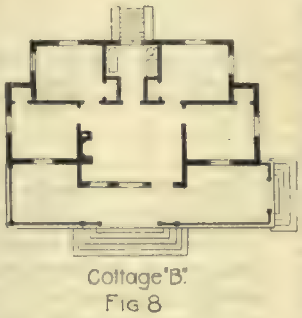
County, New York, to consumptives, and just before he died a beautiful farm was bought at Liberty for a home for curable patients. After his death it was decided by his many friends and admirers to carry out the undertaking as a memorial of his widely useful career.

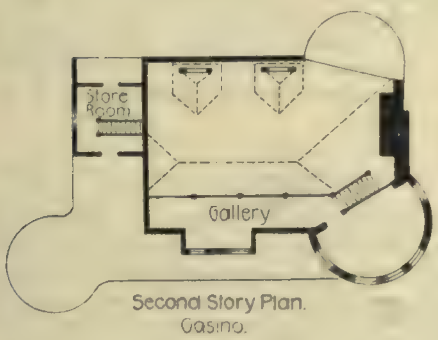
The accompanying illustrations show this highly deserving sanitarium for curable consumptives having little money, who could otherwise expect no relief from the disease. The main building was built at the expense of Mr. J. Pierpont Morgan, from the plans of Mr. Bruce Price. It is 150 feet long and has a southern exposure. The floor plans and exterior view show its construction and arrangement so well that no description is needed, while the following account of the interior indicates that the surroundings of the patients are calculated to produce that cheerful frame of mind so important in the treatment of pulmonary tuberculosis: "The interior decorations are simple but effective. Wainscotings are of white tiles; the woodwork is in white enamel paint; the walls are deep blue, crimson, pale green or yellow. The doors are in imitation of old mahogany. Floors are of hard wood and strewn with rugs. All the furnishings are in charming taste, and the dainty bedrooms, with their white enamel and brass bedsteads, comfortably cushioned lounges and muslin-curtained windows, are especially inviting."

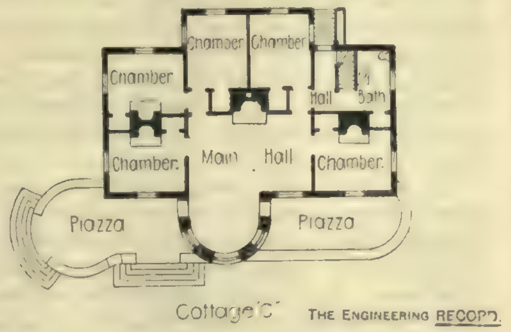
THE MAIN BUILDING OF THE SANITARIUM.

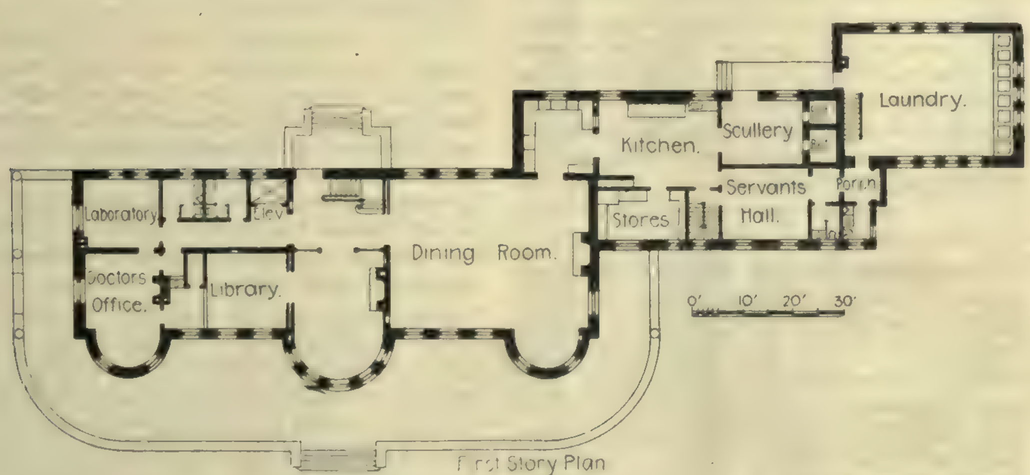












FLOOR PLANS OF THE MAIN BUILDING, CASINO AND COTTAGES.

A feature of the sanitarium is the group of one-story cottages about the main building. Plans of three of these are shown in the accompanying cuts, and the greatest need of the sanitarium is more of them, for there are a sadly large number of cases of consumption in New York, half of which might be cured could they be transferred to Liberty and placed under the healing influences there. In addition to the cottages there is a casino, with billiard and pool tables, piano, library, magazines, papers and other means of amusement. Since the accompanying illustrations were prepared other buildings have been fitted up for the sanitarium, and it is more than fulfilling the expectations of the great-hearted physician after whom it is named. The waiting list of applicants for admission is a long one, and those who know the scourge this disease is among people of small means, unable to go to Colorado and other resorts of consumptives, put the institution in the front rank of those noble undertakings of the rich who give as well as gather. It is not generally recognized that consumption causes more deaths in large cities, as a rule, than any other disease, and more in the country at large, and the same is true of European countries, except in the case of England, where bronchitis is apparently slightly more fatal.

LESSONS FROM THE NIAGARA POWER PLANT.

The occasional appearance in engineering journals of descriptions of new and projected central plants for the transmission of power, especially those of very large capacity, calls to mind once more the pioneer of the large undertakings in this line, the power development scheme at Niagara Falls. In the designs of these large stations it seems to be considered perfectly safe to adopt generating units of a capacity often without parallel. As shown by the experience at the Niagara Falls plant, however, there are minor points which can be bettered, or will be incorporated in new designing, that can only be learned after the machinery has been given a continued trial. Of course, this is doubtless true with all machinery, in a more or less degree. It will therefore not be without interest to mention some of the points which arose after the Niagara Falls plant had been in operation for some time.

The history of the development and description of the power plant at Niagara Falls has already been fully described in "The Engineering Record." Recently, however, a paper was presented to the American Society of Mechanical Engineers by Dr. Coleman Sellers, consulting engineer for the Cataract Construction Company and now chief engineer of the Niagara Falls Power Company, entitled "Some of the Mechanical Features of the Power Development at Niagara Falls," describing the condition of affairs at the plant as it stands to-day. He re-

views at some length in the paper the various projects which were considered in the inception of the scheme, mentioning the various engineers prominently identified with the work, and speaking of some of the problems not noticed or not particularly referred to hitherto. He speaks of how the Cataract Construction Company "aimed to utilize the latest achievements in all parts of the world." Notwithstanding all the effort that was made, "the amount of valuable information thus obtained seems quite limited as compared to what has since been discovered and adopted."

In starting up the machinery of the plant some difficulty was met with in the matter of turbine shaft bearings, but something of this nature was to be expected with new machinery of such unprecedented size. This will be readily recognized when it is brought to mind that supported by the vertical shaft are 160,000 pounds, rotating at a speed of 250 revolutions per minute. The lubrication of the bearings as originally designed contemplated keeping a continual flow of oil over the journal by a scooping device similar to the lifting of water from a track tank in locomotive practice. This did not work well, and when the attempt was made by the use of stuffing boxes to place the journal in a bath of oil the heat generated by the rotation was much greater than could be transmitted by the oil. Finally, a simple bearing of two parts, lined with babbitt metal, with diagonal grooves for forcing the oil and maintaining a film of it between the relatively sliding metals, gave perfect satisfaction. In fact, when it is desired to stop the machines and "the ring gates which regulate the speed of the turbines are entirely closed, and no water can escape from the wheels . . . the rotation of the machinery continues at about 40 revolutions per minute after the load is thrown off." To bring the machinery to a full stop, it is necessary to continue the load until the speed is reduced sufficiently to apply a pneumatic brake.

In the additional machinery, which is at present in process of construction and installation, Dr. Sellers has made an interesting change in the method of supporting the turbines and penstock. Instead of the heavy steel 6-foot beam, with a span of 20 feet, extending beyond the walls of the wheel pit into the rock, heavy cast-iron brackets form a part of the wheel-case of the turbine, projecting so as to rest on huge iron castings, which in turn are supported by large blocks of granite in the brickwork racked out to receive it. An iron grating floor is placed under them, enabling the workmen to get at the turbines without being hampered as formerly by the beams.

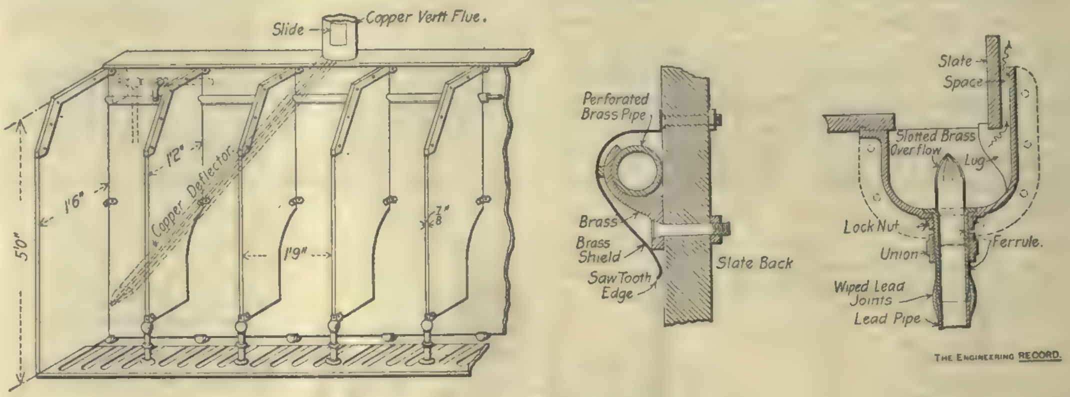
A change has been made in the design of the new generators. These, it will be remembered, are of the revolving field type. Facility for making repairs, both to the generator itself and to the turbines below, is one of the gains to be made. The feature is that the whole field may be lifted off and the spider taken from within the stationary armature, leaving a space 5 feet in diameter, through which the hoisting apparatus may be lowered to the turbines. Some considerable attention has also been paid to the matter of armature ventilation.

A very interesting circumstance arose in connection with the lining of the tunnel tail-race. This tunnel was to have been a rock excavation without any lining, but a lining was found to be essential. The board of engineers decided upon hard burned brick as the most suitable material, and the surface layers of the invert and about seven courses of the side wall rising from the invert on each side were made of vitrified brick. "About that time, Mr. John Bogart presented to the board of engineers bricks taken from sewers in New York City, which had been in use about seven years. These bricks, set in the invert of the sewers, had worn away to the extent of fully 25 per cent. from their original size as set; on edge, the worn surface presented a convex surface, the wear being greatest at the joints on each side." This led to some testing, and with the assumption that the wear was due to sand carried by the water, in a sewer of an inclination about the same as the hydraulic slope of the Niagara Falls tunnel, experiments were made with the sand blast. It was found in tests with glass "under a discharge of a fixed quantity of sand of uniform quality driven by an air blast of five pounds to the square inch, with specimens placed ½ inch from the discharge nozzle," that " . . . the quantity of glass removed at each trial was so uniform in bulk" that a delicate chemical balance failed to detect an appreciable difference in the weight of each specimen. Dr. Sellers asserts that as a result of these experiments the fact is established that with substances of uniform composition, such as neat cement, hard burned brick, marble and some limestones, the same uniformity was observable. With vitrified brick, however, he found that "in no case did a sand blast which was sufficient to make a very marked deformation of the surface of ordinary glass . . . make the slightest impression on the smooth surface of the vitrified brick."

The forging of the immense nickel-steel field rings represents the first work done by the great forging press constructed for the Bethlehem Iron Company, under the patents of Sir Joseph Whitworth, for forging by compression from steel ingots, which in their turn had been submitted to pressure while the metal was still in the fluid state. Each one of the rings weighed when finished 28,840 pounds, and were made from ingots 116,000 to 118,000 pounds each. The rings of the five new machines are to be larger than those of the three now running, and to put more metal in the ring, the shafts will be made of hollow oil-tempered steel.

AN IMPROVED URINAL STALL.

Modifications designed in the office of the Engineer Commissioner of the District of Columbia have recently been applied to the slab urinals used in the public schools in Washington, D. C. The essential features are shown in the accompanying figure, from which it will be seen that the principal improvement consists in the introduction of a continuous ventilation aperture between the extended portion of the gutter and the back slab. Most of the schools in which this fixture will be supplied are already provided with an aspiratory ventilating system, to which the connections from this apparatus can be readily attached. The slabs are of slate or alberene, ⅞ inch thick on the top, back and sides, and 2 inches thick and grooved on the bottom. The flush-pipe shield is of copper, with saw-toothed lower edge. The other metal work is of brass, except the trough, which is of cast iron, enameled inside. It is made in sections of convenient length, the ends machine-faced, and flange-bolted and cemented together. Water is supplied to the perforated flush pipe through three or more valved ¾-inch connections to a 1½-inch pipe. The floor slab has countersunk grooves, pitched to the trough, and the latter is pitched 1 inch to its waste pipe, which is trapped and vented, and accessible through a movable floor slab. The characteristic trough vent consists of a continuous open space about ½ inch wide, between the back side of the wall slab and the inner face of the rear side of the trough, which is carried up vertically about 3 inches above the floor level. Behind the wall slab in the vertical plane of the trough oblique copper deflectors are inclined from near the floor at each end to an elliptical vertical copper vent flue in the center, designed to carry off fumes. A horizontal shelf-piece rests on the tops of the



SCHOOL PLUMBING, WASHINGTON, D. C.

wall and stall slabs and covers the narrow ventilation chamber in front of the wall. The bottom of the vent flue rests on this shelf, and in it there is a slide over a hand hole to give access to an inside gas jet, provided there to accelerate the circulation.

Acknowledgment is made to Mr. Charles M. Ball, Inspector of Plumbing in the District of Columbia, for prints and specifications of this construction.

TRADE PUBLICATIONS.

The Millett Core Oven Company, Brightwood, Mass., has printed a small pamphlet describing its oven for cores, large and small, and giving a number of letters from foundrymen in various parts of the world who are using them. The same company is distributing a handy paper cutter and letter opener.

"Absolute Fireproofing" is the title of an important essay on the lessons of the Home Insurance Building fire in New York, prepared by Henry Maurer & Son, of that city. It was well said by Commissioner Brady, that if this structure had not been really fireproof, the Fire Department would probably have been forced to follow General Sheridan's example at Chicago and blow up buildings to stop the progress of a disastrous conflagration.

In its interesting and attractive circular, entitled "Draft Without a Chimney," the B. F. Sturtevant Company, Boston, tells why its tall chimney has been taken down, how draft is now produced, and how an annual fuel saving of nearly $1,000 is secured. Bulletin H, just issued by the same company, is a finely printed description of its line of electric fans, while another pamphlet giving a list of users of Sturtevant fans is an unusually tasteful piece of typography.

A large catalogue of clay-working machinery for making brick, drain tile, sewer pipe, roofing tile and terra-cotta, and for preparing clay for industrial uses like the manufacture of cement, has been issued by the American Clay-Working Machinery Company, Bucyrus, Ohio. It is a book of 200 profusely illustrated pages, and will prove of much interest to all who wish to understand the latest apparatus for producing structural ceramics. The same company is also distributing a pocket memorandum book and indexed atlas, which is the handiest thing of the sort yet received in this office.

A SYMPOSIUM ON PIPE LINES.

The monthly meeting of the New England Water-Works Association, which was held on Wednesday of this week, was noteworthy for a number of valuable papers on pipe lines for water-works. The first was by Mr. Dexter Brackett and described the new cast-iron pipe used by the Metropolitan Water Board in Boston and the vicinity. Mr. Brackett stated that the growing practice of employing sheet steel for large mains was carefully considered before the distribution system of the Metropolitan works was finally determined. It was found that the thinness of the shell of such pipes rendered their life practically dependent on the protective coating, and where they had to be laid in traveled streets it would be difficult to keep the pipe from being injured, especially in such crooked and busy thoroughfares as those of Boston. In such streets there would be many delays in using riveted pipe, which would cause the total cost to be unusually great, and it would also be impractical to expose much of the pipe for testing. Consequently, cast iron was adopted except in case of bridge or river crossings.

Having determined upon the class of pipe the thickness was next settled. Where the total length of the distribution system is small this subject is not so important, but where 75,000 tons of pipe must be used, as in this case, it amounts to considerable. There has been a tendency toward thinner pipe. In mains of small diameter, built with a factor of safety of five, the theoretical thickness is very small, only about 0.1 inch for a 6-inch pipe under a pressure of 100 pounds. Allowance, however, must be made for water hammer, imperfections in the castings, deterioration of the metal and other causes which it is unnecessary to enumerate, so the following formula was adopted to give the thickness in inches:

$$t = \frac{(\text{Stat. press.} + \text{hammer})\ \text{rad.}}{3300} + \tfrac{1}{4}.$$

The radius in this formula is expressed in inches. The water hammer was taken to vary from 70 pounds in the case of pipe 42 to 48 inches in diameter, 90 pounds for a 20-inch pipe, and 120 pounds for those from 3 to 10 inches in diameter. The thickness given by the formula is less than that used ordinarily in Boston and the vicinity. About 80 per cent. of the pipe used by the distribution department of the Metropolitan water-works is from 36 to 60 inches in diameter.

Much care was taken in the details of the manufacture of the pipe. The iron was tested by bars 2x1 inch in size, broken by transverse loads; the metal was required to have a strength of 19,000 pounds per square inch, and to deflect 0.3 inch before breaking. There was some difficulty at first in obtaining metal of this strength, but the later bars stood 23,000 to 24,000 pounds and deflected from 0.4 to 0.45 inch. About 5,000 bars were tested in all. Care was taken to have the inside of the pipes as smooth as possible. The surface of the inner core of the mold was painted with a mixture of coal dust and molasses, which was put on with a brush at first. It was found that the brush marks showed on the inside of the pipe, so in later work the core was revolved as in a lathe and the coating applied and smoothed down much as a piece of wood so mounted is polished.

Many experiments were made to find a coating for the pipe which would be better than tar, but the results were all negative and did not warrant any change. At some ovens one end of the pipe is hotter than the other when dipped, and the result is that one end is burned while the other is not hot enough. This is injurious because the coating will not dry on cold pipe and is over-distilled when applied to pipe which is too hot. The common practice is to immerse pipes in the dipping bath for from 30 to 120 seconds. The pipe for the metropolitan water supply was required to be kept in the bath for 5 minutes. The material for the coating is usually coal tar. Some plants obtain the tar directly from gas works, some use dead oil for thinning and some use fresh tar for this purpose. The interior surfaces of all pipes 36 inches or more in diameter were painted with paraffine varnish and vulcanite, as an additional protection, as they were unloaded at the pipe yards. This material dries more slowly than ordinary paint.

The second paper was a description of a new steel force main for the New Bedford waterworks, and was presented by Mr. George S. Rice. This main is 8 miles long, 48 inches in diameter, and made of steel plates 5-16 inch thick. The pipes came from the shops in lengths of about 30 feet and were put together with telescopic joints. A railway track was built for four miles along the line of the main and facilitated its construction very much. The pipe was coated with asphalt applied at a temperature of 300 degrees Fahrenheit, and at some places with P & B paint.

Careful experiments were made to determine if there was any expansion in the pipe after it was laid. The experiments were made under a range of temperature of 40 degrees, with air circulating through the pipe. No change whatever could be noticed where the sections were covered with earth, but where they were exposed there was some motion evident. About a mile and a half of the main was laid on piles through a swamp; the piles were capped and the pipes rested on these caps. Manholes were put in every 500 feet and eight air valves were placed along the line. There is 70 pounds static pressure at the pumping station.

The line was tested with water in lengths of 2,000 feet and left full for four or five days at a time; in some cases for even two weeks. At one time, when a heavy rain came on, the contractor let the water out of a section of the pipe and 400 or 500 feet floated in consequence. In all the tests only one leak was found large enough to be photographed. All the curves on the main, the sharpest being a 6-degree curve, were made in the shops.

The third paper was by Mr. L. M. Hastings, city engineer of Cambridge, Mass., on the use of steel in water mains. He believed it would be advantageous to use this material in pipes 24 inches or more in diameter, and in the leading mains supplying outlying districts of a city. The advantages of steel are its economy in first cost, relative freedom from breakage in service, and adaptability for special situations, such as river crossings. As for the first point, economy in first cost, Mr. Hastings stated that the 36-inch cast-iron main laid in Rochester in 1892 cost \$6.21 per foot, while the 38-inch steel main cost but \$5.84. At Cambridge a 40-inch steel main saved 31½ per cent. of the estimated cost of a cast-iron pipe of the same size. At New Bedford the saving was 23 per cent. in the case of 48-inch pipe. At Minneapolis the saving is estimated at 28 per cent. in the case of a 50-inch main, and at Duluth it was believed to be about 33 per cent.

In regard to the discharging capacity of pipes Mr. Hastings pointed out that many experiments made with cast-iron mains show that after a few years there is a marked diminution in their capacity, owing to tuberculation. As for steel pipes there have been very few experiments, but it seems to be true that their poorer showing as regards discharging capacity compared with cast-iron mains disappears more or less in the course of time. As an illustration he referred to the pipe at Cambridge, Mass. It was estimated that a 40-inch cast-iron main having a coefficient "c" of 105 would be equivalent to a 42-inch steel pipe having a coefficient "c" of 90. The steel pipe was selected. It cost \$116,119, or about \$4.81 per foot. It weighed 7½ pounds per foot more than the iron pipe, and length for length was 5 per cent. more expensive; consequently, the saving of 31½ per cent. previously mentioned should be reduced to 26½ per cent.

As regards protective coatings Mr. Hastings believed that steel should be more carefully treated than cast iron. On this subject he referred to the interesting experiments made at Cambridge and described very fully in the "Transactions" of the American Society of Civil Engineers for December, 1896. The durability of the steel mains was considered to be somewhat less than that of cast-iron pipe, but not enough to amount to anything.

The concluding paper was a description of the new salt-water fire-protection system in Boston, which was presented by Mr. Frank A. McInnis. A 12-inch cast-iron main has been run from the water front to the Post Office and then back over a different route to the water front again. This pipe is 5,000 feet long. At each end it branches into two 10-inch pipes which divide into six 3½-inch pipes. Hydrants are placed about 300 feet apart and there is an electric signal system connecting them with the water front, where the fire boats are attached, and with the fire headquarters. The system was described in "The Engineering Record" of January 8, 1898, and for that reason need not be further reviewed here.

The meeting was an unusually enjoyable and profitable one, and the presentation of the papers was rendered more attractive than usual by a large number of lantern views. President Forbes, Secretary Whitney and the other officers of the association are to be congratulated on the results of their labors in organizing these meetings devoted to a single subject. It was determined during the business session to hold the fall convention at Syracuse, in response to the earnest invitation of Mr. William R. Hill, engineer and superintendent of the water-works of that city.

PERSONAL NOTES.

Mr. Henry H. Bender of Albany has been appointed superintendent of buildings of the State of New York.

Mr. H. Wilmot has been elected superintendent of water-works at Columbus, Miss., a city which has recently voted to issue \$70,000 of bonds for sewerage and water-works.

Chief Engineer M. E. Cooley, U. S. N., has been ordered to the League Island Navy Yard and then home, which probably means that he will soon resume his duties in the department of mechanical engineering at the University of Michigan, which he left when the call came for marine engineers for naval service.

Mr. J. A. L. Waddell, M. Am. Soc. C. E., announces that Mr. Ira G. Hedrick, Assoc. M. Am. Soc. C. E., has become a partner in his business, which will hereafter be conducted under the firm name of Waddell & Hedrick, Gibralter Building, Kansas City. Mr. Hedrick has been in Mr. Waddell's office since his graduation in 1892 from the University of Arkansas, and since July, 1894, has been in charge of the designing department of the office.

Col. John N. Partridge has been appointed superintendent of public works of New York State. He is a native of Leicester, Mass., and lived in the state until the outbreak of the civil war, when he enlisted in a Massachusetts regiment. He served continuously until his health broke down during the siege of Petersburg. After recovering, he moved to Brooklyn, and has since held executive offices under a number of its mayors. For eleven years he was president of a street railway company of that city, which has since been absorbed by another corporation.

Civil Engineers are wanted by the Navy Department and an examination of candidates will be held at the Washington Navy Yard on January 23. Applications for permits to be examined should be made to the Secretary of the Navy.

CONTRACTING NEWS

OF SPECIAL INTEREST TO

CONTRACTORS, BUILDERS, ENGINEERS, AND MANUFACTURERS

OF ENGINEERING AND BUILDING SUPPLIES.

For Proposals see page ix.

WATER.

Plainfield, N. J.—In his annual message Mayor George Rockfellow recommends that the Council take steps to secure municipal ownership of the water-works as soon as the present contracts expire.

Columbus, Miss.—Bids are wanted Feb. 7 for $70,000 water and sewerage bonds. W. D. Humphries, Mayor.

Kings Park (L. I.), N. Y.—The State Commissioners in Lunacy have approved the plans of the Bacon Air Lift Co. for supplying the hospital at Kings Park with 1,000,000 gals. of water by means of a system of artesian wells and air compressor pumps; cost of entire plant, $18,000.

San Francisco, Cal.—It is stated that the following bids were received for the filtering system for the City Hall: California Jewel Filter Co., $6,690.50; New York Filter Mfg. Co., N. Y. City, $6,780.

Albany, N. Y.—The Board of Finance has authorized the issue of $100,000 water bonds to complete the filtration plant.

Barnesville, O.—The Council is considering the proposition to construct water-works.

Atlanta, Ga.—The City Council has been asked for an appropriation of $40,000 for the extension of water pipes.

Martins Ferry, O.—The question of issuing $30,000 bonds to improve the water-works will be submitted to the vote of the people.

Lockport, N. Y.—The Holly Manufacturing Co., Lockport, N. Y., estimates the cost of an 8,000,000-gal. horizontal pumping engine at $27,500.

Orchard Park, N. Y.—Petitions are being circulated for a system of water-works.

Heber, Utah.—It is proposed to construct a system of water-works to cost about $15,000.

Frederick, S. D.—It is stated that the Frederick Water, Light & Power Co. has been formed and will soon begin work on an artesian well.

Worcester, Mass.—It is stated that an order has been adopted authorizing the purchase of additional lands for the development of the city's water supply.

Baltimore, Md.—The Board of Public Improvements has approved the filtration ordinance which directs the Water Board to appoint a special committee to investigate the feasibility of a system of filtration.

Irvington, N. J.—It is stated that the Town Council has decided to purchase the plant of the Irvington Water Co. for $50,000.

Corsicana, Tex.—It is stated that James S. Thatcher, Engr. of Dallas, is preparing surveys and estimates for increased water supply.

New Albany, Ind.—Bids are wanted Jan. 28 for the construction of a system of water-works, as advertised in "The Engineering Record."

Honolulu, Hawaiian Is.—Bids are wanted Feb. 21 for a triple compound condensing crank and flywheel pumping engine of 200,000 gals. per hour capacity, as advertised in "The Engineering Record."

Millvale, Pa.—The following bids for a vertical pump of 2,000,000 gals. daily capacity were opened Jan. 3 by C. W. Dankmyer, City Clk.: Wilson-Snyder Mfg Co., Pittsburg, Pa., $4,985; Henry R. Worthington, N. Y. City, *$4,845.
*Contract awarded.

Hintonsburgh, Ont.—W. A. Mason, Village Clk., writes that it was voted Jan. 2 to issue $60,000 bonds for municipal water-works.

Palestine, Tex.—C. C. Merrick, City Engr., writes that the new Water-Works Co. is building a reservoir and dams and contemplates laying 21 miles of mains. When the water-works are complete the present sewerage system will be extended.

Frederick City, Md.—Local reports state that the Board of Aldermen has under consideration the increase of the water supply.

Meadville, Pa.—The plant of the Meadville Water Co. has been transferred to the city for the sum of $200,000.

Chattanooga, Tenn.—It is stated that City Engineer Robt. Hooke has prepared an estimate of the cost of building a new system of waterworks.

Rochester, N. Y.—The report of the Water-Works Committee estimates the cost of extending distributing mains at $84,906, of completing new conduit connections at reservoirs at $60,000, the total amount asked for being $176,352.

Missoula, Mont.—Local reports state that a company is being formed for the purpose of irrigating south and west of Missoula by means of water taken from the Big Blackfoot River.

Bay City, Mich.—The Committee on the Pumping Station has reported in favor of installing a new boiler, and bids will be asked at once. E. L. Dunbar, Supt. of Water-Works.

Huntsville, Ala.—It is stated that the City Council will receive bids Feb. 7 for $20,000 water-works bonds.

Cuyahoga Falls, O.—Local reports state that an election will be held Feb. 18 to vote on construction of a water-works system at a cost of $60,000.

Greenville, Tenn.—The proposition to purchase the water-works will be voted upon at the election to be held Jan. 24.

Memphis, Tenn.—The City Council has passed the bill authorizing the issue of $2,000,000 bonds for the construction or purchase of a water-works plant.

Leadville, Colo.—John Nowland and Alfred Thielan have been appoined by the City Council as appraisers of the water-works plant. The city has the option of buying the plant, the present contract expiring this year.

Oil City, Pa.—Local reports state that the Barr Pumping Engine Co. has secured the contract for a pumping engine, to cost $22,500.

Philadelphia, Pa.—Councils' Committee on Water has agreed to have prepared and reported favorably an ordinance appropriating $2,700,000 for the improvement, filtration and extension of the water supply east of the Schuylkill River; also to authorize the Director of Public Works to invite proposals for the erection of a pumping station, with filtration beds, on the Delaware River above Frankford.

Cleveland, O.—A resolution has been introduced in the City Council to advertise for bids for constructing the new pumping station at the foot of Kirtland St. Plans have been completed and call for an engine house 150x75 ft. and 80 ft. high; also a boiler house 171x60 ft. In the main building it is proposed to place 4 pumps, each with a capacity of 25,000,000 gals. in 24 hours. The City Engineer estimates that it will cost $400,000 to complete the buildings.

Brownsville, Tenn.—Local reports state that on Jan. 6 it was voted to issue $50,000 bonds for the construction of water-works, an electric light plant and public school. W. M. Crandell, Mayor.

Alliance, O.—Bids are wanted Jan. 31 for $81,000 water-works bonds. J. H. McConnell, City Clk.

Binghamton, N. Y.—Local reports state that the contract for 16,000 ft. of 6, 8 and 12-in. pipe has been awarded to M. J. Drummond & Co., New York City, at $16.55 a ton. Other bids received were as follows: Warren Foundry & Machine Co., Phillips, N. J., $18.70; Donaldson Iron Co., Philadelphia, $16.91; Buffalo Cast Iron Pipe Co., Buffalo, $18.25; McNeal Pipe & Foundry Co., Burlington, N. J., $17.40; Jackson & Woodin Mfg. Co., Berwick, Pa., $17.50.

Pittsburg, Pa.—It is stated that the following bids were opened Jan. 6 for the construction of a 48-in. riveted steel force main to the new reservoir in Highland Park: T. A. Gillespie, $74,940; James H. McQuade, Pittsburg, $84,633.75; Cronin & O'Herron, Pittsburg, $74,000; James McNeil & Bro., $82,000; Riter & Conley, $81,943; Keeling & Ridge, Pittsburg, $68,775; Stratton & Lewis, $83,471.80; W. E. Howley, Pittsburg, $73,697; T. L. McNally, $106,212.35.

SEWERAGE AND SEWAGE DISPOSAL.

Dunmore, Pa.—An ordinance has been passed providing for the issue of $60,000 sewer bonds.

Steelton, Pa.—The Council has authorized the president to employ an engineer to give attention to details for the proper sewerage of the borough.

Everett, Mass.—Mayor Hatch, in his inaugural address, recommends that the Legislature be petitioned for authority to borrow $100,000 to construct sewers.

Newport News, Va.—It is stated that the Sewerage Commission has decided to extend the sewer system, now being built, to other sections of the city, at an additional cost of $25,000.

Newburgh, N. Y.—Local reports state that the contract for constructing First St. main sewer has been awarded to M. J. Dwyer and Wm. Sager, of Newburgh, for $25,826. See our issue of Dec. 24 for list of bids received.

Houston, Tex.—The City Council has passed the ordinance providing for the issue of $100,000 bonds for sewerage and paving.

Cumberland, Md.—Plans have been accepted by the City Council for a $6,000 sewerage system in South Cumberland.

Palestine, Tex.—See "Water."

Springfield, Mo.—T. A. White, City Engr., writes that E. Plummer has secured a $1,330 sewer contract.

Spokane, Wash.—We are informed that considerable sewer extension work is contemplated. Otto A. Weile, City Engr.

Sleepy Eye, Minn.—George Glotzbach, Village Recorder, writes that the vote taken on Jan. 3 was in favor of sewerage.

Wellsville, O.—City Clk. D. A. Davidsons has advertised for a competent civil engineer to prepare plans and specifications for a complete sewer system, all propositions to be sent in by Feb. 1.

Marion, Ind.—C. G. Robbins, City Clk., writes that resolutions have passed the Council for main sanitary sewers in two alleys west of Nebraska St., and for five lateral sewers. L. M. Overman, City Engr.

Glenville, O.—Bids are wanted Feb. 6 for $30,000 sewer bonds. Robert C. Wright, Mayor.

Cleveland, O.—Bids are wanted Feb. 20 for $60,000 sewer district bonds. H. L. Rossiter, City Aud.

St. Cloud, Minn.—City Engineer Chute has been instructed to prepare plans for a district sewer on 4th St.

Pittston, Pa.—An ordinance has passed providing for the construction of a sewer on Butler St.

Lakewood, O.—It is stated that an election will be held Jan. 26 to vote on the proposition to issue $150,000 bonds for a sewer system and disposal plant.

Little Falls, N. Y.—The Common Council has ordered the south side sewer system constructed. Engineers' estimate of cost, $15,700.

Cape May, N. J.—The City Council has ordered the American Piping Co. to prepare plans, at a cost of $500, for a sewerage system.

Seattle, Wash.—The City Council has passed the bill providing for the construction of a sewer system on East Denny Way and adjoining streets.

Youngstown, O.—City Engineer Lillie recommends certain improvements in the sewerage system, to cost about $15,000.

Taunton, Mass.—The Sewer Commissioners, in their annual report, recommend the appropriation of $100,000 for the building of a trunk sewer from Grove and Adams Sts. to Whittenton Station; also the extension of Cobb Brook system.

Williamsport, Pa.—Bids are wanted Jan. 16 for 700 ft. 4-ft. brick storm sewer. Theo. Cornman, City Clk.

South Bend, Ind.—Bids are wanted Jan. 23 for an 18 and 20-in. pipe sewer and for a brick sewer in High St. L. A. Hull, City Clk.

Norristown, Pa.—Bids are wanted Feb. 3 for an 8-in. salt-glazed fire-clay pipe sewer in Chestnut St. M. D. Patterson, Boro. Engr.

Spartanburg, S. C.—Bids are wanted Feb. 3 for about 16 miles of 8 to 24-in. pipe sewers, as advertised in "The Engineering Record."

East Liverpool, O.—Bids are wanted Jan. 24 for about 7 miles of 4-in. to 12-in. terra cotta sewer pipe. F. H. Croxall, Secy. Sewer Commrs.

Granite City, Ill.—It is stated that the City Council has decided to advertise for bids for the construction of the sewer system. The city will be asked to vote bonds to the amount of $40,000 to pay for the sewer.

Toledo, O.—A resolution has been passed calling for the extension of Maumee Ave. main sewer; also a resolution for a pipe sewer in an alley, to cost $2,070, and the engineer has been instructed to establish main sewer district No. 31.

Jackson, Miss.—It is stated that bonds will be issued on March 7 for $100,000 to put in a sewerage system unless before that time the taxpayers petition against it, in which case an election will be held.

Columbus, Miss.—See "Water."

Yuma, Ariz.—It is stated that bids are wanted Jan. 23 for a sewer. R. J. Duncan, Mayor.

Kingston, Pa.—Local reports state that the following bids were opened Jan. 2 for the proposed sewerage system: Donohue & O'Boyle, Scranton, $21,791.96; V. H. O'Hara, Scranton, $18,080.81; Blear & Kennedy, Carbondale, $15,258.08; E. H. Post, Wilkesbarre, $13,259.86; A. H. Coon, Kingston, $13,009.96; D. M. Rosser, Kingston, $10,167.89.

Scranton, Pa.—The following bids were opened Jan. 5 for 1,015 ft. of 8, 10 and 12-in. pipe sewers on Van Storch Ave. and Honesdale St. *a*, price per lin. ft. for work complete, including 1 basin, 6 manholes, and 24 house connections; *b*, extra basins; *c*, extra manholes; *d*, extra house connections per lin. ft.: V. H. O'Hara, Scranton, *a*, $1.30; *b*, $90; *c*, $35; *d*, 45c. Donohoe & O'Boyle, Scranton, *a*, $1.57; *b*, $95; *c*, $33; *d*, 40c. Ed. H. Post, Wilkesbarre, Pa., *a*, $1.49; *b*, $80; *c*, $45; *d*, 40c. M. J. Gibbons, *a*, $1.57; *b*, $80; *c*, $50; *d*, 75c.. P. F. O'Hara, *a*, $1.44; *b*, $85; *c*, $35. T. F. Gannon & Co., *a*, $1.44; *b*, $85; *c*, $35.

BRIDGES.

Newark, N. J.—The Board of Freeholders has been petitioned to construct a bridge across the Passaic River between Newark and Kearny Townships.

New York, N. Y.—The Board of Aldermen on Jan. 10 passed the resolution authorizing the issue of $100,000 bonds for preliminary work on the two proposed bridges over the East River.

St. Joseph, Mo.—It is stated that the contract for the superstructure of Grand Ave. viaduct has been awarded to Hoff Bros., of Minneapolis.

Benning, D. C.—Engineer Commissioner Beach is stated to have approved the plans of the Columbia St. R.R. for a bridge across the Eastern branch.

Spokane, Wash.—B. H. Fowle, Secy. Bd. of Pub. Wks., writes that the construction of a $5,000 combination bridge is contemplated.

Reading, O.—Press reports state that the Council has under consideration the building of a bridge across Mill Creek at 5th St.

Chicago, Ill.—The Sanitary Trustees have instructed the engineer to advertise for bids for constructing the Chicago & Western Indiana bridge on Section L. Cost, about $150,000.

Chester, Pa.—The Street and Corporation Committee has under consideration the construction of a bridge over Lloyd St.

Two Rivers, Wis.—See "Electric Railways."

Hartford, Conn.—The Berlin Iron Bridge Co., East Berlin, Conn., is stated to have received the contract for constructing the Broad St. bridge with a plank flooring, at $4,494. For list of bidders see our issue of Oct. 22.

Malden, Mass.—A committee has been appointed to wait upon the Boston & Maine R.R. officials in regard to building an iron bridge over its tracks on Washington St.

Vincennes, Ind.—The Vincennes Bridge Co. has been incorporated; capital, $20,000. Incorporators: John T. Olephant, Frank L. Olephant and J. L. Riddle.

Brookhaven, Miss.—Press reports state that the Lincoln County Board of Supervisors opened bids Jan. 3 for building a steel bridge across Homochitto River. The two lowest bidders were the Southern Bridge Co., Birmingham, Ala., at $7,900, and the New Jersey Steel & Iron Co., Trenton, N. J., at $7,750. Final action to be taken at the March meeting.

Sault Ste. Marie, Mich.—It is stated that the City Engineer has been instructed to call the attention of the Michigan Lake Superior Power Co. to the necessity of a bridge across the canal at Maple St., which the company is required to construct.

North Adams, Mass.—Press reports state that the Mayor, in his message, recommends the building of a bridge at State St., to replace the present structure.

Birmingham, O.—Press reports state that a petition has been made requesting the County Commissioners to build a bridge across the Vermilion River.

Jackson, Miss.—Town Creek bridge bonds to the amount of $18,400 have been sold.

New York, N. Y.—As advertised in "The Engineering Record," the new East River Bridge Commission will, as soon as necessary appropriations are made, advertise for bids for the steel towers and end spans of the new East River bridge. Plans and specifications can now be procured from the Chief Engr., 84 Bway., Borough of Brooklyn.

Binghamton, N. Y.—The Mayor recommends that a special election be held to vote on the question of building a bridge across the Susquehanna River, at Tompkins St.

Brooklyn, N. Y.—Mayor Van Wyck has approved the ordinance authorizing the Commissioner of Bridges to advertise for bids for reconstructing the Blissville bridge, over Newtown Creek, for which $70,000 has been appropriated.

Freehold, N. J.—It is stated that an appropriation of $14,000 has been made to build a bridge across Wrecks Pond, Silver Lake. W. J. Jefferson, Chmn. Bridge Com.

South Omaha, Neb.—The construction of a viaduct across the tracks, between the stock yard and the city, has been petitioned for.

Coraopolis, Pa.—The Second Avenue Traction Co. has applied for a charter to construct a bridge over the Ohio River to connect Coraopolis with Sewickley.

Quincy, Mo.—The construction of a stone arch bridge over Curtis Creek is stated to be under consideration.

Iowa City, Ia.—It is stated that a new iron bridge will be built over the tracks of the Chicago, Rock Island & Pacific Ry.

Norfolk, Va.—City Engineer Brooke reports the Botetourt St. bridge to be unsafe, and estimates the cost of repairing at $6,150.

Brookland, D. C.—The Citizens' Association has requested the construction of a bridge across the tracks of the Baltimore & Ohio R.R. at Lansing St.

Cleveland, O.—It is proposed to build a steel bridge over the tracks of the Cleveland, Cincinnati, Chicago & St. Louis Ry., at the junction of Ridge Ave., Chestnut Ridge Road and Denison Ave.

Redwood Falls, Minn.—Press reports state that the County Commissioners have appropritaed $2,000 for rebuilding the bridge across Minnesota River, near North Redwood.

Troy, N. Y.—The construction of a steel highway bridge to replace the present structure over the Wynantskill, is stated to be under consideration; cost, about $2,500.

Deercreek, Minn.—Bids are wanted Jan. 20 for a bridge across Leaf River. Fred Bekbrock, Chmn. Supervisors.

Helena, Mont.—Bids are wanted Feb. 1 for a 75-ft. span steel bridge across the south fork of the Dearborn River. Charles J. Clark, Clk. Co. Commrs.

Portland, Ore.—It is stated that the Board of Public Works will soon ask for bids for constructing the East Yamhill St. bridge.

Pittsburg, Pa.—Director of Public Works E. M. Bigelow recommends the issue of $260,000 bonds for the new 10th St. bridge, also the following appropriations for 1899: Point bridge, reconstructing, $100,000; Wilmot St. bridge over Junction Railroad, $25,000; Lincoln Ave. bridge across Boulevard, $150,000; Haight's Run bridge, on Butler St., $110,000; South Main St. bridge across Sawmill Run, $10,000; Bond St. bridge across Negley Run, $15,000.

Baltimore, Md.—The Receivers of the Baltimore & Ohio R.R. are stated to have awarded contracts for constructing 51 bridges between Benwood, W. Va., and Chicago, as follows: To the Youngstown Bridge Co., Youngstown, O., for 31 bridges on the Central Ohio Division, to the Pencoyd Iron Wks., Philadelphia, Pa., for 11 bridges on the Lake Erie Division, and to the Edge Moor Bridge Co., Wilmington, Del., for 9 bridges on the Chicago Division. The total cost is about $300,000.

Ogden, Utah.—Press reports state that the County Commissioners opened the following bids Dec. 28 for constructing a bridge across Weber River: Canton Bridge Co., Canton, O., $7,900; Kansas City Bridge Co., Kansas City, Mo., $8,000; Missouri Valley Bridge & Iron Wks., Leavenworth, Kan., $8,494; Wrought Iron Bridge Co., Canton, O., $7,600; Gillett-Herzog Mfg. Co., Minneapolis, Minn., $7,650; Farnsworth & Blodgett, $7,500; H. M. Perham, $6,190; the Andrews Bridge Co., Ogden, Utah, $6,995, $7,095 and $6,895.

Cleveland, O.—It is stated that bids are wanted Feb. 14 for the superstructure of Center St. bridge.

Norfolk, Va.—The following bids for a steel highway and drawbridge across Smith's Creek were opened Dec. 28 by the Board of Street, Sewer and Drain Commrs., as advertised in "The Engineering Record": *a*, with brick masonry; *b*, with granite or limestone masonry facing to piers: Wrought Iron Bridge Co., Canton, O., *a*, $56,650; *b*, $59,850. Brackett Bridge Co., Cincinnati, O., *a*, $74,898; *b*, $78,398. Elmira Bridge Co., Elmira, N. Y., *a*, $56,000. Nelson & Buchanan, Chambersburg, Pa., *a*, $65,674. Groton Bridge Mfg. Co., Groton., N. Y., *a*, $71,200; *b*, $74,200. Variety Iron Wks. Co., Cleveland, O., *a*, $61,465. F. R. Long & Co., New York City, *a*, $66,500; *b*, $77,000. Geo. E. King Bridge Co., Atlanta, Ga., *a*, $61,990. The King Bridge Co., Cleveland, O., *a*, $68,430; *b*, $71,780. Youngstown Bridge Co., Youngstown, O., *a*, $63,275; *b*, $65,775. McGuire & Hall, New York City, *a*, $64,874; *b*, $65,874. The Toledo Bridge Co., Toledo, O., *a*, $59,150; *b*, $61,150. The Penn Bridge Co., Beaver Falls, Pa., *a*, $69,750. The Champion Bridge Co., Wilmington, O., *a*, $61,999. Grant Wilkins, Atlanta, Ga., *a*, $68,900; *b*, 72,900. Edge Moor Bridge Wks., Wilmington, Del., *a*, $53,500; **b*, $55,800.

*Contract awarded, according to press reports.

PAVING AND ROADMAKING.

Kansas City, Mo.—The Board of Public Works has adopted resolutions to pave with brick on four streets, and the engineer has been instructed to prepare plans for the same; also for brick paving on Barr St.

Irwin, Pa.—It is stated that street improvement bonds to the amount of $4,000 are about to be issued.

New Providence, N. J.—The County Board of Freeholders has passed a resolution to macadamize South St. at the cost of about $5,000.

Fulton, N. Y.—Village Surveyor Breed estimates that about 22,000 yds. of brick pavement and 5,000 yds. of curbing will be necessary for the improvement of Second St.

Reading, Pa.—The Select Council has passed the ordinance for the issue of $100,000 bonds for street paving.

Utica, N. Y.—The Common Council has under consideration eleven resolutions to pave and repave certain streets.

Topeka, Kan.—The City Council has been petitioned to pave Huntoon St. with brick, to cost not over $1.24 per sq. yd.

Boston, Mass.—The Street Department has been authorized to expend $22,000 for additional street improvements.

Brockton, Mass.—Mayor Low's annual message contains a recommendation for permanent pavement on several streets.

Baltimore, Md.—Mayor Malster has signed the ordinance to repave Pine St. with sheet asphalt.

Rochester, N. Y.—The lowest bid received Jan. 5 for paving South Fitzhugh St. with asphalt was from Whitmore, Rauber & Vicinus, of Rochester; estimated cost, $11,000.

Fort Wayne, Ind.—The Board of Public Works has been petitioned to pave five streets with asphalt block.

Brighton, N. Y.—The contract for improving East Ave. has been awarded to H. B. & W. A. Gillette, of Rochester, for $8,200.

Decatur, Ala.—It is stated that an election will be held Jan. 17 to vote on the issue of $75,000 bonds, to build turnpike roads.

Yonkers, N. Y.—The City Attorney has been directed to prepare an act authorizing the issue of $22,000 street paving bonds and $36,000 public dock bonds.

New York, N. Y.—Bids are wanted Jan. 17 for paving several streets with asphalt. James P. Keating, Commr. of Highways.

Jamestown, N. Y.—Bids are wanted Feb. 1 for about 5,374 sq. yds. of brick paving, 3,240 lin. ft. of curbing and 272 ft. curved curbing, as advertised in "The Engineering Record."

Marlboro, Mass.—Mayor Plunkett advocates the paving of certain streets and suggests that $5,000 be appropriated for a State highway.

Houston, Tex.—See "Sewerage and Sewage Disposal."

Savannah, Ga.—A resolution has been passed providing for the paving of Wheaton St. with brick.

New Orleans, La.—The City Council has passed an ordinance to pave several streets.

Philadelphia, Pa.—The Common Council has passed a bill appropriating $2,000,000, from the proceeds of the $11,200,000 loan, to be expended in repaving streets.

Lebanon, Ind.—John H. Hoy, City Clk., writes that the Council has under consideration the construction of brick pavements on the public square and Lebanon St.

Newport News, Va.—An election will be held Jan. 18 to vote on the issue of $90,000 bonds for paving, for a market house and garbage crematory.

Salem, O.—The City Council has passed resolutions to pave 26,000 sq. yds. with asphalt block.

Pawtucket, R. I.—The City Council has adopted a resolution to ask the Legislature for permission to issue $100,000 bonds for widening Main St.

Toledo, O.—Bids are wanted Feb. 6 for paving Milburn Ave. and Monroe St. with asphalt or block pavement. Lem P. Harris, City Clk.

Shreveport, La.—Bids will be received Feb. 1 by the City Comptroller for $40,000 street paving bonds.

Decatur, Ind.—It is stated that bids are wanted Feb. 16 for macadamizing about 5½ miles of East Washington Road, in Washington Township; estimated cost, $17,499. W. E. Fulk, Co. Surveyor.

Norwood, O.—It is stated that the following bids were opened Jan. 7 for the construction of one-half mile of macadam road, with a five year guarantee: Frank Folz, Cincinnati, $14,001; John Snyder, Norwood, $14,712; L. Drach, Cincinnati, O., $13,724; A. J. Henkel & Bro., Cincinnati, O., $16,088; John Trapp, Newport, Ky., $13,891.

New Brunswick, N. J.—Local reports state that the following bids were received by the Board of Freeholders for the construction of two macadam roads: John Reihl, Somerville, $18,500 and $9,881.70; E. L. Ragament, Rocky Hill, 56c. and 56½c. per sq. ft.; T. J. McGovern, Somerville, $18,620.19 and $8,078.20; Dennis Roe, Princeton, $19,926.87 and $9,321; R. A. Montgomery, Trenton, $17,640.18 and $8,854.95; J. Erwin Hillpot, Bound Brook, $22,427.07.

The contract for one road was awarded to R. A. Montgomery for $17,640.18.

New York, N. Y.—The following bids for asphalt paving on Astor Place and 8th St. were opened Dec. 28 by James P. Keating, Commr. of Highways:

Bidders.	4,280 sq. yds. Pavement.	4,300 sq. ft. Stone.	500 ft. new curb.	10 ft. old curb.	Total.
Atlantic Alcantraz Asphalt Co., 57 E. 59th St.	$2.94	$ .41	$ .75	$ .30	$14,724.20
Barber Asphalt Paving Co., 11 Bway	3.02	.39	.73	.22	14,969.80
Fruin-Bambrick Paving Co., 220 Bway	2.88	.46	.77	.22	14,432.60
Sicilian Asphalt Paving Co., Times Bldg.	4.02	.35	.73	.23	19,077.90
Warren-Scharf Asphalt Paving Co., 81 Fulton St.	2.86	.38	.75	.20	*14,251.80

* Contract awarded.

Other contracts have been awarded as follows: To the Sicilian Asphalt Paving Co., for 2,980 sq. yds. of asphalt at $2.68 per sq. yd , total, $9,330; and to the Barber Asphalt Paving Co. for 2,100 sq. yds. at $2.97 per sq. yd., total $7,878.45.

POWER PLANTS, GAS AND ELECTRICITY.

Ottawa, Ill.—L. B. Merrifield & Co., organ manufacturers, are said to have applied for a franchise for electric lighting.

Marion, O.—The Marion Electric Light Co. is stated to have received the contract for lighting the city.

Adrian, Mich.—Capt. J. H. Fee, Pres. of the Electric Light & Power Co., is stated to have asked the City Council for a franchise to pipe the city for a hot-water heating plant.

Moweaqua, Ill.—J. H. Culver is stated to have received a franchise to construct an electric light plant.

Rensselaer, N. Y.—It is stated that the Kinderhook Light & Power Co. has purchased a site for a new power house. This company now furnishes light to the city. M. A. Heesan, Secy.

Topeka, Kan.—The contract for improving the electric light plant has been awarded to W. M. Thompson Co. of Sioux City, Ia., at $7,045.

Hudson, N. Y.—A committee is stated to have been appointed to ascertain the cost of establishing a lighting plant in connection with the city water-works.

Bellevue, Pa.—The Council is stated to have passed an ordinance granting the Pennsylvania Light, Heat & Power Co. a franchise in the borough.

Gilboa, N. Y.—Dr. S. E. Churchill is reported to have purchased the water power at this place and will in the near future put in a plant for furnishing electric light and power for Stamford and other near-by villages.

Auburn, N. Y.—Mayor Lewis in his annual message advocates the municipal ownership of the lighting plant.

Milton, Ia.—W. H. Boyd, City Clk., writes that it was voted Jan. 4 to construct an electric light plant.

Hope, N. D.—Mr. Moores, of the Hope Roller Mills, is said to be considering the matter of constructing an electric light plant in connection with the mill.

Norwalk, Conn.—The Norwalk Gas Supply Co. is stated to have petitioned for an amendment to its charter for permission to manufacture and sell electricity for lighting and power purposes.

Richmond, Va.—E. J. Willis, H. E. Baskerville and others are stated to have petitioned the Council for the privilege of constructing a general conduit system.

Gilman, Ia.—It is stated that there is talk of putting in an electric light plant.

Valley Junction, Ia.—The question of constructing an electric light plant is said to be under consideration here.

Le Roy, N. Y.—The Le Roy Hydraulic Electric Co. is stated to have applied for a franchise for furnishing light, heat and power.

Mapleton, Ia.—It is stated that a stock company proposes to put in an electric light plant.

Maryville, N. D.—We are informed that an electric light plant to cost $18,000 will be built this spring.

Fonda, Ia.—An election will be held Jan. 23 to vote on the question of constructing an electric light plant. M. G. Coleman, Recorder.

Carthage, Mo.—It is stated that bids are wanted Jan. 17 for furnishing machinery and constructing proposed plant at an estimated cost of $25,000. C. O. Harrington, Mayor.

Brownsville, Tenn.—See "Water."

Woodsfield, O.—Bids are wanted Feb. 7 for an electric light plant. T. A. Way, Mayor.

Spartanburg, S. C.—Bids are wanted March 1 for 100 or more electric arc lights of 2,000 c. p. for a term of 5 or 10 years, as advertised in "The Engineering Record."

Portland, Me.—The Consolidated Electric Light Co. is stated to have received the contract for lighting the city by electricity.

Sea Isle City, N. J.—Bids are wanted Jan. 23 for lighting the borough with electricity, as advertised in "The Engineering Record."

Trenton, N. J.—The United Lighting & Heating Co. has been incorporated with a capital of $12,000,000, to manufacture, sell and lease to public and private consumers gas and oil machines and appliances of all kinds for the production and supply of light, heat and power. The incorporators are Edwin Hand, Jr., of Philadelphia; F. H. MacMorris, Philadelphia, and John M. Devlin, Gloucester City.

Athens, Tenn.—The Athens Electric Light Co. is stated to have received a franchise to construct an electric light plant. W. R. Hall, Pres.

Stockton, N. J.—The Stockton Light, Heat & Power Co. is said to be considering the matter of erecting a gas plant.

Duluth, Minn.—It is reported that the issue of $100,000 bonds for improving the gas system will probably be voted on at the coming election.

Kankakee, Ill.—The Kankakee Electric Light Co. is stated to have received the contract for lighting the town with electricity for five years at $59.95½ per light per year.

Newark, N. J.—It is stated that the People's Light & Power Co. is planning to make extensive improvements.

Circleville, O.—Henry R. Heffner and others have applied for a franchise to construct an electric light plant.

Penn Yan, N. Y.—It is stated that the Penn Yan Gas Co. will shortly erect new works on Water St.

Knoxville, Ill.—The Knoxville Electric Light Co. is stated to have received the contract for lighting the streets by electricity.

Marseilles, Ill.—It is stated that election will be held Jan. 17 to vote on the question of issuing $5,000 electric light bonds.

South Charleston, O.—The question of constructing an electric light plant, to cost about $6,000, is said to be under consideration.

Huron, S. D.—It is reported that the city will soon construct an electric light plant.

Ashley, Pa.—The People's Electric Light & Power Co. is stated to have petitioned the Council for a right of way through the borough.

Philadelphia, Pa.—The following contracts have been awarded for lighting the parks; price given per light, per month: The Wissahickon Electric Light Co. at $9.75 for the East Park; the Powelton Electric Light Co. at $9.72⅓ for the West Park, and the Manufacturers' Electric Light Co. at $10 for Hunting Park.

ELECTRIC RAILWAYS.

Neenah, Wis.—The Citizens' Traction Co. of Oshkosh is stated to have applied for a franchise to extend its line to this place. E. E. Downs, Gen. Mgr.

St. Croix Falls, Wis.—It is reported that local capitalists contemplate constructing an electric line to Balsam Lake, 12 miles.

East Providence, R. I.—The Union R.R. Co. is stated to have petitioned for a right of way to connect the trolley line with the Warren & Bristol Branch of the N. Y., N. H. & H. R.R.

Branford, Conn.—The Branford Electric R.R. Co. is stated to have been formed, with a capital of $200,000, to build an electric railroad to East Haven. A. M. Young, Pres.

Birmingham, Ala.—The Birmingham Traction Co. is stated to have filed a petition with the County Commissioners for a right of way to Ensley City.

Belleville, Ill.—It is stated that the Mississippi Valley Ry. Co. will petition the Supervisors for a franchise through St. Clair County.

Peoria, Ill.—The Central Ry. Co. is stated to have petitioned the City Council for permission to build two branch lines.

Prairie Grove, Ark.—Mayor M. M. Collier writes that it is proposed to construct 13 miles of electric railway.

Spring City, Pa.—The Montgomery & Chester Electric Ry. Co. is stated to have received a franchise.

Two Rivers, Wis.—The Chicago & Northwestern Ry. Co. is stated to have received a right of way on Monroe St. It will be necessary to construct a railroad bridge.

New York, N. Y.—The following bids for granite block pavement with concrete foundation on John St., were opened Dec. 28, by Jas. P. Keating, Commr. of Highways.

Bidders.	3,950 sq. yds. Pavement.	678 cu. yards Concrete.	350 sq. ft. Bridge Stone (new).	1,290 sq. ft. Bridge Stone (old).	2,250 ft. Curb (new).	150 ft. Curb (old).	Total.
C. H. Connel, 2 Cortlandt St	$2.69	$5 50	$ .55	$ .10	$ .70	$ .30	$16,287.
Wm. P. Baird, 339 E. 63d St	2.91	.01	.45	.15	.60	.10	*13,2 7.28
Asphalt Construction Co., 207 Bway	2.60	3.90	.40	.06	.60	.25	14,513.
Thielemann & Smith, 125th St. and Lexington Ave.	3.08	..	.50	.15	.60	.15	13,896 50
Cunningham & Kearns, 312 E. 34th St	2 95	.01	.55	.10	.60	.10	13,338 78
John Kane, 31 Perry St	2.33	5.	.40	.05	.55	.15	14,053.50
National Granite Co., 18 Bway	2.13	4.25	.50	.18	.69	.20	13,271.90

* Contract awarded.

Three other granite block paving contracts, amounting to 7,370 sq. yds., were awarded at the same time to Frank P. Leddy, 301 E. 32d St., at a total amount of $19,388.65.

Indianapolis, Ind.—The Indianapolis & Logansport Traction Co. has been incorporated to construct and operate an electric railroad between Indianapolis, Frankfort and Logansport; capital, $100,000. Incorporators: Geo. J. Marott, Horace F. Wood, Robert C. Light and others.

Troy, N. Y.—The Troy City Ry. Co. is stated to have received a franchise to extend its line.

Lowell, Mich.—W. H. Clark, Gen. Mgr., of the Lowell & Hastings R.R., writes that bids are wanted for rails, spikes and bolts, also for 17 miles of fencing, to be built early in the spring.

Seattle, Wash.—Malcolm MacDougall is stated to have received a franchise across tide lands owned by the county, for an electric railway.

New Rochelle, N. Y.—The Tarrytown, White Plains & Mamaroneck Trolley Co. is stated to have applied for a franchise to extend its line.

Atlanta, Ga.—The Atlanta Consolidated St. Ry. Co. is stated to have petitioned the County Commissioners for permission to extend its line in the western portion of the county.

New Brighton, Pa.—The Riverview St. Ry. Co. has petitioned for a right of way through the borough.

RAILROADS.

Port Angeles, Wash.—A charter has been granted to the Port Angeles Eastern R.R. Co. to construct and equip a standard-gauge railway from Port Angeles to Junction City; capital, $500,000. Incorporators: Wm. Martell of Port Angeles, John Lehman of Chicago, Arthur Shute of Ellsworth, Me., and Isaac C. Atkinson of Boston, Mass.

Houlton, Me.—We are informed that surveys are now being made by P. N. Burleigh & P. C. Newbyin of Patten, Me., for about 100 miles of steam railroad.

Wichita Falls, Tex.—The Wichita Falls & Oklahoma Ry. Co. has been organized, to construct a railroad from this place to some Northern trunk line. Incorporators: R. E. Huff, O. T. Bacon and others.

Hartford, Conn.—It is reported that the Philadelphia, Reading & New England Railroad Co., which runs from Campbell Hall, N. Y., to Hartford, Conn., proposes to extend its line from Hartford to Springfield, a distance of about 28 miles. W. J. Martin, Pres.; Jas. K. O. Sherwood of New York, Receiver.

Devon, W. Va.—The Virginia & Kentucky Ry. Co. has been incorporated, to operate a railroad from Devon, W. Va., to Pawpaw, Ky.; capital, $25,000. Incorporators: W. A. Briggs and Leon Isaacson.

Council Bluffs, Ia.—The Fort Dodge & Omaha Ry. Co. is stated to have applied for a franchise. John F. Duncombe of Ft. Dodge, Pres.

Terre Haute, Ind.—The New Columbus, Bloomington & Terre Haute Ry. Co. has been incorporated, with a capital of $100,000, to construct a road 85 miles long from Columbus, Ind., to Terre Haute. C. W. Shaw of Bloomington is one of the incorporators.

Eureka, Cal.—The Eureka & Klamath River R.R. Co. is stated to have received a franchise to construct a steam railroad through the city.

Wichita, Kan.—We are informed that the Wichita & Southern Ry. contemplates building from Wichita to Indian Territory coal fields. O. H. Bentley of Wichita is interested.

Blackwell, Ind. Ter.—The Hutchinson & Southern R.R. Co. will build an extension of 27 miles to Ponca, I. T. H. L. Jackson, Ch. Engr., Blackwell.

Salt Lake City, Utah.—The Salt Lake & Mercur Ry. Co. is said to be preparing to extend its line to Western Dip. J. J. Stewart, Secy.

Sharpsburg, Ky.—Col. E. L. Tutt, of Knoxville, Tenn., is said to be interested in the construction of a railroad from Sharpsburg to West Liberty.

Hannibal, Mo.—It is stated that the Wabash R.R. Co. will build a line to this place in the spring, giving Quincy a new line to St. Louis and Kansas City. W. S. Lincoln, Ch. Engr., St. Louis.

Monroe, La.—B. F. Older, of Boise City, Idaho, is stated to have submitted a proposition to the business men of this place to construct the Monroe and Natchitoches road. John P. Parker, Chmn. Business Men's Com.

Denver, Colo.—It is reported that the Denver & Rio Grande R.R. Co. will expend this year about $1,500,000 for new tracks and equipment. E. T. Jeffery, Pres.

Racine, Wis.—The Chicago & Northwestern Ry. Co. is stated to have received permission to construct its line on certain streets of this city.

NEW DEPOTS.

Philadelphia, Pa.—Engineer Nichols of the Philadelphia & Reading Ry. Co., is stated to have completed plans for alterations to the old pier and extensive additions to a ferry house and passenger station for the Delaware River Ferry Co.; probable cost of improvements, $50,000.

PUBLIC BUILDINGS.

Louisville, Ky.—The plans of Kenneth McDonald, 1401 Garvin Place, Louisville, are stated to have been accepted for a $40,000 addition to the court house.

San Francisco, Cal.—It is stated that the Board of Supervisors will shortly receive bids for a $50,000 police station.

Appleton, Wis.—The Council is stated to have voted to issue $50,000 bonds for the proposed library and city hall.

Princeton, Ind.—It is stated that Geo. P. Kidd of this city will erect a $20,000 opera house.

Iowa City, Ia.—The matter of erecting a court house is said to be under consideration by the Board of Supervisors.

New York, N. Y.—It is stated that the People's Tabernacle is to erect a new church on 102d St. near Madison Ave., to cost about $40,000.

Brooklyn, N. Y.—Hugo Smith, 836 Bway., Brooklyn, is said to be preparing plans for a theatre and office building for Chas. Reinhard and others, to be erected on Broadway and Flushing Ave.; probable cost, $175,000.

New York, N. Y.—Architects Boring & Tilton, 57 Bway., have about completed plans for the Ellis Island buildings.

Brownsville, Tenn.—L. M. Weathers, of Memphis, has prepared plans for a $17,000 church.

Vandergrift, Pa.—Architect J. E. Allison, Pittsburg, is preparing plans for a town hall, to cost about $40,000.

Mineola (L. I.), N. Y.—The Supervisors of Nassau County are stated to have decided to bond the county to the extent of $150,000, for the erection of county buildings.

Aberdeen, S. D.—The County Commissioners are stated to have decided to build a $12,500 jail.

Arkadelphia, Ark.—Bids are wanted March 1 for a court house. J. H. Crawford, Chmn.

Rocksprings, Tex.—Bids are wanted Feb. 13 for reconstructing the court-house. W. A. Johnson, Co. Clk.

Alexandria, La.—It is stated that bids are wanted Feb. 1 by the Police Jury for a jail, to cost about $25,000.

Buffalo, Minn.—Bids are wanted Jan. 17 for heating the court house. H. S. Swanberg, Co. Aud.

Cleveland, O.—Bids are wanted Feb. 4 for a ventilating and heating apparatus in the Children's Hospital, at the City Infirmary. William J. Akers, Dir. of Charities and Correction.

Milwaukee, Wis.—It is stated that a $150,000 office building will shortly be erected on Broadway and Wisconsin St. for Wm. Mariner.

Topeka, Kan.—The question of erecting a $100,000 auditorium is said to be under consideration here.

McKee's Rocks, Pa.—It is stated that plans are being prepared for a $50,000 edifice for the congregation of St. Francis de Sales' Church. C. F. Engle, Chmn. Bd. Trustees.

Philadelphia, Pa.—James T. Windrim is stated to be preparing plans for a hospital for the Jefferson Medical College.

FIRES.

Lima, O.—The Lima Paper Mills, owned by the American Strawboard Co., were destroyed by fire Jan. 6; loss, about $200,000.

NEW INDUSTRIAL PLANTS.

The Talbot Mills, North Billerica, Mass., are putting up a boiler house 75 ft. square and other large buildings.

The J. C. Hollingsworth Wheel Co., Wheel, Harford Co., Md., will put up a wheel shop and use water power to operate its machinery.

The T. B. Laycock Mfg. Co., Indianapolis, Ind., is receiving bids for constructing a new plant, work to be started in the spring if grade-crossing matters are settled so that the elevation of tracks will be definitely known.

The Karle Lithographic Co., 196-200 N. Water St., Rochester, N. Y., will erect a 5-story 80x120-ft. factory.

Mr. E. J. Turner, Galts Mill, Va., will put up a 40x55-ft. flour mill of 80 barrels daily capacity. Contracts have not yet been signed.

The Weldon Cotton Manufacturing Co., Weldon, N. C., which was recently organized with W. T. Shaw as president, W. A. Pierce secretary and treasurer, and M. A. Smith, general manager, will begin at once the erection of a 2-story and basement, 75x40-ft. brick knitting mill, and, a little later, a 56x150-ft. yarn mill and an 850 16-c. p. lighting plant, all to be driven by a turbine wheel under 30 ft. head.

The Crystal Ice Co., 75 Irwin Ave., Allegheny, Pa., will operate an ice plant at East Liberty, Pittsburg, with a daily capacity of 75 tons of ice and 1,000 tons storage. Mr. W. F. Melhuish, general manager, is now corresponding with manufacturers of machinery.

The Cole Manufacturing Co., Archer Ave. and Leo St., Chicago, Ill., is erecting a 2-story 50x300-ft. brick mill and expects to install a large gasoline engine.

The West Virginia & Pittsburg R.R. Co. has let contracts for two 65x150-ft. brick buildings for machine and woodworking shops and two 36x50-ft. buildings for blacksmith and machine work. They will be erected at Weston, W. Va., and General Manager A. H. Kunst, of that town, writes that the machinery has not yet been ordered.

The Pittsburg Reduction Co., of Pittsburg, Pa., is putting in two 14-in. billet trains and four 10-in. rod trains at its New Kensington works, and is erecting a new 70x75-ft. foundry and installing an 84-in. plate mill train. It is also increasing its Niagara Falls plant nearly 75 per cent., and will need some ironwork, for which orders have not yet been placed.

BUSINESS NOTES.

The Dodge Mfg. Co., Mishawaka, has purchased the business and good will of the Rice Machinery Co., 166-174 So. Clinton St., Chicago, which will be carried on by its new owners with the same personnel. The company reports excellent business conditions, which keep its Mishawaka shops running night and day; a 300x80-ft. brick building was added to the factory late last year, and with the added facilities the company expects to continue furnishing goods within contract time in spite of the volume of work in hand.

The Babcock & Wilcox Co. has received from Westinghouse, Church, Kerr & Co., general contractors for the power plant of the Third Ave. R.R. Co., at 218th St. and Harlem River, New York, an order for 60 forged steel boilers of 520 H.-P. each, or an aggregate of 31,200 H.-P. They are to be capable of carrying 200 lbs. pressure and will supply steam to a compound condensing engine plant of 64,000 nominal horse-power. The order is stated to be the largest ever placed for stationary boilers at one time.

The Ransome & Smith Co. has sold 3 drum concrete mixers to Logan R. Whitney, Louisville, Ky., for use on the new works of the Louisville, Ky., Water Co.

The Chapman Valve Mfg. Co. announces that it has opened an office at 40 N. Seventh St., Philadelphia, where a complete line of gate valves for water, steam, gas, oil, ammonia, air and brine will be carried.

The American Steel & Wire Co., Chicago, announces that Mr. J. S. Keefe, for 10 years traffic manager of the Illinois Steel Co., has accepted a similar position in its organization.

The Buffalo Forge Co. reports an increased demand for its pressure blowers and has reproduced a number of testimonials of their value.

The receivers of the Baltimore & Ohio Railroad have let contracts for rebuilding 51 bridges between Benwood, W. Va., and Chicago. The Youngstown Bridge Co. gets 31 bridges between the Ohio River and Newark, the Pencoyd Bridge Works have received 11 bridges between Newark and Sandusky, and the Edge Moor Bridge Co. will put up 9 bridges on the Chicago Division. The total cost of the work will be about $300,000.

BUILDING INTELLIGENCE.

NEW YORK, N. Y.

70-72 Broad st, br, stone and terra cotta offices and lofts; cost, $80,000; o, Edw Kemp; a, R W Gibson.

Stanton and Goerck sts, s e cor, 2 br stores and flats; cost, $60,000 all; o, Barnett Hamburger; a, Horenburger & Straub.

49-51 Stanton st, br stores and flat; cost, $25,000; o, J Rosenberg and J Feinberg.

64-66 Monroe st, 2 br stores and tenem'ts; cost, $32,000 all; o, Harris Silberman; a, Max Muller.

723-725 5th ave, 2 br dwell'gs; cost, $80,000 all; o, W W Astor; a, Clinton & Russell.

194 Broome st, n e cor Suffolk st, br store and flat; cost, $25,000; o, Hubener & Escher; a, Horenburger & Straub.

99th st and Boulevard, s w cor, 2 br stores and flats; cost, $175,000 all; o, W M Hyne; a, Neville & Bagge.

102d st and Boulevard, s w cor, br store and flat; cost, $200,000; o, Andrew J Kerwin, Jr; a, S B Ogden & Co.

S s 119th st, 378 e Lenox ave, br flat; cost, $30,000; o, Johanna M Lalor; a, Neville & Bagge.

N s 136th st, 96 w Willis ave, 2 br flats; cost, $40,000 all; o, Henry Muller; a, Harry T Howell.

ALTERATIONS.

164 W 44th st, stud, partitions altered, 2 elevators, 5 dumb-waiters, etc.; cost, $19,000; o, John O Baker; a, William Strom.

768 Broadway, store front, stairs, partitions, etc.; cost, $12,000; o, J W Brown; a, J C Westervelt.

83 Chambers st, floor beams, plumbing, ventilating shaft, etc.; cost, $15,000; o, Geo G De Witt; a, Wm. E. Bloodgood.

MISCELLANEOUS.

New Haven, Conn.—9 Vernon st, paper box shop; cost $15,000; o, Philando Armstrong; a, William H Allen.

PROPOSALS OPEN.

Bids Close.		See Eng. Record.
	WATER-WORKS.	
Jan. 16.	Bonds, Whittier, Cal	Jan. 7
Jan. 17.	Bonds, Bozeman, Mont	Dec. 31
Jan. 18.	Winchester, Ind	Dec. 24
Jan. 19.	Florence, Colo	Jan. 7
	Adv., Eng. RECORD, Jan. 7, 14.	
Jan. 21.	Cheboygan, Mich	Dec. 31
	Adv., Eng. RECORD, Dec. 31 to Jan. 14.	
Jan. 23.	Canton, O	Jan. 7
Jan. 24.	Canby, Minn	Dec. 31
Jan. 24.	Bonds, Wamego, Kan	Dec. 31
Jan. 25.	Phœnix, A. T	Dec. 24
Jan. 25.	Bonds, McConnelsville, O	Dec. 31
Jan. 25.	Orangeburg, S. C	Jan. 7
	Adv., Eng. RECORD, Jan. 7.	
Jan. 26.	Washington, D. C	Dec. 31
	Adv., Eng. RECORD, Dec. 31, Jan. 7.	
Jan. 27.	Cylinders, etc., Cleveland, O.	Dec. 31
Jan. 28	Bonds, Cincinnati, O.	Jan. 7
Jan. 28.	New Albany, Ind	Jan. 14
	Adv., Eng. RECORD, Jan. 14.	
Jan. 31.	Bonds, Alliance, O.	Jan. 14
Jan. —.	Bonds, Little Falls, Minn.	Dec. 24
Feb. 1.	Tuskegee, Ala	Dec. 31
Feb. 6.	Bonds, Berea, O	Dec. 31
Feb. 7.	Bonds, Huntsville, Ala	Jan. 14
Feb. 7.	Bonds, Columbus, Miss	Jan. 14
Feb. 13.	Bonds, Reno, Nev	Dec. 24
Feb. 21.	Honolulu, Hawaiian Is	Jan. 14
	Adv., Eng. RECORD, Jan. 14.	
Mar. 15.	Belem, Para, Brazil	Nov. 26
	SEWERAGE AND SEWAGE DISPOSAL.	
Jan. 16.	Elizabeth, N. J	Dec. 24
Jan. 16.	Denver, Colo	Jan. 7
Jan. 16.	Toledo, O	Jan. 7
Jan. 16.	Williamsport, Pa	Jan. 14
Jan. 17.	Mt. Vernon, N. Y	Dec. 31
Jan. 18.	Aiken, S. C	Dec. 17
Jan. 23.	Sewer pipe, etc., New London, Conn.	Dec. 24
Jan. 23.	South Bend, Ind	Jan. 14
Jan. 23	Yuma, Ariz	Jan 14
Jan. 24.	East Liverpool, O	Jan. 14
Jan. 25.	Phœnix, A. T	Dec. 24
Feb. 3.	Spartanburg, S. C	Jan. 14
	Adv., Eng. RECORD, Jan. 14.	
Feb. 3.	Norristown, Pa	Jan. 14
Feb. 6.	Bonds, Glenville, O	Jan. 14
Feb. 7.	Bonds, Columbus, Miss	Jan. 14
Feb. 20.	Bonds, Cleveland, O	Jan. 14
	BRIDGES.	
Jan. 16.	Boston, Mass	Jan. 7
Jan. 17.	St. Paul, Minn	Jan. 7
Jan. 17.	Plans, Binghamton, N. Y	Dec. 24
Jan. 20.	Deer Creek, Minn	Jan. 14
Jan. 24.	St. Thomas, Ont	Dec. 24
Jan. 24.	Waverly, Ia	Jan. 7
Jan. 31.	Bonds, Jackson, Miss	Dec. 24
Jan. —.	Hastings, Neb	Dec. 10
Feb. 1.	Helena, Mont	Jan. 14
Feb. 14.	Superstructure, Cleveland, O	Jan. 14
Feb. 20.	Chicago, Ill	Dec. 31
	Adv., Eng. RECORD, Dec. 31.	
Mar. 1.	Quebec, Que	Jan. 7
Apr. 1.	Substructure, St. Joseph, Mo	Jan. 7
——	Spring Lake, N. J	Jan. 7
	PAVING AND ROADMAKING.	
Jan. 16.	Atlantic City, N. J.	Jan. 7
	Adv., Eng. RECORD, Jan. 7.	
Jan. 17.	Cincinnati, O.	Dec. 24
Jan. 17.	New York, N. Y	Jan. 14
Jan. 30.	Kokomo, Ind	Jan. 7
Feb. 1.	Bonds, Shreveport, La	Jan. 14
Feb. 1.	Jamestown, N. Y	Jan. 14
	Adv., Eng. RECORD, Jan. 14.	
Feb. 6.	Toledo, O	Jan. 14
Feb. 16.	Decatur, Ind	Jan. 14
Feb. 27.	Yonkers, N. Y	Dec. 3
	POWER, GAS AND ELECTRICITY	
Jan. 16.	Duluth, Minn.	Dec. 10
Jan. 17.	Mt. Vernon, Ind	Dec. 31
Jan. 17.	Carthage, Mo	Jan. 14
Jan. 18.	Winchester, Ind.	Dec. 24
Jan. 20	Belding, Mich	Dec. 31
Jan. 23.	Sea Isle City, N. J	Jan. 14
	Adv., Eng. RECORD, Jan. 14.	
Jan. 25.	Baltimore, Md	Jan. 7
	Adv., Eng. RECORD, Jan. 14.	
Jan. 25.	Orangeburg, S. C	Jan. 7
	Adv., Eng. RECORD, Jan. 7.	
Jan. 28.	Gas lamps, Cleveland, O	Jan. 7
Jan. —.	Bonds, Little Falls, Minn	Dec. 24
Feb. 1.	Richmond, Va	Jan. 7
Feb. 1.	Tuskegee, Ala	Dec. 31
Feb. 1.	Menahgo, Minn	Dec. 31
Feb. 7.	Woodsfield, O	Jan. 14
Mar. 1.	Sault Ste. Marie, Mich	Dec. 24
Mar. 1.	Spartanburg, S. C	Jan. 14
	Adv., Eng. RECORD, Jan. 14	
Mar. 31.	Telephone, Shanghai, China	Nov. 19
——	Pleasantville, O	Dec. 24
	GOVERNMENT WORK.	
Jan. 16.	St. Augustine, Fla	Dec. 31
	Adv., ENG. RECORD, Dec. 31, Jan. 7.	
Jan. 19.	Akron, O	Dec. 24
	Adv., Eng. RECORD, Dec. 24, 31.	
Jan. 19.	Pottsville, Pa	Dec. 24
	Adv., Eng. RECORD, Dec. 24, 31.	
Jan. 20.	Wharves, etc, Washington, D. C.	Dec. 24
Jan. 20.	Fog signals, St. Joseph, Mich	Dec. 31
Jan. 20.	Revetment work, Houghton, Mich.	Jan. 7
Jan. 23.	Stone, etc., New London, Conn	Dec. 24
Jan. 24.	Batteries, Fort Monroe, Va	Dec. 24
Jan. 30.	Beacons, Mobile, Ala	Jan. 7
Jan. 31.	Dry dock, Boston, Mass	Dec. 31
Jan. 31.	Wharf, Atlanta, Ga	Jan. 14
Feb. 1.	Duluth, Minn	Jan. 7
	Adv., Eng. RECORD, Jan. 7, 14.	
Feb. 3.	Dredging, Duluth, Minn	Jan. 7
Feb. 13.	New Orleans, La	Jan. 14
	Adv., Eng. RECORD, Jan. 14.	
	BUILDINGS.	
Jan. 16.	Belgrade, Minn	Jan. 7
Jan. 17.	Lexington, Ky	Jan. 7
Jan. 17.	Heating, Buffalo, Minn	Jan. 14
Jan. 18.	Plans, Mineola, N. Y.	Dec. 24
Jan. 20.	Evansville, Ind	Jan. 7
Jan. 21.	Washington, D. C.	Dec. 24
Jan. 23.	New Orleans, La	Jan. 7
Jan. 24.	School bonds, Mt. Vernon, N. Y	Jan. 7
Jan. 25.	Dormitory, etc., Phœnix, A. T.	Dec. 24
Jan. 30.	Oshkosh, Wis	Jan. 7
Jan. 30.	School, Chattanooga, O	Jan. 14
Jan. 31.	School bonds, Jackson, Miss	Dec. 24
Jan. —.	Superstructure, Newport, R. I	Nov. 19
Feb. 1.	School, Peoria, Ill	Dec. 3
Feb. 1.	Owatonna, Minn	Jan. 7
Feb. 1.	Alexandria, La	Jan. 14
Feb. 4.	Ventilating, etc., Cleveland, O	Jan. 14
Feb. 10.	Keyser, W. Va	Nov. 5
Feb. 13.	Rock Springs, Tex	Jan. 14
Feb. 16.	School, Ellendale, N. D	Jan. 7
Feb. 25.	Douglass, Ga	Dec. 31
Mar. 1.	Arkadelphia, Ark	Jan. 14
	MISCELLANEOUS	
Jan. 16.	Engineer's supplies, etc., Brooklyn, N. Y	Jan. 7
Jan. 16.	Wharf, Port Johnston, N. J	Jan. 14
Jan. 17.	El. Rys., Pasadena, Cal	Jan. 7
Jan. 18.	Garbage dis., San Francisco, Cal	Dec. 31
Jan. 19.	Docks, etc., Cleveland, O	Dec. 24
Jan. 24.	Tunnel, London, England	Nov. 5
Jan. 24.	Garbage disposal, Chicago, Ill	Jan. 7
Jan. 25.	Conduit material, Baltimore, Md	Jan. 1
	Adv., Eng. RECORD, Jan. 14.	
Jan. 26.	Washington, D. C	Dec. 31
	Adv, Eng. RECORD, Dec. 31.	
Feb. 1.	Crane, Townsville, Australia.	Dec. 17
Feb. 6.	Levee work, Pointé a la Hache, La.	Jan. 14
Mar. 15.	El. Ry., Shanghai, China	Nov. 19

NEW SCHOOLS.

Chattanooga, O.—Bids are wanted Jan. 30 for a school in Dist. No. 5. Henry Bernard, Clk. of Bd.

Evanston, Ill.—The Township Board of Education is stated to have decided to erect a high school; probable cost, $50,000.

Plattsburg, N. Y.—It is stated that the citizens will vote on building a $65,000 school.

Dothen, Ala.—The matter of erecting a $12,000 school is said to be under consideration.

Chicago, Ill.—The plans of Architect Mundie, of the Board of Education, are stated to have been adopted for the North Division high school; probable cost, $150,000.

Bids for the 14-room addition to the Madison Ave. school are stated to have been rejected, and the architect directed to alter the plans to erect the building with the appropriation of $50,000.

Pawtucket, R. I.—The City Council has adopted a resolution to ask the Legislature for permission to issue $50,000 bonds for new schools.

Wilmington, Del.—The lowest bid received Jan. 9 for the high school was from A. S. Reed & Bro.'s Co., $169,000.

Brownsville, Tenn.—See "Water."

Bridgeton, N. J.—Frank L. Hewitt, City Recorder, writes that $15,000 bonds are to be issued for a new school.

Marietta, Pa.—The School Board is stated to have adopted a resolution to submit the question of issuing $15,000 bonds for the erection of a new school.

Austin, Tex.—The question of erecting a $25,000 high school is said to be under consideration.

Boston, Mass.—The following bids for ventilating and heating system for Mechanic Arts high school were opened Jan. 3 by William T. Eaton, Chmn. Com. on New Bldgs., of the School Com.: Ingalls & Kendricken, 80 and 82 Sudbury St., $4,653; Walworth Construction & Supply Co., 16-20 Oliver St., $4,393; Buerkel & Co., 28 Union Park St., $4,392; Evans, Almirall & Co., 178 Devonshire St., $4,383; Lynch & Woodward, 26 Beach St., $4,226; Albert B. Franklin, 165 and 167 Fort Hill Sq., $4,067; Huey Bros., 55 Hartford St., $3,987, and Isaac Coffin & Co., 52 Sudbury St., $3,972. Bidders all of Boston.

Lima, O.—The plans of W. R. Brown, of Cincinnati, are stated to have been accepted for a $40,000 high school.

STREET CLEANING AND GARBAGE DISPOSAL.

Philadelphia, Pa.—Thos. M. Thompson, Director Dept. of Pub. Wks., opened the following bids on Jan. 12 for cleaning streets, removal of ashes, etc., in two districts; *a*, 5th dist.; *b*., 6th dist.: David McMahon, Germantown, *a*, $81,891. R. P. Bennis, Germantown, *b*, $21,494. G. W. Ruch, 2851 N. 9th, *a*, $80,700; *b*, $20,973. R. J. & D. Peoples, 25th & Callowhill, *a*, $82,990; *b*, $21,400. Thos. Parker, 9 N. 13th, *a*, $82,400; *b*, $20,100. Thos. Cunningham, 1211 Whartow, *b*, $20,500. James Curran, 2617 William, *a*, $85,500; *b*, $22,900.

Philadelphia, Pa.—Local reports state that the contract for collecting and destroying all garbage in the city during 1899 has been awarded to the American Reduction Co. for $358,000.

Washington, D. C.—The District Commissioners have recommended that an additional appropriation of $10,000 be made to remove snow and ice.

Atlantic City, N. J.—It is stated that the following bids were opened Jan. 3 for the collection and removal of garbage; prices given are for the first, second and third years, respectively: Mark Townsend, Somers Point, N. J., $9,800, $9,900, $10,000; Benjamin F. Leeds, $9,700, $9,900, $10,200.

Atlanta, Ga.—J. T. Lowry, Chm. of the Sanitary Department, in his annual report recommends the construction of a $30,000 crematory.

Erie, Pa.—B. E. Briggs, City Engr., writes that an ordinance has been introduced in the Councils for the construction of a garbage disposal plant.

GOVERNMENT WORK.

Atlanta, Ga.—Bids are wanted Jan. 31 for constructing a wharf at Fort Barrancas, Fla. John Simpson, Ch. Q. M., Dept. Q. M. Gen., U. S. A.

Washington, D. C.—We are informed that in addition to the bids given in our issue of Dec. 31, for gas and electric fixtures in the U. S. Post Office, there was received a bid from B. Goetz Mfg. Co., 347 3d ave., New York City, for $9,446.

New Orleans, La.—Bids are wanted Feb. 13 at the U. S. Engineer Office for steel hull spud frame and cutter frame for a dredge, as advertised in "The Engineering Record."

CUBA, ECUADOR AND HONOLULU.

Electric Railway.—Articles of incorporation of the Havana Electric Railway Co. were filed at Trenton, N. J., on Jan. 7. The incorporators are W. P. S. Melvin, East Orange, and G. C. B. Ward and Herbert A. Howell of New York City. The objects of the company are to manufacture, produce and sell electricity, gas and fuel, and to operate railways, telephone lines, gas and electric light plants, etc. Capital, $5,000,000.

Railways.—Press reports state tha Gen. S. W. Ferguson, of Charleston, S C., has been appointed as an engineer in the construction of a railroad 300 miles long in the Republic of Ecuador, S. A.

Pumping Engine.—Bids are wanted Feb. 21 at the office of the Minister o the Interior at Honolulu, Hawaiian Islands, for a pumping engine of 200,000 gals. capacity per hour, as advertised in "The Engineering Record."

Wharves and Dredging.—It is stated that the date for receiving bids for the construction of wharves and the excavation of slips in the harbor of Honolulu, Hawaiian Is., has been postponed until Feb. 1. R. B. Bradford, Ch. o Bureau of Equipment, Navy Dept. Washington, D. C.

MISCELLANEOUS.

Baltimore, Md.—Bids are wanted Jan 25 for furnishing 1,000,000 duct ft. of conduit material, as advertised in "The Engineering Record."

Philadelphia, Pa.—Thomas M. Thompson, Director Dept. of Pub. Wks., on Jan 9 awarded the contract to Armstrong & Printzenhoff, Land Title Bldg., for constructing a pavilion on Chestnut St. Pier for $85,300. For list of bids received see our issue of Dec. 17.

Yonkers, N. Y.—See "Paving and Roadmaking."

Pueblo, Colo.—It is stated that bids are about to be asked by the City Engineer for a levee to be constructed on the Arkansas River, west of Victoria Ave.

Pointé a la Hache, La.—Bids are wanted Feb. 6 for building about 23 miles of back levees for the Grand Prairie Levee Dist. I. L. Haspel, Pres. Bd. Commrs Grand Prairie Levee Dist.

THE ENGINEERING RECORD.
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TABLE OF LEADING ARTICLES.

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THE IMPORTANCE OF CLEANING HAVANA.

Between ten and eleven years ago the people of this country were thrown into a condition verging on panic by yellow fever in Florida. Persons who are unacquainted with the conditions of life in the South can hardly appreciate what a menace to all prosperity this constant fear of yellow fever is, and for this reason the following extracts from an editorial in "The Engineering Record" of August 25, 1888, are reprinted as an introduction to a suggestion it wishes to make at this time:

"Yellow fever exists in Jacksonville and other points in Florida in a form which the press calls epidemic, meaning that it is very liable to become so, there being at present about four or five new cases a day in the city, though once or twice there has been double that number. Precisely how it got there is not clear, but probably no one supposes that it originated spontaneously in Jacksonville, in connection with filth or with anything else. Its germs were brought there, and have probably been living in Florida all winter, being descendants of importations from Cuba last fall.

"Those who have not themselves seen and heard what takes place in Southern towns and villages when yellow fever is announced as being epidemic in them, or in the vicinity, can have very little idea of the unreasoning panic which occurs, or of the follies and even cruelties to which fear gives rise under such circumstances. This is perhaps not to be wondered at, for in those regions the traditions of a century and the personal experience of those now living teach that this particular disease, when once fairly started in a place, has never been checked or controlled until the appearance of a frost. There are few who have not lost some relatives from it. Drugs have no effect on it. Its cause has not been isolated, so as to be recognized, and its precise mode of diffusion is still a mystery. All this tends to increase the terror of the people, and to induce them to try any scheme, however absurd, which any one asserts will prevent the disease in an individual or in a community. They have been firing cannon in Jacksonville to stun or kill the germs by concussion, making bonfires in the street to purify the air, and probably there has been a considerable sale of amulets, fever cures and other nostrums. Outside of the affected towns the people are resorting to what they are pleased to term a quarantine, but what is practically non-intercourse, so far as they are able to maintain it. Meantime, the local health authorities and the officers of the Marine Hospital Service, acting for the general government, have established refuge camps and fumigation stations, and are endeavoring to put an end to panic by establishing a system of inspection which will give confidence to the communities interested, and will permit of at least sufficient communication between them to prevent suffering.

"As to the means of preventing future importations, they will have to be applied in Cuba to be of much use. Havana in its present condition is a perpetual menace to the peace and commercial prosperity of the Gulf and South Atlantic States, but just how this nuisance is to be abated is a question as much for diplomats as for sanitary engineers."

Particular attention is drawn to the last paragraph just quoted, for the army and navy of the United States have made diplomacy no longer a factor to be considered. In continuation of the same idea, "The Engineering Record" stated on October 20, 1888:

"As was anticipated when yellow fever was first found to be spreading in Jacksonville, it has steadily extended, and has been carried to several other Southern towns, creating much panic and interruption to traffic and business. The actual loss of life has not been very great and no doubt, the worst is over, but, as usual, the disease will not disappear until a well-marked frost has occurred in the localities where it prevails.

"It has again aroused public attention to the desirability of preventing such outbreaks in the future, and has given rise to some more than usually absurd propositions looking to that end. Among these may be mentioned the bill introduced in the Senate by Senator Call, by which it is proposed to establish a scientific bureau in the city of Jacksonville, to gather facts in relation to yellow fever. This so-called bureau is to be composed of seven physicians of the different schools of medicine, and if it were ever so constituted it would be anything but scientific. Another bill equally, if not more absurd, is the one introduced by Senator Plumb, offering a reward of $100,000 to any person or persons who shall discover the cause, remedy and treatment of yellow fever. The method of treatment is to be copyrighted, and must cure 98 per cent. of all cases. The evidence required is that all persons who recover from yellow fever under any copyrighted remedy are to file a sworn statement to that effect with the Surgeon-General of the army, and all "medical doctors" (!) and nurses who attend any one who dies while being treated with a copyrighted remedy are to report the same to the Surgeon-General. One would suppose from such legislation as this that the prevention of yellow fever was a hopeless business, and that we know nothing whatever about it.

"As a matter of fact, we do know some things about it which are of great practical importance in a preventive point of view, and we know precisely what direction a scientific investigation into its causes should take. We know that yellow fever never spontaneously arises in the United States; that its cause is always imported to begin with, though it may linger through two or three years when once introduced. We know also that it is usually brought from Cuba or Vera Cruz; that infected ships, cargoes and baggage are the chief source of danger, and that it is not directly contagious from person to person. Experience has shown that by a careful system of cleansing and disinfection of ships and cargoes, and by a short period of observation of persons, the introduction of the disease at any particular port can be prevented. But experience also teaches that while this may be done for particular ports, such as New Orleans, Mobile, Savannah, etc., it cannot be done for the whole line of the Gulf and South Atlantic Coast for any long period of years.

"Now suppose that at intervals of from three to five years bands of pirates come to our Southern coasts from Cuba or Vera Cruz and proceed to slaughter and rob the people, what should we do? Should we approve of legislation that merely provided forts at the great ports? Should not we want to get at the homes of the pirates and destroy them, root and branch; and should we not hold the government of the country whence they came responsible for their misdeeds. So long as two or three localities in Cuba and Central America are allowed to remain as hot-beds and nurseries for yellow fever, so long no complete and reasonably economical protection of this country against the invasion of that disease is possible. It must be remembered that in all the West India Islands, except Cuba, and in much the greater part of Cuba, yellow fever soon dies out, and does not reappear until freshly imported from the two or three foul centers to which we have referred. We have got to recognize that we are in constant danger of invasion from these two or three points, and we must demand that this danger shall be removed by the government which has control of these places.

"If the Spanish government cannot or will not put Havana and Matanzas into decent sanitary condition, and destroy the lurking places for infection which they contain, we have got to face the problem as to how we shall enforce our rights to life and property which are being invaded from this source. Details as to what the Cuban authorities can and should do are unneeded here; the point to be now insisted on is that they are responsible and must be made to feel their responsibility."

The fortune of war has now put the whole responsibility of the subject on the shoulders of Congress. For all practical purposes, for the present, Cuba is part of the United States. In its issue of January 7, "The Engineering Record" put its readers in possession of the facts concerning the reeking filth of Havana, as reported by General Greene. The late Colonel Waring told the same story in the report he never lived to finish. Mr. G. Everett Hill, his secretary, states that he estimated the cost of cleaning Havana, of making it a fit place to live in, and of doing away with the danger of fever it has always held out to this country, at about $10,000,000. A single epidemic of yellow fever introduced into the United States from Havana has been estimated to cost, directly and indirectly, at least ten times this sum.

The opportunity and duty, then, of carrying out a great humanitarian work is now open to us. It must be seized at once, while our representatives are in direct control of Cuban affairs, and before the foul conditions on the island have had an opportunity to breed and disseminate the diseases otherwise sure to work havoc among the unacclimated people sent to Cuba, and to spread through the Gulf and South Atlantic States. Cuba should be cleaned up at once, and Congress should make immediate ample appropriations for the purpose, that the country may remain free from this scourge. The cost will be trifling to what we must pay in lives and money if there is delay or false economy.

THE PENNSYLVANIA STATE CAPITOL.

The new state capitol building at Harrisburg was formally opened to the public on January 3. The building, as readers of "The Engineering Record" probably know very well, replaces a structure which was destroyed by fire early in February, 1897. A month later the Governor sent to the Legislature a message calling attention to the necessity of prompt action

to provide for another structure. Three of the group of buildings forming the capitol remained standing, and it was therefore suggested that public interest would best be served by erecting at once a structure suitable for the General Assembly, and subsequently two additional buildings. A bill corresponding with these recommendations was passed and approved in April, 1897. The commission created by the act, composed of members of the board of public grounds and buildings, the acting president of the senate and the speaker of the house, employed an architect as professional adviser and inaugurated a program of competition for plans for a new building. This was entered by thirty architects from all parts of the United States. Under the terms of the competition a board of experts was required to select eight plans and from these eight three were to be chosen by the commissioners. It was in carrying out this part of the program that the scandal arose which attracted so much attention twelve to eighteen months ago, and led to the publication in "The Engineering Record" of January 1, 1898, of an elaborate review of the legal questions which must govern competitions of this nature.

Governor Daniel H. Hastings, whose course in this matter has already been commended in these columns, has recently presented in his annual address a summary of the various troubles and the highly undesirable result of the system that was followed in the matter. It seems that after the eight plans were duly selected by the board of experts and submitted to the commissioners in accordance with the terms of the competition, four to five members of the latter body declined to make a selection and set aside, by resolution, all the plans presented. The only reason made public by them for taking such action was that the building if erected under any of the plans would exceed the limit of the appropriation and require modifications to come within the $550,000 which was available. This excuse ignored the provision of the program of the competition, which distinctly required the successful architect to revise his competitive drawing to meet the further requirement of the commissioners, by which means, so Governor Hastings states, the cost could readily have been brought within the limit of the appropriation. After this action on the part of the commissioners the Governor refrained from further participation in their deliberations.

One firm of architects brought a suit to compel the commissioners to carry out their agreement with the architects taking part in the competition; the supreme court, however, decided the suit against them. The four commissioners then had plans and specifications drawn by an architect of their selection, and about twelve months ago advertised for sealed proposals for the erection of a building. An examination of the plans showed that the commissioners proposed to let a contract for the erection, not of one building, as required by the legislature, but of an incomplete part of a larger structure intended ultimately for the accommodation of all the departments of the state government. The attorney general filed a bill in equity to restrain the commissioners from carrying out these plans, but the supreme court again decided in favor of the commissioners. The plans were carried out, and the result, as viewed by Governor Hastings, is described in his address as follows:

"The structure in which you are assembling to-day is unworthy of your honorable bodies and is a disgrace to the commonwealth. In its present condition it is hardly fit for human habitation, much less the official abode of the representatives of the great commonwealth. There are scores of farmers' barns in Pennsylvania more attractive in appearance than this building. It is made of common brick embedded in cheap mortar, looks like a hastily erected factory building and is repulsive to the eye.

"The roof is made of hemlock and pine boards covered with tarred felt, pitch and sand; the gables and dome are covered with third-rate quality of pine fencing boards, and the floors are made of common pine boards, which give under the feet. The stairs and staircases, including the main entrance, are all of wood, and the partitions between the rotunda and west wings and upper floors are of ⅞-inch matched pine fencing, and the same material is placed in front of the elevator shafts. Only about one-fifth of the entire building is plastered at all, and such as is plastered is of two-coat work. There is no plastering whatever in the halls of the senate and the house of representatives. The senate chamber walls are finished with burlap stained green, fastened to the rough sides of the wall, composed of brick and tiles. The walls of the house of representatives are finished with burlap stained garnet, and fastened to the rough brick walls, also made of tile and brick. Although the act of assembly requires that the building shall be "made as nearly fireproof as possible," the roof and most of the interior fittings are as combustible as possible. Furthermore, I am advised by a competent and trustworthy builder, who has personally examined this building, that a fair estimate of the cost of the present structure would not exceed $225,000, as it now is, and that it will cost to complete the building, according to the plans adopted, not less than $2,500,000. This estimate, I am informed, is a conservative one and may be relied upon. It is more than probable that it will require twice that sum to complete the building, and it has been so deliberately planned as to require continuing appropriations, which, in my judgment, will last during the present generation.

"The commissioners will not relieve themselves from just criticism by alleging that the appropriation was too small. It was not for them to say what the appropriation should be. That judgment belonged to the legislative branch of the government. It was the duty of the commission to erect the building in accordance with the provisions of the act. One of the provisions limited the expense to $550,000. They distinctly averred before the courts that every provision of the act would be complied with and that a complete building for the legislature, its officers and employees would be constructed within the limit of the appropriation. The commissioners had no right to determine that the appropriation was too small. The legislature had already fixed the amount. They had no right or power to ignore any provision of the act. That is violation of the law. They had no right to foist upon the taxpayers of the commonwealth an incomplete structure, which will require an expenditure of at least a million of dollars to make it habitable under their present plan, and millions more to add the wings as set out in their drawings. They had not the right to expend the money appropriated in such a way as to compel the legislative branch of the government either to tear down and render comparatively valueless all that has been done, or to add millions of dollars to carry out their ultimate design. The commissioners were created by the legislature to fulfill, in good faith, its solemn enactments, and it is insulting to the commonwealth for the commissioners to assume legislative power or to so administer their trust as to compel the taxpayers to take the hazard of expending large additional sums for the consummation of the unlawful purpose of commissioners appointed by them to execute their sovereign will.

"The only part of the structure to be commended is the foundation, which is ample to support any building, even the capitol of the United States. This foundation has been so planned as to leave an extension on the outside surface of about 10 inches from the brick wall. It can hardly be supposed, however, that this elaboration of the foundation was made with the intention of inducing this or future legislatures to hide the shameful appearance of the present brick walls by a veneering of marble or granite, because the commissioners have sworn to the court that the structure would be a complete building and within the limit of the present appropriation.

"The further plans of the commissioners to erect wings at the ends of the present structure, so enlarging it as to provide quarters for other departments of the state government, under one roof, as part and parcel of their general scheme, when viewed in the light of the act, savors of an usurpation of authority which is at once illegal, unjust and burdensome to the people of the commonwealth.

"I respectfully submit to your honorable bodies that it will be more economical and more businesslike to tear down everything above the foundation walls and sacrifice the money already expended, rather than to continue the commission and accede to its demands for future appropriations, which are certain to extend into millions of dollars."

MUNICIPAL ENGINEERING NOTES.

An Experimental Garbage Crematory has been built by Mr. F. W. Dennis at Atlanta, Ga., on what is stated to be an entirely new principle.

The New York State Road Law, which was reviewed in these columns on April 2, 1898, has been tried by 43 towns in the few months since it went into effect, and roadwork costing $138,000 has been done under its provisions.

The Sewerage and Paving of Havana are discussed in an interesting report by Mr. A. T. Byrne to M. J. Dady & Company, of Brooklyn, N. Y., which is of particular value at this time because of the contracts Colonel Dady secured with the authorities of Havana under Spanish rule. These contracts are for very large sums, and a strong effort is being made to have them recognized by the present officers.

Plans for a Dust Cart are wanted by the London County Council until February 28. The cart must be so constructed that no refuse can escape from it and no nuisance can be caused by carrying offensive refuse in it. The designs will be judged by Captain Sir Douglas Galton and a premium of £25 will be paid for the best, if any are considered by the judge to be of sufficient merit to receive the prize. The designs should be sent to "The Clerk, London County Council, Spring Gardens," in an envelope indorsed "Dust Cart and Cover" in the left hand corner.

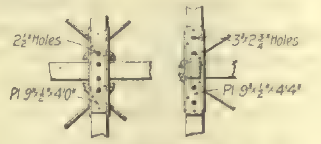
A Small Sewage Disposal Plant is being constructed at Norfolk, Conn., from the plans of Mr. T. H. McKenzie, M. Am. Soc. C. E., who recently read a paper concerning it before the Connecticut Civil Engineers and Surveyors' Association. From this paper it appears that the permanent population of the town is only 2,500, but during the summer 1,500 summer residents move into the many large country houses recently built there. As the natural drainage of the whole town is into a stream which is bordered for several miles below the place with dairies, some sort of a sewerage system had to be built. About 6 miles of 8 and 12-inch pipe have been laid, much of it on a private property in the rear of houses in order to save distance, and an outfall has been constructed to filter beds about 1½ miles distant. The beds are of coarse gravel and cover an area of about 1¾ acres. They will be operated intermittently, and as soon as their capacity is reached it is proposed to construct a pair of settling tanks to receive

the sewage before it is turned on the beds. More land suitable for filters is available at the site in case extensions become necesssary.

The Repair Clause in a Paving Contract was recently brought before the Kansas Court of Appeals in the case of City of Kansas City vs. Hanson et al., 55 Pac. Rep. 513. The clause read as follows: "The contractor expressly agrees to give a good and substantial bond to maintain in good order the aforesaid pavement for five years after the date of its acceptance, and binds himself, his heirs and assigns, to make all repairs which may, from imperfection in said work or material, or from any crumbling or disintegration of the material, become necessary within that time; and the contractor shall, whenever notified by the City Engineer that such repairs are necessary, at once make such repairs at his own expense, and, if they are not made within 15 days after the date of said notice, the City Engineer shall cause such repairs to be made at the expense and cost of the said contractor." The court rules that such a clause is something more than a mere guaranty of the performance of the contract, that the bond makes the contractor pay for any faults or errors of the inspection or other engineering work done by the city, and that such a clause must render the cost of the work, met by owners of abutting property, higher than would otherwise be the case. It was therefore held to be illegal. The pavement was one of brick.

THE NEW SOUTHERN TERMINAL STATION, BOSTON.—IV.

In erecting the train-shed, the columns were first set by small A derricks, and then, commencing at the front, both sets of side trusses were assembled, and all the truss bracing, purlins, column struts and other secondary members connected and bolted up panel by panel as the main trusses were swung. Riveting gangs followed, and as soon as they were sufficiently advanced carpenters laid the sheathing plank, and the roofing work was executed. The side spans were each erected by a traveler, shown in Figure 16, which was essentially composed of two 31 x 42-foot wooden towers 30 feet high. These were trussed with iron diagonal rods in every panel, and braced together so as to move as one structure parallel to the planes of the trusses, rolling on 12 double-flanged wheels. In front of the towers and connected to them was a double bent of framed falsework, with its caps supporting a platform which corresponded in outline and position with the lower chord of the truss. This falsework was mounted on seven wheels, one at the foot of each post, and rolled on seven rails, spaced about 21 feet apart and laid on the ground parallel to the longitudinal axis of the train-shed. All the panels of the falsework and traveler were X-braced except one between the towers, which was left open to give an unobstructed passage for a material track on which cars passed through to deliver the truss members. On top of each tower, two stiff-legged derricks with 42-foot booms were set flush with the front edge and braced together. Each derrick boom had a six-part hoisting tackle of ⅞-inch manila rope, and a capacity of about 20,000 pounds, and a ⅞-inch whip line was also reeved through a side sheave on each boom.



Detail of Splice at A.

A four-spool hoisting engine was set in the base of each tower, to operate the hoisting tackle and move the traveler by winding up on anchor lines. The gable trusses, being made deeper on account of the wall members, were assembled on special falsework bents; the separate members were handled by the traveler booms, and, after being swung, were guyed fast until the traveler was moved back of the second truss to assemble it on its attached erecting platform, on which the lower chord was arranged on the usual blocks and wedges. Then the purlins, etc., were put in place and the traveler moved backwards another panel, and so on, always taking the falsework with it. Two duplicate travelers, i. e., four single towers, were built and erected the two sets of side trusses simultaneously. After operations were well under way one traveler and a gang of 100

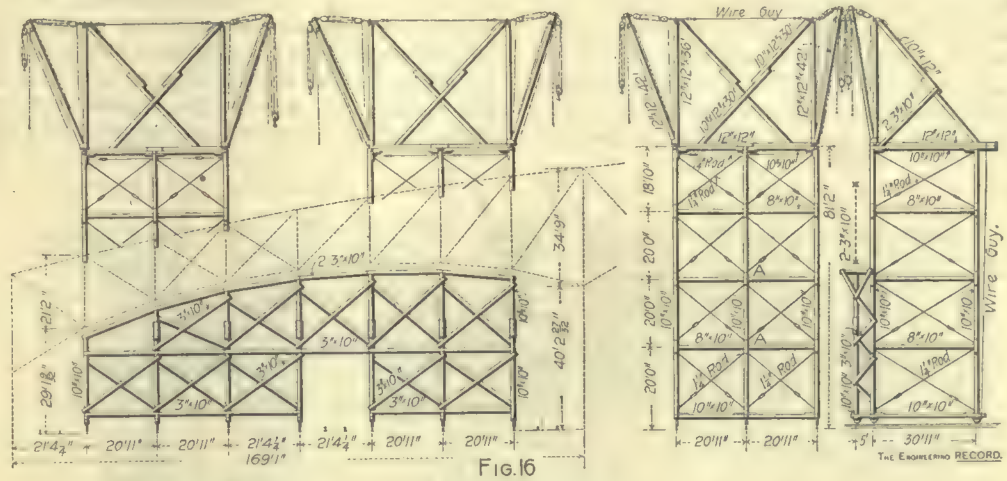


FIG.16

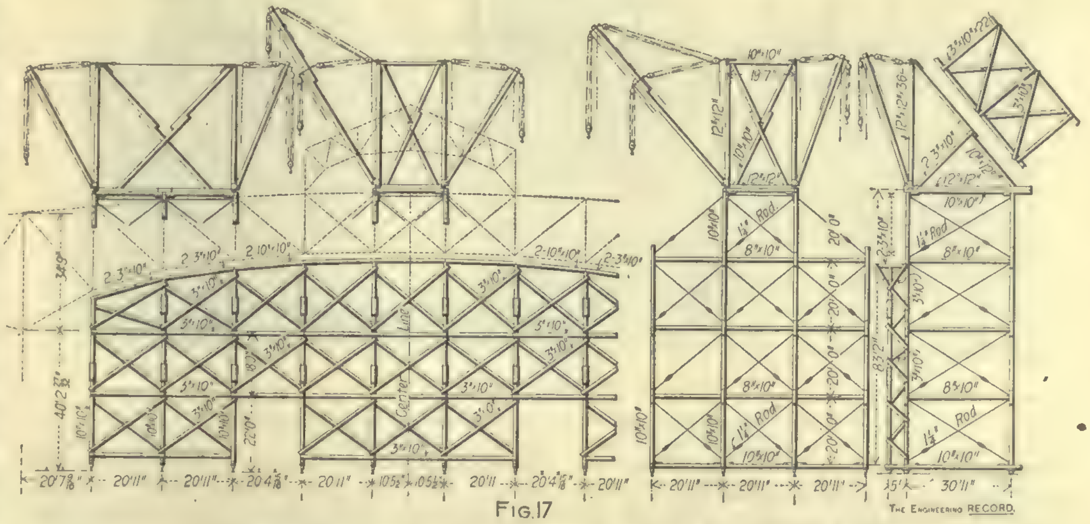


FIG.17

THE TRAVELERS USED ON THE TRAINSHED OF THE NEW BOSTON STATION.

FIGURE 19.—First Stage of Erection.

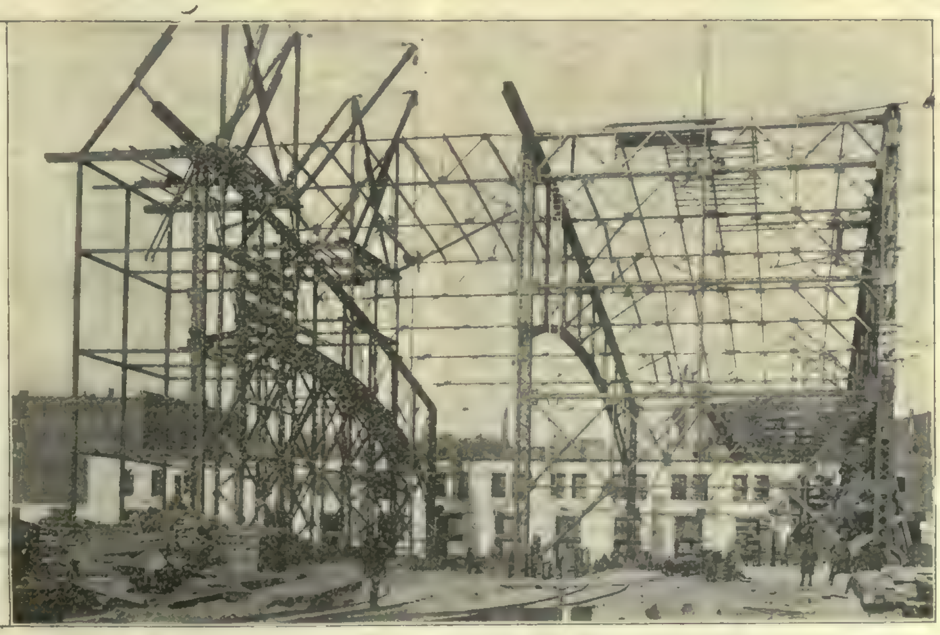


FIGURE 20.—View of Three Side Trusses and Traveler.

THE ERECTION OF THE TRAINSHED OF THE BOSTON SOUTHERN TERMINAL STATION.
MR. GEORGE B. FRANCIS, RESIDENT ENGINEER; THE PENNSYLVANIA STEEL COMPANY, CONTRACTORS.

men, including riveters, could erect and complete one full panel of the side section of the roof, measuring 60 x 169 feet, in about two working days of nine hours each.

After the 169-foot trusses were erected on both sides, the middle traveler shown in Figure 17 was constructed at one end of the train-shed, and with it were erected the long center spans in the same way as the side spans. This traveler consisted of three towers braced together, with boom derricks on top, and falsework and erecting platform in front. It was equipped with three four-spool hoisting engines, and with a gang of 100 men, assembled and finished one 60 x 228½-foot panel in two days of nine hours each. In one case, however, a truss was completely erected in four hours and nine minutes.

A diagram of the three connected spans which virtually form one continuous complete roof truss, and the travelers used in erecting them, is shown in Figure 18. It must be remembered, however, that although the system of erection is thus shown correctly, the three travelers were never all in line as there represented, at one time,

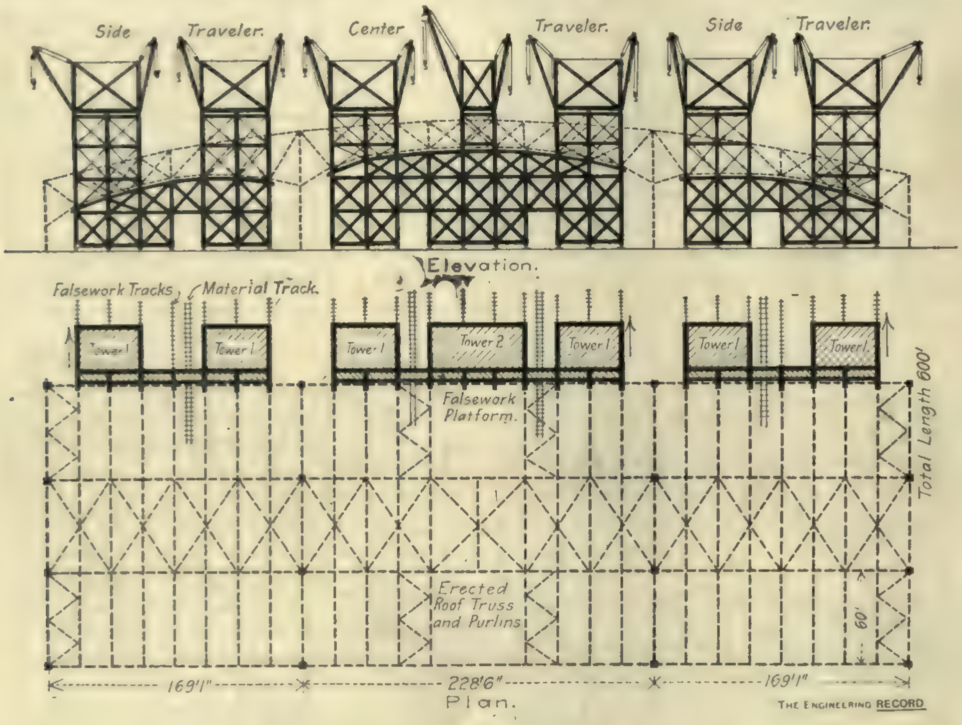


FIGURE 18.—THE ARRANGEMENT OF TRAVELERS FOR THE TRAINSHED.

though each was in that position at some time. After part of the 169-foot spans on the Cove Street side had been erected, the second side traveler was built and commenced the erection of the Dorchester Avenue 169-foot spans, and was still busy with them when the two towers No. I., from the Cove Street side were combined with a new tower, No. II., to make the center traveler, so that only four of the No. I. towers were built. They were built of 8 x 10 and 10 x 10-inch timber and 1¼-inch round upset rods, and their posts had four steel cover plates at each splice. The falsework was made with posts 10 inches square, spliced with four 3 x 10-inch cover planks 5 feet long, and braced with 3 x 10-inch plank. All connections in the travelers and falsework were bolted. The falsework was so braced as to form virtually a deep continuous vertical truss across the faces of the towers for each span, which were united by it. Although the side trusses act as cantilevers they were not so erected, and none of the cantilever members were assembled until after the center trusses, except the end sections of the top chord, which projected about a panel length beyond the column centers.

A graphic record of erection progress was kept by the resident engineer, who had an isometric diagram of the principal members of the entire train-shed framework drawn in red ink, and then had it inked over with heavier black lines as fast as the work progressed.

A view of the commencement of the erection, made from a photograph taken February 19, 1898, is given in Figure 19 to show the side traveler assembling the gable truss on its special fixed falsework. A progress picture taken March 18 is given in Figure 20 to show three side trusses erected and one panel of their whole framework complete except the monitor frames. This view shows the longitudinal bracing between columns, the connections for the center truss, and, at the right hand side, the heavy horizontal lateral truss.

The steel work in the roof of the train-shed weighed about 11½ million pounds, and there was a total weight of about 15,000 tons of steel in the whole terminal construction. The first pair of roof trusses was connected together to be independently stable on March 7, 1898, and the train-shed was thrown into regular service January 1, 1899. The steel framework of the train-shed was manufactured and erected by the Pennsylvania Steel Company, Mr. J. V. W. Reynders, M. Am. Soc. C. E., superintendent of the building and construction department, according to the designs and specifications of Resident Engineer George B. Francis, M. Am. Soc. C. E. The Pennsylvania Steel Company was a direct contractor for the trainshed and track bridge floors, and not a sub-contractor, as stated in the issue of January 14. The general plans of this portion of the station were prepared under Mr. Françis' direction by Mr. Joseph R. Worcester, M. Am. Soc. C. E. Mr. Francis prepared the general outlines of the roof, the arrangement of columns, spans, trusses, purlins, monitors, ventilation and lighting; and Mr. Worcester performed the work required for the strain sheets, dimensioning and general detailed drawings. The shop cards were prepared by the Pennsylvania Company.

BRIDGE NOTES.

The Highway Bridge across the Mississippi River at Brainard, Minn., is a steel deck structure with three channel spans and viaduct spans and trestles in the approaches. It was designed by Mr. C. F. Loweth, M. Am. Soc. C. E., St. Paul, Minn., who introduced a combination of timber, steel and concrete for the two river piers. The substructure is of piles, cut off and capped with a timber grillage below low water, and the superstructure is a concrete mass protected from ice and drift by a solid steel shell. This shell is about 37 feet long, 7½ feet wide on the bottom and 11 feet high. The downstream end is semi-circular, and nearly vertical. The upstream end is wedge shaped and slopes 3 horizontal to 4 vertical, and its 90-degree front cutwater is protected by a 6 x 6 x ½-inch angle. It is all made of ⅜-inch steel except the nose, which is ½ inch thick. The sides batter 1 in 24 to give the top a width of 6 feet. In construction, the grillage was bolted together and floated to receive the steel case which was spiked to it through the horizontal flange of an angle having its vertical flange riveted to the bottom of the shell inside. The nose was shop riveted complete, and the sides in two pieces so as to leave a minimum of field work. The lower section of the case was secured to the grillage and loaded with concrete until it sank into position on the pile heads. Then the upper section of the case was riveted on, filled with concrete, which was rounded off on top to receive two stones for the pedestals of the single-trestle bents, which supported the adjacent ends of the spans. To prevent bulging, tie rods were put through the concrete and held the steel sides together at about every 2 feet both ways. A tower at one end has four steel columns, two of them founded on small stone piers on dry land, and the other two resting on a substructure bent consisting of two small steel cylinders filled with concrete and rigidly united by a solid vertical steel diaphragm transverse to the bridge axis, and sunk at the edge of the river. This concrete work is considered very satisfactory, and was constructed at a considerably lower cost than would have been incurred for equivalent stone masonry.

A Deflectometer for measuring the deflection of bridges under proof loads has been devised in the Ecole des Ponts et Chaussées, according to the "Genie Civil." It is stated to consist of two vertical telescopic tubes connected by an interior spiral spring terminating in hooks at each end. The outer tube is about 10 inches long, 1 inch in diameter and has a narrow longitudinal slot extending to within half an inch of each end. A scale of millimeters is marked along one side of the slot, the zero point being at the top. A solid cap at the bottom of the tube is hooked to the lower end of the spring. The inner tube slips easily within the outer one, and carries an index which registers with the scale; the upper end of this tube is hooked by a solid cap to the top of the spring.

Above and below the index two stops slide easily on the exterior tube. The interior tube is attached to a fine iron wire clamped to the girder under observation, and a second fine wire is attached to the exterior tube and anchored to the ground vertically beneath the point of attachment to the girder. The index is set in the middle of the scale, and its exact position is noted. If the girder is loaded and deflects, the interior tube moves to correspond while the exterior one remains fixed and the exact deflection is indicated on the scale. After unloading, the position of the index shows whether the girder has sustained any permanent deformation. For a rolling load the apparatus is arranged the same, and both stops are placed in contact with the index. Under the influence of a load the index will move one stop or the other, and after its removal the position of the index will show whether there has been any permanent deformation. These arrangements suffice as long as the girder is near the ground, but in order to be exact it is desirable to use very perfect wires carefully fastened at their extremities to prevent any slip during the test. For large deflections and great heights under the girders, it would be necessary to allow for the elongation of the wire under the tension of the anchorage; to avoid this difficulty a weight of 20 or 30 pounds is suspended from the girder by a long heavy wire, and below this weight the instrument is anchored to the ground with its fine wires as before, and the difference of strain in the spring from the amplitude of the deflection will not appreciably influence the an-

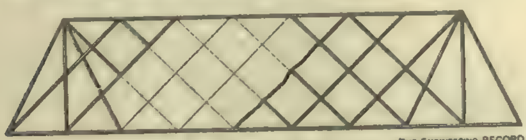
chor wire. The tension of the spring, which is only 4½ pounds when the index is set at five, will not prevent the lower wire from being curved by the current if anchored to the bottom of a rapid river. In this case a scaffold is suspended from the girder and a heavy weight is sunk to the bottom of the river, and to it is attached a thick anchor wire whose upper end is attached to one extremity of a lever set on the scaffold and strained by a counterweight of 20 or 30 pounds at the other extremity. The fine wires of the apparatus are attached one to the girder and the other to the upper end of the anchor wire. With this arrangement the instrument is said to give exact measurements of deflections.

A STRONG THOUGH DAMAGED BRIDGE.

In the "Transactions" of the American Society of Civil Engineers for October, 1895, Col. Walter Katté stated that from long observation of the bridges on the New York Central Railroad, he had become convinced "that solidly riveted lattice girders unquestionably give the best, safest and most durable service for such constant and heavy traffic as that required by the New York Central system, and especially so in cases where the masonry support is not of the best." That criticism and one to the same effect by Mr. T. C. Clarke led to the writing of a valuable historical paper by Mr. George E. Gray, one of the society's honorary members, and probably the first designer and builder of an all wrought iron bridge of any considerable span in the United States. In this paper, published in volume xxxvii. of the same "Transactions," he tells an interesting story of the construction of such a span, and its test to destruction at Albany in order to convince the officials of the railway company that structures of this sort were safe. Riveted spans, however, gave place for many years to those with pin-connections, and it is only within a comparatively few years that the type has returned to general favor again. Just how much influence the excellent record of riveted bridges standing after injury had in bringing about this return to old practice it is idle to discuss. There is no question, however, that it had much weight in accomplishing this result, and through the kindness of Mr. W. H. Finley, engineer of bridges of the Chicago & Milwaukee Railway, "The Engineering Record" is able to present the following facts concerning a recent accident of the same sort.

The bridge in question consisted of a single track riveted lattice truss span 115 feet long, designed by Mr. Finley, under the direction of Mr. J. E. Blunt, chief engineer of the railway company, and built in 1895 by the Lassig Bridge & Iron Works, of Chicago.

A few months ago a double-header freight train and a passenger train met on this structure in a head-end collision, which threw the second engine of the freight train through the side of the bridge, and damaged one truss, as shown in the accompanying engraving, from a photograph taken shortly after the accident. Although there were a sufficient number of web members destroyed to leave one floor beam only partly supported, and three entirely unsupported except by the bottom chord, yet the freight train was pulled across the span without causing any undue distortion of the truss.



The accompanying outline diagram of the truss, with the destroyed web members indicated by dotted lines, gives an idea of the number and position of truss members injured. A careful examination of the structure shortly after the accident showed it to be still in perfect line, with no perceptible sagging of the damaged truss. Before traffic was resumed, temporary bents were put under the unsupported floor-beams, and two posts were placed between the top and bottom chords, as shown in the engraving. In sending the data concerning this bridge, Mr. Finley writes:

"When the length of this span, 115 feet, is taken into consideration, I think that the result of this accident goes far to support the assertion that this type of through truss bridge, between the limits of 100 and 130 feet, is superior to any kind of an articulated structure or to a riveted pony truss span. A similar accident on a pony truss span or on one of the lately patented A trusses would result, I believe, in the total collapse of the span and consequent wrecking of the train."

A WRECKED BUT SECURE BRIDGE.

THE PRESERVATION OF CLIPPINGS.

Every progressive man finds from time to time valuable and interesting articles in the various periodicals which he would be glad to preserve for future reference. Only a few of the best periodicals can be preserved entire, and in the restricted quarters of offices in large cities room cannot be afforded for bulky or disorderly data, and some method of classifying and preserving clippings is very desirable. As their selection is usually wholly a matter of personal judgment it cannot generally be intrusted to an assistant, and some system which enables the material to be disposed of rapidly in such a manner as to be easily accesible long after it is forgotten, is a desideratum for many people. Scrapbooks are bulky and troublesome; they do not allow of interpolation nor the removal of their contents, and cannot receive matter whose printed pages must be accessible on both sides. In a system of filing there is likely to be difficulty in properly securing clippings from different sources, on account of their irregular sizes and the conflict of subjects on opposite sides of the same paper. A system of nominal cost, simple in its method, and easily maintained, which has given satisfaction for several years, is here explained for the benefit of those who may wish to copy or modify it.

Mr. John Carlin, of Thomas Carlin's Sons, builders of contractors' machinery, Allegheny, Pa., preserves miscellaneous clippings of about 800 subjects in ordinary letter filing cases 12 inches square and 3 inches thick, which cost about 25 cents each. Originally three of these cases were required. The first one was marked A to E, and the filing pages beyond letter E removed. The second one was marked F to O, and the pages not included removed. The third was marked P to Z. Later on, as these cases overflowed, some of their pages were taken out and placed in empty cases as required from time to time. Each clipping is laid flat or folded if necessary, in its proper page, and is marked by a large-type rubber stamp with the initial letter of its leading subject, and is filed under that letter in the index. The contents of this division of the file may be further arranged topically or alphabetically, as the file grows or it becomes desirable. An index finger is also stamped on the clipping to point out the article or articles selected, so they will be conspicuous in the first glance at the page.

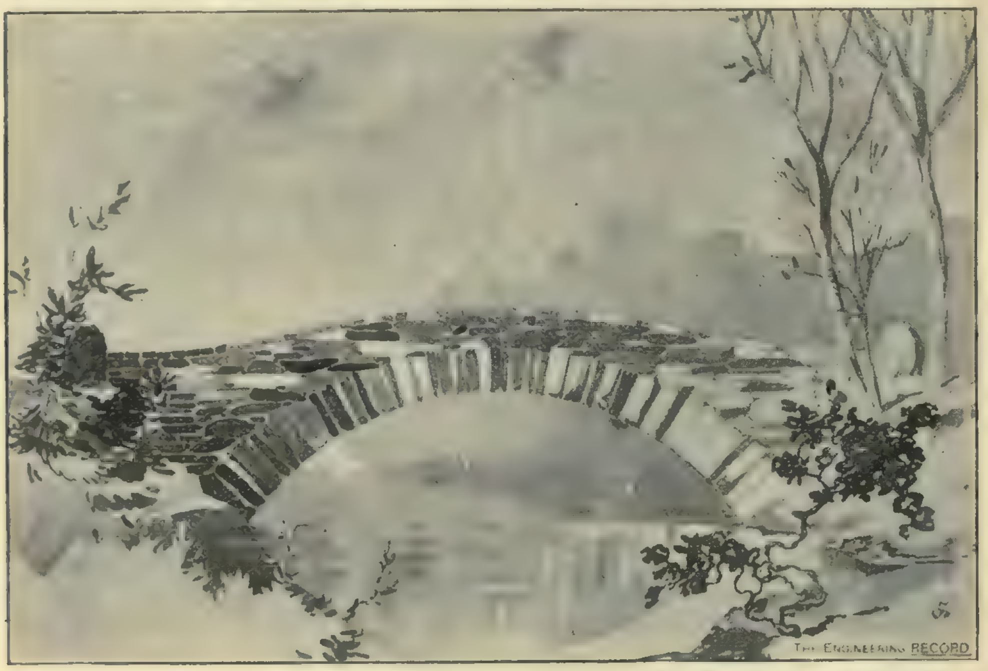
Each clipping is recorded on an index card, a separate one being made out for every subject to which the article may relate. The subjects are either simply stated by title or have brief notes added. The whole system is clearly illustrated by a sample clipping, which consisted of a single page of a technical paper 10½ inches wide and 15 inches long. This was folded once across, so as to make a double sheet, 10½ by 7½, within the limits of the file case. The principal article in this clipping was a description entitled "Cars for Export," which occupied part of one side of the sheet. On the other side of the sheet was an article about a consolidation locomotive which overran a few lines on another page. These lines were cut out and pasted on the clipping, so as to make it complete. This clipping was stamped C, for car, under file C of the letter case and indexed with six cards, each stamped C, to correspond, and numbered 483 or 484, for the page number of the journal. Two of the cards gave cross references to the car, and were inscribed respectively "Export Cars" and "Cars for Export," and filed under E and C of the card index. The other four cards referred to the locomotive and boiler, and were marked respectively "Consolidation Locomotive, 22x28," "Locomotive, consolidation, 22x 28," "Locomotive Boiler," and "Boiler-Locomotive," and were correspondingly arranged in the card index under letters C, L, L and B.

It is evident that with a careful arrangement of the clippings under their different letters in the file and by the exercise of good judgment in defining the different topics relative to the subject embraced in each clipping, and some pains in making the characteristic and prominent word of each title appear first, a large collection of clippings on different subjects can easily be preserved and made available for immediate reference under any of the heads which may be desired. The details of such a system may, of course, be modified in many directions. Complete equipments of cases and indexes can be purchased or the apparatus may be largely home made.

A PARK BRIDGE.

There has recently been built for one of the driveways in Central Park, New York, a masonry arch of which the principal features and dimensions are shown in the accompanying engravings. The structure supports a roadway, wide enough for two carriages to pass, which rises slightly from both ends to the middle and is protected by a low parapet and face wall of masonry on each side. The bridge itself consists essentially of a segmental brick arch of 45 feet span, 12 feet rise, 14 feet width and 3 feet thickness, and has abutments and spandrel filling of stone masonry. Each side of the arch in the plane of the parapet wall is faced with a ring of voussoirs made of rough flat stones comparatively wide and thin, set in mortar beds, and having only the four beds at the two joints of the keystone in each side dressed. The brickwork can only be seen in the intrados and the general effect is of irregular rubble masonry of different harmonious shades of color.

The arch was built at a period of very low water and was constructed on heavy falsework trusses having their lower chords set close to the surface of the water. Continuous 3x4-inch lagging was laid on the top chords of the trusses and sustained the load imposed before the closing of the arch. The trusses were adjusted to the exact required height by pairs of oak wedges on top of a transverse 12x12-inch timber sill at each end. It was intended to leave them in position at least a month after the arch was closed, but the work was so hurried that in about two weeks the wedges were driven out and the falsework removed so as to open the water way. No resulting settlement was observed. Earth and stone filling was moistened and rammed above the arch masonry and around the abutments, and carefully trimmed to a regular surface at subgrade. On this surface a bed of concrete was laid from back to back of the abutment walls, and covered with an asphalt pavement. The drainage flows both ways from the middle of the bridge and is discharged through an iron drain pipe and an inclined weep hole in each end of each face wall. Local stone, hard red brick and Portland cement were used in the structure. Messrs. Howard & Cauldwell were the architects of the bridge, and Mr. Alexander Rice McKim, M. Am. Soc. C. E., the engineer.

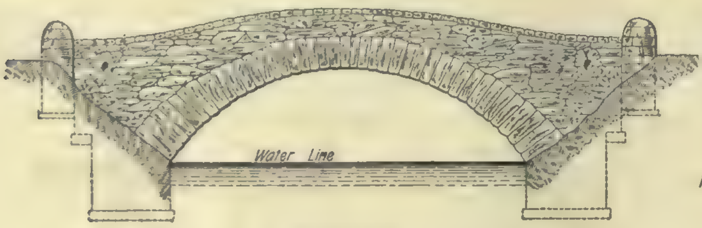


THE NEW DULUTH WATER-WORKS.

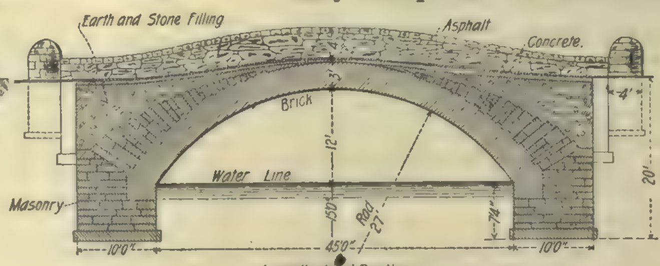
The city of Duluth, Minn., is situated at the western end of Lake Superior, extending along the shore of the lake for about 25½ miles, with an average width of 2.7 miles and an area of about 67½ square miles. The ground rises from the lake until it reaches a height of about 800 feet, which adds to the difficulties attending a system of water supply. Up to within a short time the city has been supplied by the Duluth Gas & Water Company, which took water from the lake quite near the center of the city, and had a reservoir and system of distribution pipes. In course of time the water in the lake around the intake naturally became polluted by sewage, and a series of typhoid fever epidemics resulted, the most serious being about three years ago.

About seven years ago a municipal system was designed by City Engineer E. H. Keating, M. Am. Soc. C. E., in which an intake was to be located about 6½ miles from the city hall. The city was divided into three sections, a low-level, a middle-level, and a high-level district. Other plans were finally completed about two years ago by Mr. W. B. Patten, M. Am. Soc. C. E., who was then city engineer, and were approved, with some slight changes, by Mr. L. W. Rundlett, M. Am. Soc. C. E., city engineer of St. Paul, who was employed as consulting engineer. In these plans, the general arrangement of three levels was preserved, but the contours separating them were somewhat changed.

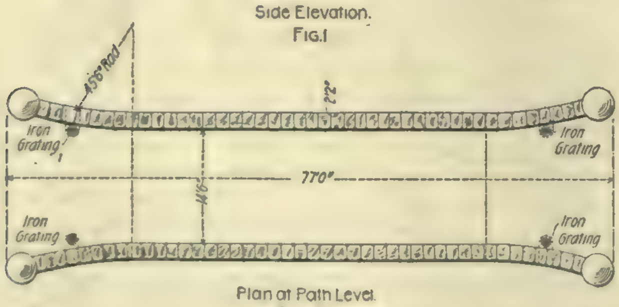
The low-service district comprises all that part of the city below a height of 290 feet, and contains the business section and about 90 per cent. of the population. The middle-service district includes all that portion above 290 feet and below 565 feet, and is thinly settled. The high-service district includes all that portion above 565 feet, and at present consists of two suburbs, Woodland Park and Duluth Heights, about four miles apart. The general plan of the system consists of an intake and pumping station about eight miles east of the center of the city, and a 42-inch force main to a reservoir supplying the low-level section. From the low-level reservoir water will be pumped to one supplying the middle-level section, and as the population increases and demands it, pumps will have to be installed to supply the high-level section. After many attempts and law suits on both sides, an



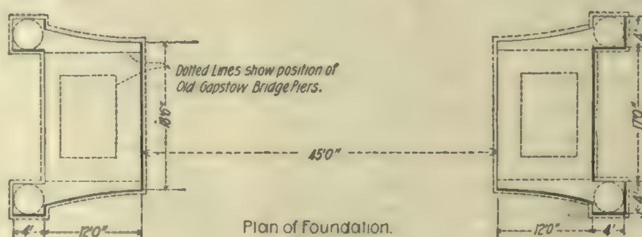
Side Elevation.
Fig. 1



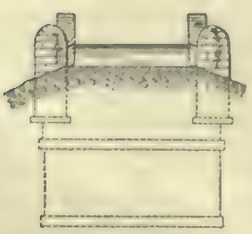
Longitudinal Section.
Fig. 6



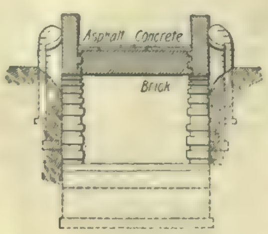
Plan at Path Level.
Fig 2



Plan of Foundation.
Fig 3



End Elevation.
Fig 4



Transverse Section
Fig. 5

Centering
Fig 7
Section Z Z

MASONRY ARCH BRIDGE, CENTRAL PARK, NEW YORK CITY.
HOWARD & CAULDWELL, ARCHITECTS; ALEX. RICE M'KIM, ENGINEER.

agreement was finally reached in January, 1898, by which the city purchased the plant of the Duluth Gas & Water Company for the sum of $1,250,000, but previous to this time the city had begun the construction of the plant which is described hereafter.

The intake pipe is 60 inches in diameter, built of riveted steel, and extends into the lake 1,560 feet from the intake well at the pumping station. It is ⅜ inch thick, coated with asphaltum, and was delivered at the bank of the lake in lengths of 116 feet, each length weighing about 16 tons. The end piece is bell-shaped, turned up vertically 10 feet, and draws water from a point about 55 feet below the surface of the lake. This pipe cost $11.91 per linear foot delivered on the ground. The excavation consisted of 300 feet of tunnel and 500 feet of open trench in rock, ending in 35 feet of water. The rest of the pipe was laid on the bottom of the lake, which was smooth rock for 560 feet and sand and gravel for the last 200 feet. To overcome angles in the grade, four flexible joints were used and proved to be perfectly watertight. The cost of each of these joints complete was $398.25.

In laying the pipe a wooden bulkhead was built in the outer end of a section and calked tight with oakum and white lead. The pipe was made fast to the side of a scow, towed into place and lowered to the bottom, resting upon wooden blocks attached to it; the sleeve joints were put in place and the hook bolts screwed up tight. The water in the intake well was then pumped down and the gate in the well was opened. Any increase in height in the water in the well could come only from leakage in the section just laid. If there was any leakage the hook bolts were tightened until it stopped. After the pipe was laid, the tunnel and trench were filled with sand and the trench covered with riprap. Where the pipe rests on the bed of the lake riprap was laid along its sides to a height of about 2 feet. It was originally intended to cover this portion with sand, but owing to a strong undertow and the heavy wave action, this was abandoned, and five anchor cribs were used to hold it in place. These were made of green white-pine timber in three compartments, and so arranged as to go entirely over the pipe. The side compartments were filled with large rocks, and blocks weighing a ton each were used for filling the top. The spaces between the pipe and the corners of the crib were filled with Portland cement concrete rammed in soft, making, when set, a rigid joint between the pipe and the crib. Large size riprap with a slope of two to one was placed on all sides of the cribs. Over the intake a special crib with a grillage screen was placed.

Figure 1 is a profile, showing the intake well, pipe and cribs. Figure 2 shows a half section of the flexible joint, and Figure 3 shows a section of the intake crib. The intake well and about 200 feet of the tunnel were built by the city, but the rest of the work, including excavation, laying, covering and securing the pipe and joints, supplying and placing the cribs and riprap, was done by contract at a cost of about $37,000.

The intake well was built in solid rock close to the bank of the lake. It is 20 feet in diameter and 20 feet deep below the level of the lake. The walls are 24 inches thick, of hard-burned sewer brick laid in Portland cement mortar made of two parts of cement and one part of sand. Outside of the walls is a backing of 6 inches of native cement concrete. In the well are two sets of copper screens of ¾-inch mesh, placed just in front of the gate valve. The total cost of the well and screens was $9,408.

The main building of the pumping station is 94½ x 56 feet, with a tower on one corner having a radius of 12½ feet, and a machine shop 29 1/3 x 31 feet, all two stories in height. The foundation is rubble masonry in native cement mortar resting on solid rock, above which are six courses of cut sandstone laid with alternate headers and stretchers. Above this the walls are of brick and 24 inches thick. Portland cement mortar was used in laying the sandstone and brickwork. A track supported by nine steel columns built into the walls carries a 20-ton traveling crane for use in setting up and repairing the engines. The basement floor is of Portland cement concrete, with a top layer of one part cement and one part sand, troweled to a dry finish. There are four engine beds rising from the basement to the level of the first story floor, and built of Kettle River sandstone laid in Portland cement. The building is designed for four pumps, two of 5,000,000 and two of 10,000,000 gallons capacity, and an engine and dynamo for electric lighting. The boiler annex is 70 x 46 feet, 24 feet high, and built of brick. It is to accommodate two batteries of three boilers each. One of these is now in place and has a capacity for furnishing steam sufficient to pump 14,000,000 gallons of water in 24 hours. Adjoining one side of the boiler house is to be a building for storing coal. The roofs of the pumping station and boiler house are of slate supported by steel trusses. The total cost of the pumping station, including the boiler house and crane, was $32,000. The smokestack is of riveted steel lined with fire-brick, and is 150 feet high, with a minimum diameter of 6 feet. At the bottom the steel plates are ⅜ inch, and the brick lining is 18 inches thick, decreasing to the top, where they are 3/16 inch and 3 inches respectively. The shell was delivered in sections 3 feet long, which were hoisted into place and then riveted together. The total cost of the chimney, including two coatings of turpentine asphaltum paint, was $3,600.

From the pumping station the water is forced to the low-level reservoir through six miles of 42-inch riveted lap-jointed steel pipe. This pipe is designed for a capacity of 30,000,000 gallons in 24 hours. It varies in thickness from ¼ to ½ inch, and weighs from 138 to 265 pounds per linear foot. It was coated with asphaltum in the shops and was delivered in lengths of 28 feet. The round joints are single and the longitudinal joints double riveted. Two or three sections, according to their weight, were riveted together on the surface of the ground and then lowered into the trench, three derricks usually being required for this. The pipe was made tapering at one end, so as to slip easily into place in the adjoining length. The end next to the piece last laid was first lowered until the top rivet holes came opposite each other, and was then held temporarily in place by means of a pin. The pipe was next lowered until the other holes came into the proper place and were secured by pins. The two sections were finally riveted together. Where the trench was in soft ground, sticks of pine timber 6 x 6 inches and 3½ feet long were sunk 8 feet apart and the pipe placed on these. Before any back-filling was done, the pipe was tested to a pressure 50 per cent. greater than the working pressure and all leaks were calked under half of this pressure. The back-filling was carefully returned to the trench and tamped or slushed to a height of 3 feet above the top of the pipe.

Four check valves are placed along the line of the pipe and also six Rensselaer gate valves built to resist temperature strains. At the low points 8-inch blow-offs were put in and air-valve open-

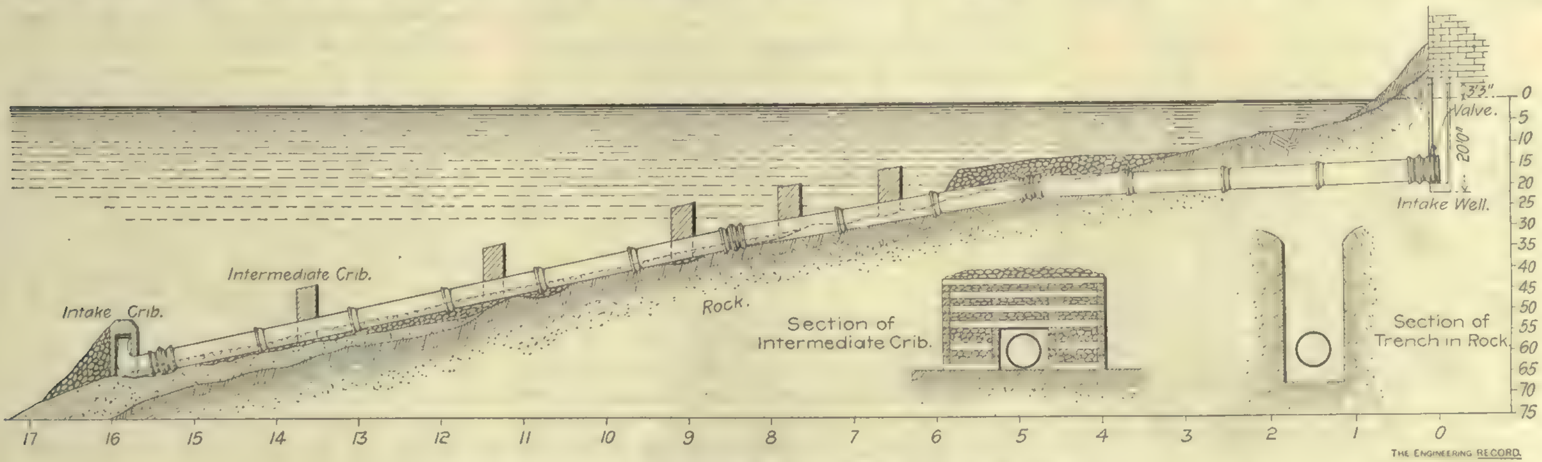


FIGURE 1.—Profile of Intake Pipe and Section of Intermediate Crib.

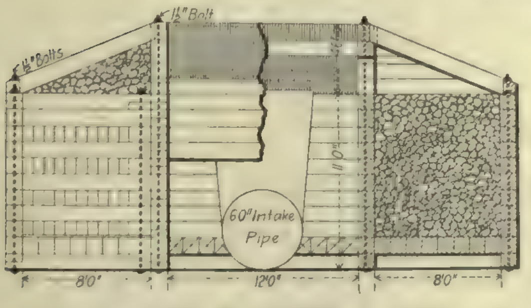


FIGURE 3.—Section of Intake Crib.

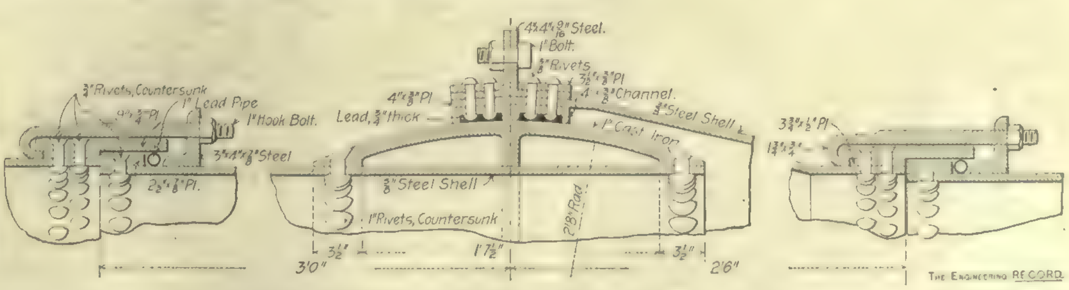


FIGURE 2.—Details of Flexible and Hook Joints.

THE NEW WATER-WORKS SYSTEM, DULUTH, MINN.

W. B. PATTEN, DESIGNING ENGINEER; L. W. RUNDLETT, CONSULTING ENGINEER; T. F. M'GILVRAY, CITY ENGINEER.

ings were placed at the high points. As the main follows the layout of streets and avenues, a number of right-angle turns were necessary, and, with one exception, these were run with a radius of 73 feet. At the cross streets 10-inch openings were put in for connecting future distribution pipes. Through Lakeside, a residential portion of Duluth, a 10-inch cast-iron distributing pipe was laid in the same trench with the force main, and connected to it every 800 feet by means of a tee and a gate. This pipe is ⅝ inch thick, and cost $0.935 per linear foot laid. It was subjected to the same test as the force main.

Near the reservoir two chambers were built, one of 26 and the other of 20 feet radius, to accommodate the gates for the inlet, outlet and overflow pipes of the reservoir. The walls of these chambers are 12 and 16 inches thick, of sewer brick in native cement on a concrete foundation, and were coated on the outside with a 1-inch layer of mortar made of Portland cement and sand in equal parts. The asphaltum-coated overflow pipe is of 30-inch cast iron ⅞ inch thick, and runs from the reservoir to a creek, a distance of 1,116 feet. It was laid on strips of 6 x 6-inch blocking, 2 feet long, and cost in place, exclusive of excavating and refilling the trench, $3.26¾ per linear foot. Near

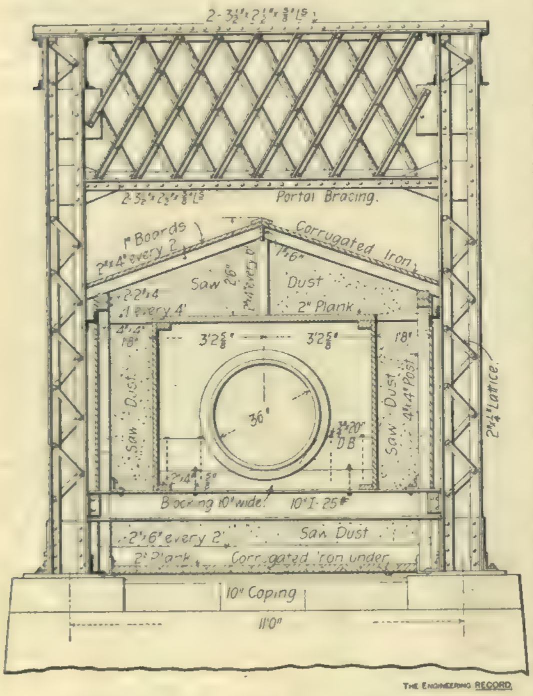


FIGURE 4.—SECTION OF FROST BOX.

the reservoir 600 feet of 20-inch cast-iron pipe ⅞ inch thick was laid in the same trench with the force main for future connection with the middle-level service. This was laid on 6 x 6-inch pine blocking, 2 feet long, placed 6 feet apart, and cost $2.44 per linear foot. The cost of the 42-inch pipe, laid, including manholes, branch valves, air and blow-off openings, was $64 per ton, or from $9 to $4.80 per linear foot excluding manholes and branch openings. The trench digging in earth and rock to an average depth of 8½ feet, refilling, repairs to streets, gutters, culverts and sidewalks, constructing manholes, valve chambers and foundations cost an average price of $1.957 per linear foot.

From the low-level reservoir to the distribution pipes a 36-inch cast-iron pipe capable of carrying 25,000,000 gallons per 24 hours will be used, and most of it has been laid. It is ⅞ and 1 inch thick, and weighs 344 and 395 pounds per linear foot, including the hub and spigot. The joints are quite deep, 100 pounds of lead being used in each. Three lengths were jointed together on the bank and then these 36-foot sections were lowered into the trench by means of two derricks. Pine blocks 6 inches square and 3½ feet long were placed in the bottom of the trench 6 feet apart, and the pipe laid on these. There are four gate valves built to resist temperature strains. All right-angle curves were made with a radius of 56 feet. There are six 4-inch air-valves of the combination poppet and ball-and-lever type, placed at the high points. At the low points, 8-inch blow-offs were put in and 10-inch openings were placed at the street intersections for distribution pipes. The cost of the 36-inch pipe, including manhole, branch, and air-openings, asphaltum coated inside and out, was $4.46 per linear foot delivered on the ground. The average depth of the trench was 7½ feet, and the total cost of laying, digging and back filling, including all repairs, was $2.27 per linear foot.

The 42-inch force main with 10-inch rider crosses a stream on a steel truss of three short spans. To protect the main from frost a double box was built around it of 2 x 4-inch stuff with 1-inch white pine covering. Between the inner box and main is an air space of 15 inches. The outer box was built about 18 inches from the inner one, and the space between them was filled with dry sawdust. This outer box was entirely covered with corrugated iron, having three coats of mineral paint to protect it from the weather and forest fires. This main also crosses ravines at two different street intersections, on wooden trestles of 12 x 12-inch white pine. Similar frost boxes were used here and were painted, but no sheathing of iron was used, as they will be filled in and covered when the streets are graded. The 30-inch supply main crosses a creek on a riveted steel truss 168 feet long. Similar frost boxes were built, but sawdust was used only for a layer of 1 foot on the bottom. This was due to the fact that no dry sawdust could be obtained, and the packing, if made of the wet material, would weigh more than the combined weight of the pipe and water. In its place building paper was used, so arranged that there were three air spaces around the pipe. The box was covered with corrugated iron and painted like the others. This pipe also crosses a ravine on a 60-foot truss with frost box similar to that used on the 42-inch pipe. Figure 4 shows a typical section of such a box.

The low-level reservoir is under construction and is to consist of two basins, with a total capacity of 30,000,000 gallons. A temporary connection has been made between the new mains of the city and the mains of the old system, by which the reservoir of the latter can be filled and thus supply a portion of the city. The new reservoir will be about 4 feet higher than the old one, and so will be able to fill it by gravity.

The plans for the middle and high-level districts have not been prepared as yet. In a general way each will be supplied by pumping from the reservoir of the district below it.

These facts have been compiled from an interesting report by City Engineer Thomas F. McGilvray in the eleventh annual report of the Duluth Board of Public Works.

NOTES.

The Snoqualmie Falls Power Plant will, it is believed, be completed by the last of next month. The current is to be transmitted from the falls to Seattle, Gilman and Renton over two separate pole lines carrying four independent 25,000-volt circuits. The initial plant has four units of 1,500 horse-power each.

Repairs to Pumping Machinery in Chicago have had very good results, according to figures given by City Engineer John Ericson in a recent report. Notwithstanding the total average daily pumpage for 1898 exceeded that of 1897 by 6,689,000 gallons, and the price of fuel was higher, the total expenditure for coal was nearly $16,000 less.

The Waring Fund has been fully subscribed, thanks to the energetic action of the New York Chamber of Commerce. The amount is $100,000, the interest on which will be paid to the widow and daughter of Colonel Waring so long as they live. After their death the money is to be used as the endowment of a Waring memorial chair at Columbia University, for giving instruction in municipal affairs.

The Deep Waterways' Survey which has been in progress for some time under the direction of Lieut.-Col. C. W. Raymond and Messrs. Alfred Noble and George Y. Wisner is rapidly approaching completion. In a report recently transmitted to the House of Representatives by Secretary Alger, these engineers state that sufficient data have probably been obtained for a complete investigation of the control of the level of Lake Erie and the effect of adjacent waterways. Minor surveys and some diamond drill borings are still wanting on the lines of the ship canal routes around Niagara Falls, on the Oswego-Oneida-Mohawk route, and the St. Lawrence-Champlain route.

The Influence of Architectural Engineering on the æsthetic side of the profession was referred to by Prof. Aitchison, in his recent presidential address before the Royal Institute of British Architects, in the following words: "As our knowledge of the strength of materials, of the strains and stresses that result from the different forms of buildings, becomes more accurate, it will naturally affect the shapes of the different parts of the building, and I think we must look very much to this for future advancement in architecture. * * * I think it is obvious that architecture is the poetry of construction, and consequently the very first thing to be taught is construction; and it is not the mere rough knowledge of the main principles, but that exact and accurate knowledge which was possessed by the late Romanesque architects of the properties of stone. They got this knowledge mostly by the failure of their buildings; but they reasoned on the causes of the failure; they observed, they thought, and they dared; while we have most accurate means of testing the strength of every material that falls to our hand, and if we be mathematicians we can solve every stress and strain."

A Slight Steam-Pipe Accident on the twin-screw transatlantic liner "St. Paul" has again brought the vessel to public notice. She left Southampton for New York January 1, and had been out but two days when a small fissure was discovered in a large cast-iron elbow in the steam line supplying the starboard engine. While this engine might have been cut out and its mate run under full-pressure steam, nominally 200 pounds per square inch, it was decided to make a quick repair and proceed with both engines at 100 pounds pressure. There was bound to be a loss of speed in either case, but the use of both engines meant much less difficulty in holding the ship to her course. After some interesting work on the part of Chief Engineer John Hunter the ship continued at reduced speed, arriving at her destination after a voyage of nearly ten days. The pipe line in which the trouble arose was 16 inches in diameter. The crack was found to lie parallel with the axis of the elbow, measuring approximately 8 inches long and 1-16 inch wide. To close it and prevent an absolute failure of the elbow, two heavy wrought-iron straps, which, it seems, are carried by all the boats of the American Line for such an emergency, were encircled about the elbow and tightened by bolts and nuts. Between the straps, four turns of 1½-inch steel wire were wrapped about the elbow. The two ends of this were fastened together and the coiled wire was tightened by means of a jack inserted between the elbow and the spliced loop. The whole operation is said to have taken about an hour and a quarter. "The Engineering Record" is indebted to Mr. Clement A. Griscom, Jr., General Manager of the International Navigation Company, the owners of the vessel, for this information.

FLOOD DISCHARGES.

The problems presented by flood discharges and the channels required to carry them off are among the most interesting which civil engineers have to solve. The city engineer encounters them in sewerage work and in the design of highway culverts, the bridge engineer often has them thrust on him when he has to design piers and abutments, while the railway engineer worries over them whenever the season of washouts approaches. Much has been written on the subject, but it is ever fresh, and the following article, which discusses it in an interesting manner, adds one more to the already long list of discharge formulas. The paper was written by Mr. George Chamier, M. Inst. C. E., and is taken from the "Selected Papers" of the Institution of Civil Engineers:

The capacity of any waterway should suffice to carry without undue strain the greatest discharge to be anticipated from floods. This maximum discharge depends in every case on the heaviest rainfall, and upon certain physical conditions which may be approximately known, and which furnish the elements for determining by calculation the required dimensions of the opening. It is the purpose of this paper to endeavor to bring these elements together in their simplest forms, and to indicate a method of employing them which may be adapted to varying conditions and can be readily applied in practice. In countries where roads and railways traverse cultivated lands or well-known localities no such calculations may be needed; for ample information is usually obtainable from ancient flood-marks, or from the capacities of existing waterways, to enable the engineer to determine the required proportions of all such structures. But this is by no means the case in new settlements and over tracts of unoccupied lands, where the banks of streams are often not clearly defined and where information as to the extent of previous floods is generally unreliable, if not entirely wanting. In all such cases the engineer is compelled to resort to some basis for estimating, within reasonable limits, the greatest discharges to be provided for. It must be admitted that many of the empirical rules that have been offered for this purpose are not generally applicable, and are found to give widely divergent results; yet, where the necessary data are available, some reliable method, based on general principles, for the determination of the required capacities of waterways, ought to be adopted, in order to secure the safety of the work on the one hand, and to avoid useless or extravagant expenditure on the other.

In attempting to arrive at a conclusion with regard to such reliable methods of determination, it is necessary in the first instance to refer to the primary elements upon which all such calculations must be based. These may be grouped under the following heads: (1) The catchment-area; (2) the rainfall; (3) the amount of surface-discharge; (4) the diminution in proportionate flood-discharge due to area.

The Catchment-Area.—The extent of the drainage-basin must in all cases be approximately known. For small catchment-areas it is necessary that this information should be fairly accurate. In the case of large watersheds, however, comprising several hundreds of square miles, the element of area is important. The form and greatest length of the catchment-area are of almost as great consequence as its extent; and so also are the outlines of the principal valleys and the distances traversed by the main watercourses. The latter information is essential, for upon it will depend the time required for the flood-waters to reach the outlet from the farthest extremities of the catchment. It is upon this time that the rate of precipitation to be adopted in the calculation, will mainly depend. In connection with the catchment-area, it is also important to note the general declivities of the ground and the average fall of the valleys toward the outlet, as affecting the flood-velocities of the streams. Two catchment-basins of the same area, subject to precisely the same rainfall and presenting similar physical conditions, will not necessarily give similar flood-discharges at their respective outlets.

As an example of such divergence, let two basins be taken of the same area, say 50 square miles. Let the first catchment be approximately of circular form with moderate slopes; the watercourses all converging toward the outlet, and not more than nine miles in greatest length. The second catchment may be supposed to be of a different form—a long oval, with a winding valley down the middle, and a distance of 25 miles for the water to traverse from the farthest extremities of the basin to the outlet.

It is evident that, although the elevation of the ridges may be the same in both cases, the declivity of the ground will be much greater in the case of the circular basin than in that of the oval one, and that the flood-waters will be delivered off the first in much less time than off the second area. If a continuous downpour amounting to one inch in four hours should fall on both these areas at the same time, the results will differ widely. For, while the flood-water, running at the rate of two miles per hour, would discharge off the circular basin in about 8½ hours, the same quantity of water, running at the rate of 1¼ miles per hour in the oval basin, would occupy more than 20½ hours discharging. Therefore the capacity of the flood-opening would have to be at least twice as great in the first case as in the second. It follows that no formulas for calculating flood-discharges from given areas, that neglect the shape of the basin and the inclination of the ground, can be relied upon to give results of any practical use. This is especially so in regard to the comparatively small areas with which this paper deals.

In taking the catchment-area as a factor for calculating the maximum flood-discharge, it must be assumed that the rain is general, and falls over the whole extent of the drainage-area simultaneously; also that the rainfall is of sufficient duration to allow the flood-waters from all parts of the drainage-area to reach the outlet at the same time. The duration of the rainfall is the main consideration, but this period is intimately connected with the extent of the drainage-area and the velocity of the flow, which depends mainly on the inclination of the country.

The Rainfall.—The amount of rain which may be anticipated is the most important factor in the calculation of flood discharges; but, as already pointed out, the element of duration of fall must not be overlooked. The average rate of the precipitation is found everywhere to vary inversely as its duration. In temperate zones as much as one-fourth the mean yearly rainfall has been known to occur in one day, and about one-fourth the maximum daily fall has been registered in one hour. This rapidly decreasing ratio does not seem to be dependent on any fixed law, but it can be ascertained with sufficient accuracy, in most settled localities, from the records of rainfall that are generally kept. Approximate data as to the diminution of the rainfall according to duration are absolutely necessary in order to calculate flood-discharges from small areas. Thus, in designing drainage works for towns it is required, in the first instance, to decide upon the greatest rainfall to be anticipated for one hour, and often for much shorter periods. In the case of roads and railways it frequently happens that provision has to be made for the greatest precipitation for a period of one-half hour. The general rule to be followed is to take the greatest rainfall to be anticipated, from previous records, for such a time as is required for the flood-water to reach the outlet from the farthest extremities of the catchment-area. This is the only safe basis to proceed upon.

There are two difficulties to be overcome in applying this method, but they are by no means insuperable. In the first place, the registers of rainfall are usually only daily, and precise information as to the heaviest falls for shorter periods is not often procurable. Nevertheless, there are generally sufficient data to be collected from independent observations to allow a few leading facts to be established; and from these a diagram should be prepared, showing approximately the diminution in the rate of fall according to time. Thus, the author has found, from comparing a great number of observations taken in New South Wales, that the maximum rainfall in that country for one hour approximates to one-fourth of the greatest daily fall. In a period of four hours the maximum is about double that for one hour. This proportion would appear to hold fairly well in many other places, and where it is at fault it will be found to err on the safe side.

The corresponding figures would be:

Duration in hours..........	1	4	12	24
Rainfall in inches...........	1	2	3	4

But it does not follow that the greatest storms, giving the maximum rainfall for any particular period, should accord with the foregoing series. Such is not generally the case, for the heaviest rain is not usually of a continuous character, but falls in intermittent showers. This fact, however, does not affect the matter under consideration. For the purpose of calculating the greatest flood-discharge to be provided for in connection with any particular catchment-area, all that is needed is approximate knowledge of the maximum rainfall that may occur during a period corresponding with the size of the catchment-area. If the area is so large that only the greatest daily fall need be taken into account, it will not materially affect the result whether the rain falls at the same rate for 24 hours, or whether it falls in heavy and intermittent showers over the same period. The second difficulty concerns the fixing of the duration corresponding with different areas. Here it is required to estimate the time needed for the flood-water to traverse the whole length of the catchment-area, which is a matter that it would be almost impossible to determine exactly. But the velocities of streams can always be approximately ascertained from the dimensions of the channel, the volume of flow and the fall of the land. These velocities, under average conditions, may be taken to range between two miles and four miles per hour. The case of a mountain torrent, or of a rapid river, would be different. The time that rain-water takes to flow off the surface of the ground into rills, or small subsidiary streams, can only be guessed, and must depend mainly on the nature and inclination of the ground. Over grassy downs, with moderate slopes, the rate of flow for surface-drainage may be estimated at one-half mile per hour, while for steep declivities the rate will be about twice as great. When the water is collected into well-defined channels, the velocity admits of being approximately calculated, and the estimate can always be rendered safe by assuming the least time that the water could be expected to take in passing over a known distance under given conditions. The less the time allowed the greater the margin of safety.

The Surface Discharge.—Only a certain portion of the rain which falls on the surface need be taken into account in calculating the flood-discharge at any outlet. There is loss of water from many causes; from absorption, which depends mainly on the porosity of the soil, and its condition at the time of the rainfall; from evaporation, which depends principally on the temperature and the length of exposure; and from percolation into subterranean channels, arising from the geological character of the country. The two latter causes of decrease of surface-discharge will be considered together, although all these sources of loss are so bound together that it is often difficult to discriminate between

them. By "coefficient of surface-discharge" is to be understood that portion of the rainfall which immediately flows off the surface and finds its way into running streams. It would be extremely difficult to estimate this amount with confidence, if all the varying conditions which naturally affect the result had to be taken into account; but the problem is much simplified by the fact that only the maximum discharge under conditions most conducive to surface-drainage has to be dealt with. In countries where the ground is often frozen, and thereby rendered almost impervious, it is usual to assume that two-thirds of the total precipitation will flow off the land in times of flood, and this amount is therefore adopted as a maximum. But in warmer climates, where no such condition of general application can occur, it is necessary to take into consideration the absorbent nature of the soil, the slope of the ground, and the physical features of the country. In all cases, however, the utmost previous saturation which the conditions of the climate and rainfall will permit should be allowed. As a general rule, the coefficient of surface-discharge may be taken to be between one-third and two-thirds of the total rainfall in times of flood. In the opinion of the author the surface-drainage may be taken approximately to be:

	Per cent.
For flat country, sandy soil or cultivated land	0.25 to 0.35
For meadows and gentle declivities, absorbent ground	0.35 " 0.45
For wooded hill slopes and compact or stony ground	0.45 " 0.55
For mountainous and rocky country or non-absorbent surfaces	0.55 " 0.65

For naked, unfissured mountains, very steep ground, or paved streets, the coefficient may exceed 0.80. As a fair and safe allowance for wooded slopes and compact surfaces, a coefficient of 0.50 may be assumed, with 0.65 as a maximum for ordinary cases. The determination, however, must be left largely to experience and individual judgment.

Diminution in Proportionate Flood-Discharge Due to Area.—It has been proved by experience that flood-volumes are inversely proportional to the extent of the catchment-areas. This rule has been embodied in all formulas for calculating flood-discharges. The ratio of decrease according to area, however, has not been determined with certainty. Many formulas have been devised for dealing with the problem, but most are empirical and assume uniform conditions of rainfall and surface-drainage. Rainfall varies greatly in different countries, and even in different parts of the same country, and the physical conditions are so diverse that such formulas do not admit of general application. The diminution in the flood-volume due to area must not be confounded with the diminution in the rate of rainfall on account of its duration, which is also related to the extent of the watershed. Although both these causes conspire to decrease the flood-discharge at the outlet, they are quite different, and must be taken separately. If a uniform rainfall, of sufficient duration to give the maximum results in both cases, occurs on two catchments of one square mile and 1,000 square miles respectively, the flood-discharge from the large area will not be nearly 1,000 times that of the small one. The volume will be greatly reduced by evaporation and absorption along the course, and generally by percolation through the surface, but chiefly by the obstructions which impede the flow and thus diminish the rate of discharge if they do not reduce the quantity. In warm climates the loss from evaporation is very great, and in dry countries, especially over sandy plains, nearly the whole of the rainfall is absorbed. Thus, in Algeria, with an average yearly rainfall of 15 inches, the soil is so thirsty that, according to official returns, only 2.7 per cent. of the precipitation appears in the streams. On the great basin of the Darling, in Australia, it has been shown that with a mean annual rainfall of 24.59 inches only 1.44 per cent. of the total precipitation flows in the river at Bourke. Then all lakes and swamps act as "flood moderators," and contribute largely to the reduction due to area. Judging from his experience and from a number of observations that have come under his notice, the author is of opinion that, for average cases, $M^{3/4} \div M$ may be adopted as the ratio of decrease due to area, where M denotes the area of the catchment in square miles. It has given remarkably accurate results, but probably other powers of M may be found to be required under different conditions, and the question admits of determination only by observation in many places.

Method of Calculation.—When the above-mentioned data have been obtained, the process of calculating the greatest discharge to be anticipated is very simple.

It may be assumed that one inch of rainfall per hour, on one acre of surface, gives a discharge at the outlet of one cubic foot per second, supposing all the water to flow off. The number of acres, A, therefore, multiplied by the average rate of rainfall per hour in inches and by the coefficient of surface-discharge, will give the maximum flood-discharge to be provided for. But where the watershed exceeds one square mile the factor for diminution according to area, $M^{3/4} \div M$, should be included in the expression. Thus:

$$Q = ARCM^{3/4} \div M;$$

substituting for A its value in square miles,

$$Q = 640 \times R \times C \times M^{3/4},$$

where Q denotes the maximum discharge at the outlet in cubic feet per second; R denotes the average rate of greatest rainfall anticipated, in inches per hour, for such duration as will allow of the flood-water flowing to the outlet from the farthest extremity of the catchment-area; and C is a coefficient of surface-discharge, giving the proportion of rainfall that may be expected to flow off the surface.

The leading characteristic of this formula is that it takes special account of the duration of the rainfall. As already explained, it is a natural law that the average rate of precipitation varies inversely as the duration, which must depend on the size and shape of the basin, the length of the principal watercourses, and the inclination of the ground. The factor R brings all these elements into the calculation.

As an example of the application of this formula, let the following case be taken: Rainfall assumed at 12 inches for 24 hours, with a maximum of three inches for one hour; coefficient of surface-discharge taken at its greatest value, ⅔, the catchment-area 75 square miles, with 14 miles as the longest distance for the flood-water to traverse; a rapidly discharging basin, with compact and steep ground; and the inclination of valleys such as to give the main stream an average velocity of about 3½ miles per hour. It follows that the duration of the rainfall would have to be taken for a period of not less than four hours, and, as the greatest downpour in that time could not be expected to exceed six inches, the average rate would be 1½ inches per hour. Then Q = 16,384. This is more than twice the quantity given by Mr. J. T. Fanning for an area of 75 miles, but the cause of the difference may be seen at a glance. His tables are based on an assumed maximum rainfall of 12 inches in 24 hours, with two-thirds flowing off the surface, as in the foregoing calculation; but the rainfall is taken as uniform for the whole period of one day, giving an average fall of only ½ inch per hour. This is obviously inaccurate. If the maximum be taken at 12 inches of rain for one day, then the maximum for one hour should certainly not be less than two inches. In Sydney, for instance, the records for the past 25 years show that the heaviest rain for one day has been nearly 12 inches, that for four hours nearly six inches, and for one hour about 2¼ inches.

Capacity Required.—Given the greatest discharge to be anticipated at any outlet, the area to be assigned to the opening will depend on the greatest velocity of flow that it may be deemed safe or advisable to permit. This is a matter requiring particular attention. Where a culvert or conduit is subject to a constant discharge, as in the case of underground sewers, it is advisable to provide for a slow and steady flow, to avoid erosion of the material, or scouring away of foundations. Under such circumstances the velocity of the stream is generally limited to about five feet per second. But the case is different for short waterways that may not have to discharge a flood once in many years, and then only for a period of a few hours. Mountain streams and flooded rivers often approach the openings with velocities of 10 feet to 12 feet per second and even greater, and all waterways should be suitable for carrying any stream at its highest natural velocity. There is no reason why flood-openings, on such rare occasions, should not be taxed to their utmost safe carrying capacities, or that culverts should not be allowed to discharge under moderate pressure. Care must be exercised, in all cases, to secure the foundations of structures from the action of scour; but apart from this a velocity of 10 feet per second may generally be safely allowed. Nor is there any necessity for a margin of safety in the dimensions of the opening, because a maximum of rainfall has been provided for in the calculation of the greatest flood-discharge.

Practical Applications.—The above method of calculation admits of being easily tested by experience and applied to all cases when the rainfall has been sufficient to allow of the ratio assumed as the coefficient of surface-discharge to flow off the ground. It is necessary to consider this, because light rains, at some periods of the year, will not cause streams to run, and even heavy showers, occurring after a period of drought, may not give nearly the ordinary surface-discharge. The author was afforded an excellent opportunity of testing the accuracy of the formula by a number of conclusive observations in January, 1897, while engaged in an investigation as to the sufficiency of the waterways on the Cootamundra-Gundagai Railway, for the Government of New South Wales. This line is situated on the southeastern portion of the colony. It is about 30 miles in length, running over undulating land, and skirting a steep range of wooded hills to the west. Numerous small creeks, and also several larger watercourses issuing from the high ground, cross the line; the catchment-areas varying from 20 acres to more than 400 square miles. The watersheds had been surveyed and information had been collected as to the positions and lengths of the main streams, and the average slopes of the ground. The mean annual rainfall for the district was 26 inches, and the greatest recorded fall for one day was somewhat more than five inches.

A few days previous to the author's visit to the locality exceptionally heavy rains occurred. At Cootamundra, 3.75 inches fell in one day, and at the other end of the line seven inches were registered in four days, with a record downpour of 5.07 inches in 24 hours. All the creeks had run full, and the flood-marks at most of the culverts and bridges along the line were clearly indicated, thus affording the means of ascertaining the greatest discharge that had taken place at each site with considerable precision. The author was associated in this inquiry with Mr. J. H. Cardew, Assoc. M. Inst. C. E., who took all the levels and measurements on the ground for the purposes of calculation. A careful inspection was also made of the most important features of the watersheds. The coefficients of surface-drainage were determined by the author, in consultation with Mr. Cardew, from examination of the ground, and were recorded on

the spot before any results had been ascertained. The flood-discharges were afterwards calculated from actual measurements. The amounts of rainfall were taken from the official registers. The author found that the flood-discharges given by the formula agreed closely with the results obtained by measurement. A few average cases are given, by way of illustration, ranging from very small catchments to the largest.

Case 1.—Area 586 acres. A flat gully with steep hills at the sides; clear grassy land; coefficient taken at 0.40. This being a small basin, it was required to take the heaviest downpour for one hour, which on this occasion was about ¾ inch.

Max. dis., formula . =176 cu. ft. per sec.
Max. dis., measurement=122 cu. ft. per sec.

Case 2.—Area 2½ square miles. Creek bed very tortuous, valley about two miles to the foot of steep hills; greatest distance for the water to travel about four miles, which would take fully two hours; coefficient of surface-discharge taken at 0.50; the greatest rainfall for two hours' duration could not be ascertained with certainty, but it must have been very nearly ½ inch per hour. Then by the formula—

Max. dis., formula . =319 cu. ft. per sec.
Max. dis., measurement=210 cu. ft. per sec.

Case 3.—Area 49 square miles. The principal valley about 13 miles long, with a rise of 20 feet to the mile; the water had to travel over 20 miles, which was estimated to require seven hours to eight hours. For the value of R, three inches fell in seven hours, so that the average rate was 3/7 inch per hour.

Max. dis., formula . =2,035 cu. ft. per sec.
Max. dis., measurement=1,820 cu. ft. per sec.

Case 4.—Muttama Creek. Area 418 square miles; the main watercourse extended back 26 miles, with many miles of branches; a flat valley, with an inclination of 142 feet in 15 miles. It was assumed that flood-water would take about one day to traverse the whole length of the basin. Nearly four inches of rain fell in one day, so that the average rate of precipitation was 1/6 inch per hour. The land in the valley is partly arable, but the hills are steep and wooded; coefficient of surface discharge taken at 0.45. Then—

Max. dis., formula . =4,435 cu. ft. per sec.
Max. dis., measurement=4,681 cu. ft. per sec.

In the section of Mr. Chamier's paper in which he discusses the area of culverts necessary to pass floods, he assumes that a velocity of 10 feet per second can be produced in the waterway. It is not always possible to obtain such a velocity, however, without allowing the water to dam up on the upstream side of the culvert, because the approach is not adapted to such an end or because the conditions below the outlet of the culvert prevent the water from attaining this rate of discharge.

WATER-WORKS NOTES.

A Rotary Pump has been installed in wells in California recently by Mr. Preston K. Wood, of Los Angeles. It consists of two or more rotary wheels or propellers, arranged on a vertical shaft running down the casing of the well. The wheels are some distance apart, and just below each is a special guide for the shaft.

Water Meters are strongly recommended in a recent report by William Dalton, Water Commissioner of New York, as a means of checking the waste of water in the boroughs of Manhattan and the Bronx of that city. The daily consumption and waste were estimated to reach 119 gallons per capita during the quarter ending June 30, 1898, an amount he comments on as follows: "It is not conceivable that so large a rate of consumption is necessary, even for luxurious use, and the conviction forces itself on the mind that a considerable portion of the supply is absolutely wasted. The consumption for June this year exceeds that for June of last year by 17,000,000 gallons. If this rate of increase were to continue, even the great resources of the Croton, Bronx and Byram watersheds would be exhausted or exceeded in less than ten years."

The Rainfall and Stream-Flow Observations in the watersheds about Philadelphia, which have been carried on continuously since their inauguration about 16 years ago by Mr. Rudolph Hering, have proved of great value to the city as well as the engineering profession at large. They cost only $1,600 a year, and every administration of the city has willingly made this small appropriation until that now in office, which has apparently decided to discontinue the work, just as the observations are of particular value as showing the final effects of a period of protracted drought. It is to be hoped the omission of the appropriation in the proposed budget was an oversight.

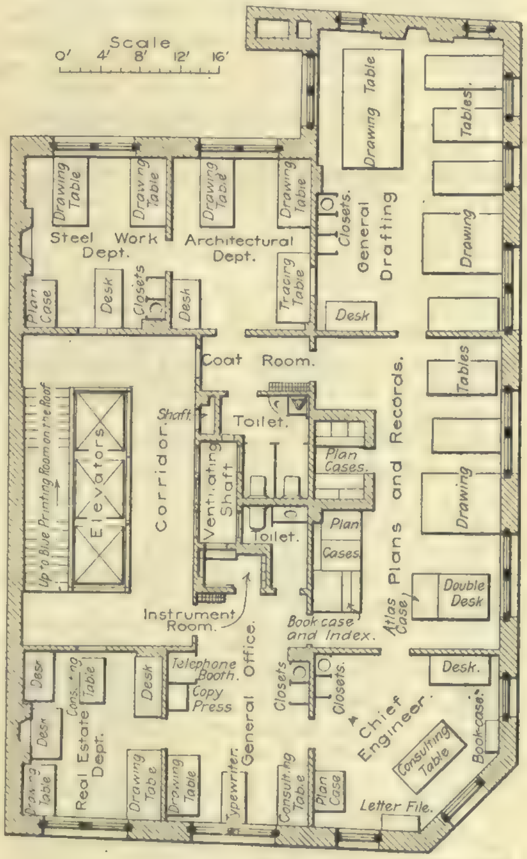
The Problem of Acquiring Water-Works by a city so near its debt limit that it cannot purchase them outright seems to have been solved by the city of Atlantic, Ia. A water company was organized with a capital stock of $20,000 and a bonded indebtedness of $50,000. The bonds matured about five years ago and were not paid, and as a result foreclosure proceedings have been threatened. The city has been operating the plant under a lease and has expended about $15,000 in extensions and improvements. In case of foreclosure this sum would be lost, in addition to the $20,000 worth of stock which is held by local parties. As the city is quite near its debt limit it cannot purchase the system outright, and the Legislature is to be asked to ratify the following agreement: The city is to pay $4,000 per year as hydrant rental, and this money is to be used to purchase the bonds of the company, which are to be held in trust for the city. Further information can be had from Mr. A. M. Nipper, city clerk and superintendent of the water and electric plants.

A Large Water Filtration Project has been submitted to the Philadelphia Councils by Director Thompson, of the Department of Public Works. It provides for filtering 270,000,000 gallons daily and a new pumping station of 150,000,000 gallons capacity on the Delaware River. Sand filters are recommended at three stations and mechanical filters at two. Mr. J. W. Ledoux, M. Am. Soc. C. E., whose study of the subject was reviewed January 7, sends the following criticisms of Mr. Thompson's figures: "His plan would cost about $11,600,000, while his figures are $9,325,000. I believe he has failed to take into consideration the cost of about nine miles of pipe, comprising three 72-inch mains, which are required to conduct the water from the Delaware River to the main distributing reservoir. His prices are no more liberal than mine, and I believe it would be better to go to the Delaware for the whole supply at once than to spend nearly $12,000,000 and still utilize for the largest portion the Schuylkill, whose contamination is far greater and increasing from year to year. You will note that the total cost per million gallons filtered is about $22,200, while, according to my first plan, the cost is $13,136. Then again, he provides for two methods of filtration, which I think is quite an objection. If mechanical filtration is good enough for sections like Queen Lane and Belmont, it ought to be good enough for the whole supply, so that one or the other system should be recommended. Then again, he uses the Cambria reservoir site, which is a valuable piece of property whose cost does not occur in his estimate."

OFFICE SYSTEM, ENGINEERING DEPARTMENT OF ELEVATED LINES, BOSTON ELEVATED RAILWAY COMPANY.

The main offices of the Boston Elevated Railway Company occupy the eight upper stories of the Converse Building, a ten-story fireproof structure, located at the corner of Milk and Pearl Streets, Boston. The two lower floors are used as offices by the Boston Rubber Shoe Company; the next six are given up to the business interests of the railway company, while the two remaining floors are devoted wholly to its engineering departments, which comprise the surface and subway systems now in operation and the elevated lines now in course of construction. Notwithstanding these commodious quarters, it may be interesting to add that the work of the company requires many branch offices distributed along its lines.

The Converse Building was originally designed and built solely for office purposes, but since its occupancy by the railway company such alterations have been made in the arrangement of rooms on the different floors as to afford every facility for rapid and systematic work. The main office and drafting rooms of Chief Engineer George A. Kimball,



FLOOR PLAN OF ENGINEER'S OFFICE.

M. Am. Soc. C. E., of the elevated lines, occupy the entire tenth floor, with branch offices in Roxbury and Charlestown. There are seven divisions in the main office, four of which are used as drafting rooms, one as a general office, one as a private office of the chief engineer, and one as a real estate office. Besides these, there are toilet rooms, a coat room, an instrument room and a fireproof vault for plans, contracts and other valuable data.

The rooms are so arranged as to compel every person entering or leaving this department to pass through the general office, and with a large number of people calling daily the desirability of such a plan is apparent.

The building is the tallest in the vicinity, and has windows on three sides, which afford excellent light on the upper floors during the whole day.

Artificial light is furnished by 32 candle power C. R. frosted incandescent lamps fitted with either aluminum reflectors or conical-shaped green glass shades. They are attached to adjustable arm-and-joint fixtures, which permit the lamps to be placed in any desired position.

Means of communication between the chief engineer's office and the general office and various drafting rooms is had by a system of electric call bells. Telephones, connecting with a central station in another part of the building, provide a quick and ready way of conversation between all the different offices and departments of the company, many of which are on private lines, besides the usual telephone service.

The office furniture consists of roll and flat top desks, plan cases, card index cases, tracing and drawing tables, etc., all handsomely made of quartered oak, excepting, of course, the tops of the drafting tables, which are made of 2-inch strips of white pine glued together and shellaced. Many of the draftsmen are furnished with individual drawing tables. These are 7 feet by 3 feet 4 inches in size, containing one large drawer for unfinished plans, tracings, etc., and six smaller ones, which are put to various uses by the draftsmen, such as places for keeping personal effects, drawing instruments, and supplies. Every assistant is provided with a drawer fitted with lock and key.

Each engineer and assistant is required to keep a record of the number of hours spent by him on each class of work. These reports are made daily on blanks furnished for the purpose and are handed to the stenographer at the end of the month.

The vault is 8 feet long by 5 feet wide, and is made fireproof. The plan cases are of four sizes, determined by the sizes of materials upon which the plans are made. The two larger cases are of quartered oak, made in cabinet form with shallow drawers 1⅛ inches deep, and enough larger than the plans to permit of ready removal. To assist the person looking for plans, a hole 1½ inches in diameter was made near the right hand corner of the drawer. All plans in the drawer can thus be raised without danger of tearing or crushing.

The smaller sizes of plans are filed in strong black cloth-covered boxes, the top and one side of which are made with a hinge and kept in oak cases of shelves.

All plans are made on standard sizes of materials, and each size has a corresponding series of numbers as follows:

Name of Size.	Outside Dimensions.	Corresponding Series of Nos.
Record	11 x 14 inches	10,000 — 14,999
Demy	15 x 20 "	15,000 — 19,999
Imperial	23 x 31 "	20,000 — 24,999
Double elephant.	27 x 40 "	25,000 — 29,999

Each size is then classified by subjects, such as "Foundations," "Details of Curves," etc., and each subject is given a sub-series of numbers within the limits of the series corresponding to its size.

In whatever the plans are filed—drawers, boxes or pigeon holes—the subject and sub-series of numbers appear on the outside, thus:

Foundations
20,550 — 20,599

meaning in this case that all plans which have numbers between 20,550 and 20,599 inclusive are filed in that drawer, are of imperial size, having a sub-series of numbers within the limits of 20,000 and 24,999, and pertain to foundations.

A card index is kept as a record of and reference to plans in the office, differing from many others in use only in the size of its cards. The card used in this office is 8½ x 7 inches, upon which 25 plans are indexed; so that a shallow plan drawer containing 50 plans of one subject, as foundations, for example, is indexed with only two cards. The object of a large card containing a long list of plans is to reduce the time spent in searching for any particular plan; for one can read the description of 25 plans all on one large card much more quickly than he can read the descriptions on 25 small cards.

The plans are indexed on the cards by subjects, and the drawers, boxes, or pigeon holes where they are filed are marked to correspond, as already described. In many cases, subjects have plans of only one size, and therefore many subjects are found in but one case.

The advantage of the above system is to enable one familiar with the office to find many plans without consulting the card index. When a plan is wanted, either its number or subject is known. If the number is known the size of the plan is determined, and therefore the case in which it is filed, and it is only necessary to look through the drawer containing that particular number. If the subject is known the plan will be found in a drawer titled with that subject.

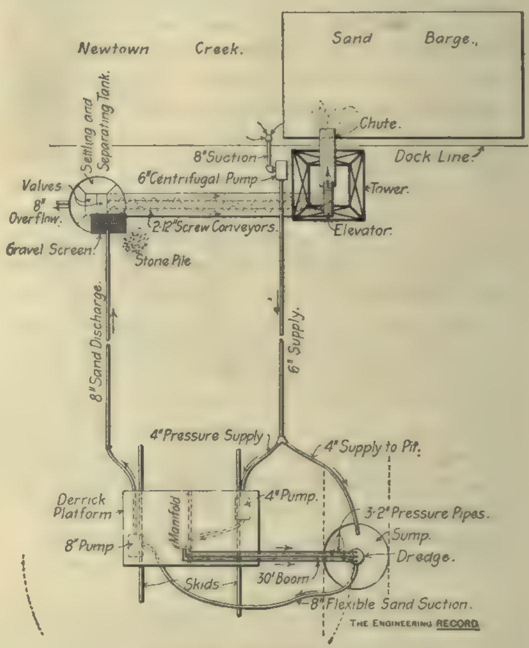
The blue printing is done on the roof of the building, where a wooden-framed room of 19 x 9 feet floor dimensions and 6 feet high was erected. This room is covered with copper plate, is heated by steam, fitted with incandescent lamps, and contains the usual apparatus for washing and drying blue prints. A large printing frame is mounted on a track which passes through a window in the easterly end of the room out on to the roof. This frame is so attached to the car as to allow of its being placed in any position to receive the rays of the sun. A telephone connects the blue print room with that of the chief draftsman below.

A HYDRAULIC SAND PLANT.

In the Borough of Brooklyn, New York City, there is a large deposit of excellent building sand running from very fine to coarse, which forms a hill about 50 feet high, from 300 to 1,000 feet wide, and 1,000 feet or more in length, about 400 feet distant from Newtown Creek. The depth of the bank is unknown, but its quality is said to be better at the bottom of 40-foot test holes than it is at the surface. In order to utilize this sand for building purposes, a hydraulic plant has been installed by the Greater New York Sand & Gravel Company to excavate it with a suction dredge, transport it by water carriage to the creek and there automatically separate it and load it on barges. There is a pumping system at the creek to deliver a large quantity of water in the sand pit, and at the pit a pressure pump for the hydraulic jets and another pump to deliver the dredged material to the separating, conveying and elevating apparatus, which discharges it into the boats. The installation was designed to have a capacity of 550 cubic yards of sand delivered into boats in 10 hours.

A centrifugal pump driven by a 15 horse-power General Electric motor at a speed of about 560 revolutions per minute takes the creek water through an eight-inch suction, and delivers it to a six-inch steel pipe, about 450 feet long, divided at the opposite end into two four-inch branches. One of these discharges freely into a sump about eight feet in diameter and four feet deep in the sand bank; the other branch supplies a four-inch centrifugal pump, the discharge of which passes through a manifold and reducers, separating it into three two-inch pressure jets. This pump and the dredge suction pump are belted to the shaft of a 30 horse-power General Electric motor, and all three machines are installed in a house built on the 14×23-foot platform of a stiff-leg derrick having a 30-foot dredge boom and movable on a pair of 14×16-inch skids 12 feet apart laid across the sand pit. Each skid has sections of loose 6×⅜-inch iron track plates laid on top to receive the sliding shoes of 4×4-inch angles four feet long, which are bolted to each of the crossbeams in the derrick platform, where they intersect the skids, thus permitting it to slide easily on the metal surface and be turned to a considerable angle if necessary. This arrangement enables the boom working on only one side of the derrick to command a belt about 20 feet wide across the width of the sand bank and excavate it to the required depth, after which the skids can be moved transversely and another strip excavated, and so on. The manifold branches are connected to three two-inch steel pipes, running out to the end of the boom and fastened on top and on each side of it by short, flexible sections of hose, which enable the boom to be swung in any position without interfering with the pipe. From the point of the boom three chains about six feet long suspend a Prindle patent dredging head.

The ends of the three steel pipes each terminate in downward bends just beyond the point of the boom, and from each of them a flexible tube is coupled to the dredging head. One of them supplies an annular chamber around the outside of the bottom, which is perforated with small holes to give vertical downward jets. Another is arranged to give a concentrated downward jet in the center, and a third is bent upwards inside the dredging head, so as to point through its hollow center into the suction pipe and promote the flow of sand and water upward into it. From the top of the dredging head an eight-inch rubber suction pipe is carried on the surface of the ground to the five-inch centrifugal pump, which discharges through an eight-inch spiral riveted pipe 450 feet long, running back to the bank where the supply pump is located. This pipe runs in a nearly straight line with a slight vertical



HANDLING BUILDING SAND.

curve for about 400 feet, when it rises 20 feet at an angle of 45 degrees with two 45-degree bends, and discharges on a gravel screen of one-quarter-inch mesh, inclined 45 degrees to the horizontal, which separates the stones, gravel, etc. This screen is set at a height of 19 feet above the dock, over the top of a settling tank, which receives the sand and water that passes through the screen. The tank is a wooden stave cylinder, 16 feet in diameter and 15 feet deep, elevated about five feet above the dock on a wooden tower and having a hopper-shaped bottom, with steep sides, terminating in 12×26-inch rectangular openings, closed by separate flat iron slides.

The dredge discharge, containing from 10 to 20 per cent. of solid matter, is received in the tank and quickly separated by gravity, the water overflowing through a six-inch pipe at the top. The sand is drawn off through the bottom valves, which let it fall on two 12-inch spiral conveyors 16 feet long. These deliver it to the bottom of a bucket conveyor, which raises it to the top of a 25-foot wooden tower and discharges it through a chute into the boats. The elevator and conveyor machinery, as well as the supply pump and its motor, are set in an enclosure near the elevator tower, and are driven by a separate 10 horse-power General Electric motor. It is found in operation that, although the four-inch centrifugal pump is not

adapted to pressure service, no difficulty is encountered in dredging and conveying the sand, which passes through the pipe with a velocity of nine or ten feet per second, but the output with a force of four men is limited by the difficulty of securing a continuous discharge of sand from the settling tank, where the water, instead of overflowing at the top, bores a hole through the bottom, and escapes with the sand in the form of thin mud when the valves above the screw conveyor are opened while the dredge pipe is discharging into the tank. The sand is easily dredged by the hydraulic jets, all or part of which are used simultaneously, according to the conditions encountered. The annular jet is always used. In hard material the central downward jet is used to help cut it out, and the aspirating jet is shut off to give increased pressure, while in loose material the center down jet is shut off and the aspirating jet is operated.

The accompanying diagram is an unscaled one to show the arrangement and system of operation of the plant.

RAPID BRIDGE MOVING.

The method employed in floating a drawbridge span on the Chicago & Northwestern Railway at Milwaukee, was briefly described in these columns on December 31, 1898. Since the publication of that note some further information has been received from Mr. W. H. Finley, engineer of bridges of the railway company, and is presented herewith. The bridge consisted of a pair of bowstring trusses about 176 feet long, supported on a 22-foot turntable. The entire structure, including track, turning gear and drums, weighed 255,800 pounds, and was towed 219 feet down stream from its location in the permanent track to a parallel position at a temporary site. Two 28 x 82-foot scows 6½ feet deep were placed across and below the trusses, one under the third panel from the center each way. The axes of the scows were parallel to that of the Kinnickinnic River, which made an angle of 60½ degrees with the closed bridge. The scows were deeply sunk by water ballast, and timber blocking arranged on their decks so as to give bearing between the bottom of the trusses and floor beams, and six lines of longitudinal stringers at twelve or more points for each scow. The water was pumped out so that the scows lifted the span 2 feet clear of its center pier, so as to be readily moved to the new position. The bearings of the panel points had calculated reactions of 39,600 and 37,300 pounds each, and were adjusted by pairs of oak wedges, each 3 feet long, 8 inches wide and tapering from 5 inches to 1 inch.

The time required to do all work in connection with moving the bridge and placing it at temporary site ready to carry trains and for swinging by its own machinery was two hours and fifty minutes.

The pumps used, both in pumping out the water ballast from the scows to lift the bridge and the contrary operation to lower it, were one steam pump with a 6 x 14-inch water cylinder, one steam pump with an 8 x 14-inch water cylinder and working at about 80 revolutions, two fire engines and two fire tugs, the last using the steam siphon only. The total amount of water pumped to lift the bridge 2 feet clear of the center pier was 92,600 gallons; the amount of water pumped out of scows per minute was 1,624 gallons for the actual working time. The total amount pumped into scows to lower the bridge to its bearings on the temporary center pier was 69,400 gallons, making a total of 162,000 gallons of water handled in doing the work. The entire bridge, including all machinery, wheels, rack, wheel track, pivot center and deck for railroad track, was moved bodily.

The last train passed over the bridge at the permanent site at 9.05 A. M. Between 9.05 A. M. and 9.30 A. M. an ice jam was removed in order to get one of the scows under the bridge into its proper position; a fire tug and two scows with a fire engine on each were placed in position west of bridge; and a fire tug and two pile driver scows were placed in position east of bridge, and all other preparations made ready for the work to begin. The boilers on the pile driver scows furnished the steam for steam pumps. Up to 9.30 A. M. there was no interference with railway traffic on the bridge. At 9.30 A. M. all pumps were started, except on one fire tug, which was started at 9.35, and at 10.35 all water was out of the scows and the bridge stood 2 feet clear of center pier. Between 9.30 and 10.35 all pumps were stopped for an interval of eight minutes to inspect work. At 10.45, the bridge was started down channel, and at 11.15 it was over the temporary pier ready to be lowered. At 11.17 four plugs 3 inches in diameter in each scow were pulled, and all pumps were started to pump water into the scows to lower the bridge. At noon the bridge was landed on the pier, and at 12.10 P. M. the scows were released. At 12.20 P. M. the bridge was swung open by its own machinery. At 2.45 P. M. a heavy locomotive was run over the bridge and temporary trestle to test the structure.

TEST OF A STEAM PUMPING ENGINE.

Through the courtesy of Mr. L. Brown, superintendent of water-works, of Waltham, Mass., and Messrs. Dean & Main, mechanical engineers, of Boston, "The Engineering Record" is able to print the results of a test recently made by the latter on a 5,000,000-gallon cross-compound horizontal fly-wheel pumping engine, built by the Barr Pumping Engine Company of Philadelphia, Pa. The test is interesting as showing what might be expected from a pump of this type. The high and low-pressure cylinders are 22 and 48 inches in diameter, respectively, and the plunger 15 inches, and the stroke of all is 36 inches. The cylinders are steam jacketed and a reheater is placed between them. The steam cylinders have Corliss valves; the high-pressure cut-off is under the control of a centrifugal governor, while the low-pressure cut-off is fixed by hand. A duty of 110 million foot-pounds, based upon the consumption of 1,000 pounds of dry steam, was guaranteed. The test was of eight hours' duration, and the following data and results were obtained:

Average steam pressure, lbs.	111.47
" vacuum, lbs.	13.49
Total head, ft.	176.94
Steam delivered at throttle, lbs.	19,336
Moisture at throttle by calorim., per cent.	1.32
Dry steam delivered to engine, lbs.	19,081
Average revs. per minute	32.38
Duty per 1,000 lbs. dry steam, ft.-lbs.	128,865,000
Excess over guarantee, per cent.	17.15
Work of plungers per minute, ft.-lbs.	5,122,638
Pump horse-power	155.23
Indicated power steam cylinders	167.08
Approx. efficiency of mechanism, per cent.	92.9

The report states that the horse-power developed by the steam cylinders was determined from two sets of indicator diagrams, and is, therefore, only an approximation.

The report of the experts concludes as follows:

"The engine was built to pump against about 273 feet dynamic head, instead of 176.94 feet, but this could not be obtained, on account of projected extensions of the water-works not having been carried out. Furthermore, the boiler pressure of 150 pounds promised by the specifications could not be carried on account of the low head. The boiler pressure used was 113.1 pounds. If the pressure had been 150 pounds, the pressure at the engine would have been about 147.5 pounds by gauge or 162.3 pounds absolute, instead of 126.28 pounds absolute. On the principle that the steam consumption of an engine is nearly proportional to the logarithms of the steam pressures, the duty would have been about 135,000,000 foot-pounds, with the higher pressure. Moreover, if the greater head had existed, the duty would have been a little greater, because less relative work would have been consumed by the friction of the engine and pumps.

"On acount of the slight derangement of a valve gear detail the engine was slowed down a little after running a few hours and averaged 0.95 revolution per minute during the whole test, less than that required by the specifications, and therefore fell a little short of the required capacity. It had, however, on a sufficient number of other occasions shown its ability to give more than the normal capacity. This engine is a good specimen of designing and building, possesses ample stability for reliable service, and the duty is among the highest recorded for compound engines."

AN ENGINE BUILDER'S VIEW OF PRESENT PUMPING PRACTICE.

Among the interesting papers presented recently before the New England Water-Works Association was one by Mr. Irving H. Reynolds on the present pumping engine practice of the Edward P. Allis Company, as compared with that of a quarter century ago. In the introductory remarks he referred to the opposition of prominent builders to the introduction of the compound pumping engine, and mentioned particularly the hard lessons the late George H. Corliss had to learn before he built for sale a pump of this type. This opposition, Mr. Reynolds holds, was of the same nature as the later difference of opinion as to the merits of the triple-expansion engine, when that was introduced. The Allis Company began its work as pump builders in 1873 by constructing a machine of 16,000,000 gallons capacity, having an overhead beam, and resembling engines in Brooklyn and London, except that it was compound. It cost with its boilers about $165,000, and was guaranteed to have a duty of 60,000,000 foot-pounds per 100 pounds of anthracite coal. On a 48-hour test its duty was about 76,000,000 foot-pounds. The company's second pump, built in 1881, was a compound vertical beam engine, having a capacity of 12,000,000 gallons in 24 hours, and costing about $65,000. With 80 pounds steam pressure it developed a duty of nearly 105,000,000 foot-pounds per 100 pounds of coal. In 1891 an 18,000,000-gallon triple-expansion pumping engine was placed in the Milwaukee water-works, which cost $76,000 with its boilers, the guaranteed duty being 125,000,000 foot-pounds per 100 pounds of anthracite coal. Although this engine is of greater capacity than that first mentioned, it cost less than half as much per million gallons capacity, its guaranteed duty was twice that of the early pump, it occupied but half as much space, and its foundations cost considerably less than half. Eighteen years' progress of one builder represented equal capacity with double the duty at half the cost.

Between 1881 and 1886 the company built sixteen compound engines of various types, some of them giving duties as high as 107,000,000 foot-pounds per 1,000 pounds of steam. Nearly all of the earlier crank and flywheel pumps were of the beam type, but since the triple-expansion engine was introduced in 1886, the Allis type, with very few exceptions, has been direct-connected, and all forms of beams, bell cranks and levers have been avoided.

The first triple-expansion pumping engine built in the United States, Mr. Reynolds states, was constructed from his designs, in 1886, by the Allis Company, for the Milwaukee water-works. So far as he has been able to ascertain it was also the first triple-expansion pump to be designed by anyone, although an engine was constructed about the same time for the works of the East London Water Company. Concerning these two pioneer pumps of their class, the paper reads: "The English engine was built from marine engine patterns, fitted with piston and slide valves, and although supplied with steam at nearly double the pressure of

the Allis engine, never attained as high economy. The Milwaukee triple was guaranteed to develop a duty of 118,000,000 foot-pounds for each 100 pounds of anthracite coal burned, the steam pressure being limited by the city's specifications to 80 pounds, the guaranty being unprecedentedly high for such low steam pressure. But the engine actually developed a duty of over 125,000,000 foot-pounds per 100 pounds of coal burned."

The company has built 45 triple-expansion engines, 33 vertical and 12 horizontal. With such an output it has naturally accumulated a fund of important data relating to the design and management of such machinery. Mr. Reynolds goes quite deeply into matters of design in his paper, for which the reader is referred to the "Journal" of the New England Water-Works Association. This section of the paper is quite long, and explains in detail the position taken by the author, which he states in a general way as follows: "I am an advocate of the triple-expansion engine, not solely because of the economy due to the triple-expansion steam end, but more particularly because it is a triplex pump, which, on account of the arrangement of the three cranks, gives a practically uniform flow of water with pumps of very simple construction. For this reason I consider the triple-expansion engines which have, say, two plungers and either three or four steam cylinders, but little better than compound engines, for while they undoubtedly effect some gain in economy, the delivery of water is no better than that of the compound engine. On this point I cannot agree with Dr. Leavitt as to the relative merits of the single-crank and three-crank engines, for I believe that the three-crank engine, solely because of its merit, has come to stay, and I feel equally sure that the single-crank beam engine will become practically obsolete in the near future. This opinion is based not only on pumping engine practice, but on general steam engineering practice the world over, which tends towards simple and direct machines."

Passing, then, over the section of the paper which is a detailed description of the Allis pumps to the remarks on boilers, there will be found some statements which aroused some expressions of contrary opinion when presented. Mr. Reynolds does not believe that there is more than 10 per cent. difference in efficiency between any of the recognized standard types of boilers now in the market. "Taking the ordinary horizontal tubular boiler at 100," he says, "the best internally fired boiler would rate 105 and brick-set water-tube boilers at 95. The inferior efficiency of the horizontal tubular and water-tube boilers, as compared with the internally fired type, is almost entirely due to the radiation and air leakage in the brick boiler settings. There being so little difference in the efficiency of the boilers, the question becomes largely one of first cost and details of mechanical design and construction. Where steam pressures of not over 125 pounds are to be carried, the ordinary horizontal tubular boiler answers every purpose, and, all things considered, it is perhaps the most generally satisfactory. Higher steam pressures, however, render the adoption of water-tube boilers or the more expensive internally fired boilers desirable.

"Marine practice has set the pace for higher steam pressures, due largely to the effort to produce horse-power with the smallest possible engine, and while high steam pressure is undoubtedly desirable, it must be remembered that stationary engines are not subject to the same requirements as marine. The tendency, however, is rightly towards higher pressures, but for practical reasons I do not at present advocate the use of pressures much above 150 or 160 pounds, although so far as any economy is concerned 200 or 250 pounds would be better. At 150 pounds ordinary piping, valves, non-conductors, etc., can be used, and no expensive or unusual construction is incurred, either in the boiler plant or engine, nor is special cylinder lubrication necessary. At higher pressures, however, everything becomes special, and the very slight increase in steam economy hardly warrants the extra expense and care incurred.

"The question as to what steam pressure to carry is one to be determined largely by the type of boiler selected. If ordinary horizontal tubular boilers are to be used, the steam pressure should not be over 125 pounds, although in extreme cases it is carried as high as 150 pounds. For pressures above 125 pounds any of the various types of water-tube boilers may be used, and if one is not limited as to the first cost of the plant, slightly higher efficiency may be obtained by using specially designed internally fired boilers. There is an erroneous impression that there is nothing gained by using a triple-expansion engine with steam pressures of less than 160 pounds. Our experience has shown that with steam at any pressure above 80 pounds the triple-expansion engine will show an economy from 10 to 15 per cent. better than a compound engine of the same general construction, using steam at the same pressure, and 75 per cent. of the triple-expansion engines we have built are operated with steam pressures of 125 pounds or less, the lowest being 80 pounds."

The concluding portion of the paper relating to duty is so interesting to all users of pumping machinery that it is reproduced almost entire.

"While the coal duty in every-day service is the true test of efficiency of a pumping plant (and also of the efficiency of its management), so many of the elements which go to make up this efficiency are entirely beyond control of the engine builder that it is hardly fair to make official duty trials on a coal basis, particularly as coal tests of less than 24 hours' duration are practically valueless. Few engine builders are makers of boilers, and, if they are, the questions of quality of coal, efficiency of firemen, draft, chimney, etc., so affect results as to render coal guaranties largely guesswork. On the other hand, engine design has gotten to be a reasonably exact science, and builders can estimate the steam economy of any type of engine very closely. Therefore, it seems proper to make official duty trials on the basis of steam consumed by the engines, or on the heat unit basis recommended by the American Society of Mechanical Engineers. The work done should, in the case of outside-packed plunger pumps, be figured on the basis of plunger displacement, after making proper tests for leakage of valves, for the reason that with packed plungers the pump itself is a more accurate meter than a weir or Venturi meter.

"The contention is frequently made that high-duty engines fall very much below their test records on every-day service, and in the majority of cases it is to be expected that the average duty should be somewhat less than that shown on a test, owing to the difficulty of watching all small matters on a continuous run, which are looked after very sharply on a short test. But the greater part of the falling off in duty under every-day conditions is due to the fact that the engines are not run under contract conditions, either as to speed of the engine, or steam and water pressures. The first is of much less importance than the last, for our experience has shown that a high-duty engine running at one-half its rated capacity will give within 10 per cent. of as high economy as it will running at full capacity, providing steam and water pressures are kept the same. It is a very common practice, however, when purchasing a pumping engine, to specify the maximum requirements as to water pressure, and the duty test is made under these conditions, while in regular service the water pressure may be 10 to 25 per cent. less than that originally specified. This means that in regular operation steam is carried at a considerably lower pressure, and the engine is throughout very much underloaded, and therefore necessarily uneconomical.

"A properly designed pumping engine will work with water pressures from 10 to 25 per cent. higher than the nominal pressures without appreciably falling off in economy, but if the water pressures are from 10 to 25 per cent. less than the engine was designed for, the falling off in economy becomes very marked. It will, therefore, be seen that it is very important that specifications for pumping engines should call for duty tests to be made under ordinary working pressures, the engine being guaranteed to work properly under maximum conditions. It is also desirable that the engine should be built as nearly as possible of the capacity required for ordinary work, for while not as important as the matter of water pressures, still, if the best results are to be obtained, it is desirable to have the engine run at approximately its rated speed. Of course, on direct-service work the speed of the engine must necessarily be subject to considerable variation between the hours of maximum and minimum consumption.

"The efficiency of a boiler plant is very frequently not maintained to its full standard. More boilers are often operated than are actually required, thus burning less coal per square foot of grate than is economical, and there are numberless opportunities about the plant for wastes, which, while individually small, in the aggregate reach a very appreciable item.

"In a general way, therefore, the falling off in economy under ordinary running conditions is due, not to faulty construction of the machinery, but the fact that it is operated under different conditions from those named in the specifications, the requirements of which it was designed to meet. Therefore, the matter rests more in the hands of the purchasers of the machinery than in those of the builders.

"What a modern high-duty engine will do under regular running conditions is well shown by the record of an 18,000,000-gallon triple-expansion engine in the Milwaukee water-works. This engine has been in service a little over seven years, averaging over 23 hours per day at full speed. It pumps about 70 per cent. of all the water used by the city, the remaining 30 per cent. being pumped by compound engines, the newest of which is 17 years old. The duty of the station on all coal burned for all purposes, without deductions or allowances of any kind, in 1891, was about 80 millions, all of the water being pumped by compound engines. The first year that the triple ran (pumping only 63 per cent. of the water), the duty rose to 99 millions, and has since steadily risen until 1897, when it was 109,172,618 foot-pounds per 100 pounds of coal burned, the coal being Youghiogheny slack, costing $1.78 a ton delivered at the station, and carrying 14 per cent. ash. While this engine ordinarily takes steam from the same boilers which supply the compound engines, it recently became possible to separate it for a period of five weeks, and during that time the engine averaged 23.72 hours per day, running at full speed, and gave a duty of above 122,000,000 foot-pounds per 100 pounds of coal. The cost of coal to raise 1,000,000 gallons 157.43 feet was 95½ cents, the coal per indicated horse-power per hour being under 1½ pounds. When it is considered that this record is made by an engine which has been in continuous operation seven years, without having the cylinders heads removed, or even the steam valves removed for examination, the result is certainly very good.

"Under test conditions compound engines with steam from 100 to 125 pounds, 110 to 115 million duty per thousand pounds of steam is all that can be expected, although in a few cases where very high steam has been carried, or other conditions are particularly favorable,

this duty has been very considerably exceeded, noticeably in the case of Mr. Leavitt's engine at Louisville, and the four Allis compound engines at Pittsburg.

"For triple-expansion engines, with steam at from 90 to 110 pounds, duties of 120 to 130 millions may be easily obtained, while with steam pressures at from 125 to 150 pounds, a triple-expansion engine will easily run up to 140 to 150 millions, and very probably with steam pressures at from 175 to 200 pounds, under favorable conditions, the triple will give 160 millions duty per thousand pounds of water.

"Just what the future will show in the direction of duty it is difficult to predict. The quadruple-expansion engine, using high pressure steam, would undoubtedly effect some increase in economy, but on account of the satisfactory mechanical construction of the present triple-expansion engine, I consider the immediate adoption of the quadruple as doubtful, until our steam pressures exceed 200 pounds.

"Our present ideal is to produce a horse-power on 10 pounds of steam, and if our boiler designers will give us an actual evaporation of 10 pounds of water per pound of coal, we shall have a horse-power with one pound of coal, or approximately 180 millions duty on coal. But the case is something like the race for speed in steamship practice, and we have approached a very steep part of the ascending curve of efficiency, so that the last fraction of duty comes very hard."

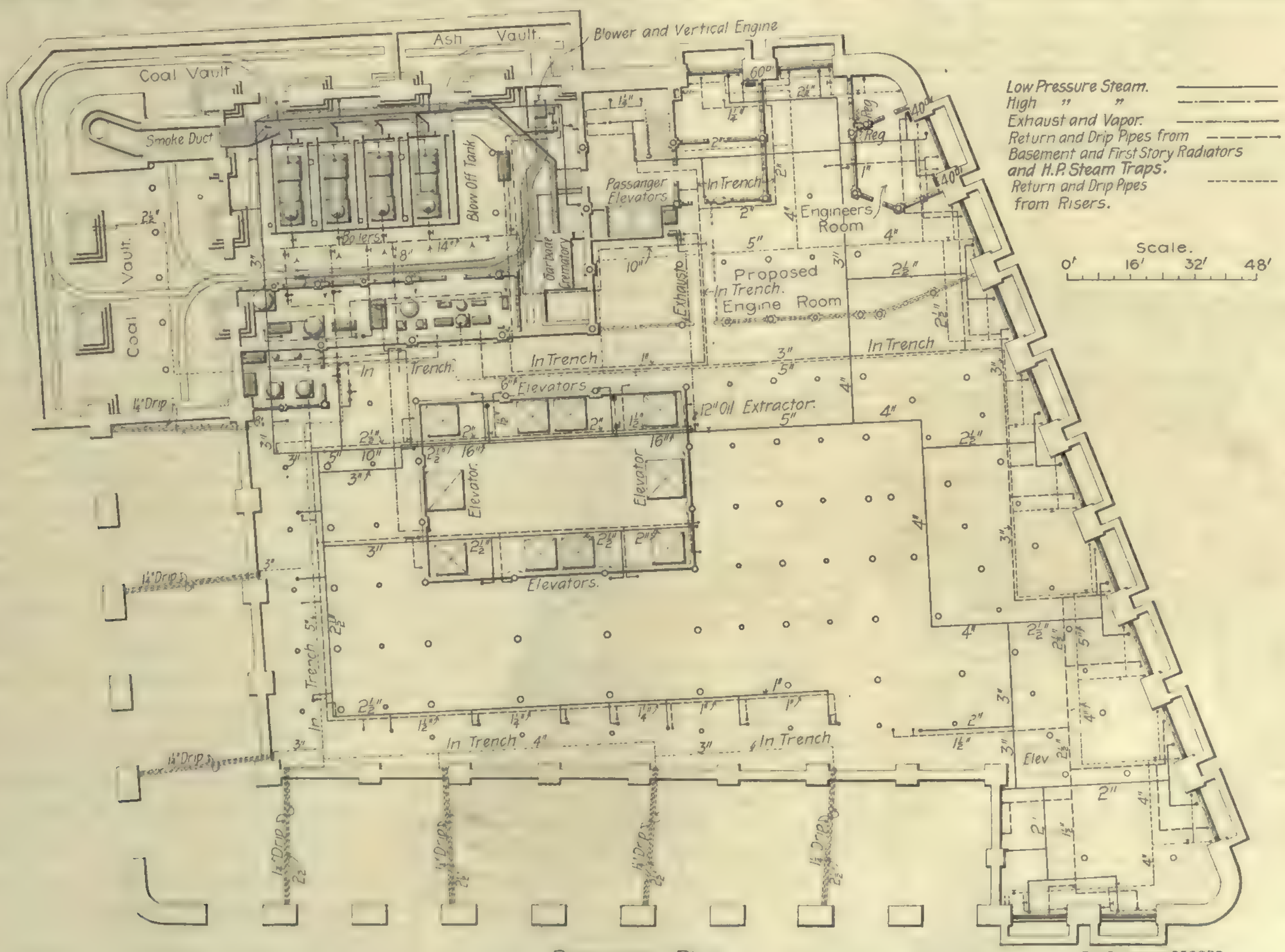
HEATING OF THE U. S. APPRAISERS' WAREHOUSE.

The large new U. S. Appraisers' Warehouse in New York City, which was described in detail on September 17, 1898, is warmed by direct radiation, presenting in its heating plant various features, which, especially as applied to so large a building, are quite interesting. The Webster system of vacuum return is used, with the overhead system of distribution, and, in the latter respect, the building is one of the first so equipped in New York City. A low-pressure steam main rises in the center of the building to the ceiling of the top floor, where a system of horizontal mains leads to pipes which drop at the outside walls of the building to the basement ceiling. Horizontal flow connections are made at every floor from these risers to individual radiators, from which correspondingly short connections lead to return pipes descending parallel to the flow risers.

The purpose of the warehouse is to provide storage for imports to the United States, and a place where they may be appraised by the customs officials. The building is ten stories high and occupies the whole block bounded by Christopher, Washington, Greenwich and Barrow Streets. It was erected under the direction of Mr. James Knox Taylor, supervising architect, Washington, D. C.; the heating and power plant was designed by Mr. Henry Adams, heating and ventilating engineer of the supervising architect's office, and installed by Messrs. George A. Suter & Company, of New York City. The plans of the basement, first floor, and the top floor are shown in the accompanying cuts. The entrance to the building is on Washington Street, and opens on a short stairway leading to two passenger elevators. Merchandise brought to the warehouse for inspection, appraisal and storage, is loaded and unloaded under cover from wagons, which back up level with the first floor along Barrow and Greenwich Streets. It is then carried to the various departments by ten freight elevators, located in a large shaft which rises from the center of the basement to the roof. No two of the upper floors are exactly alike in arrangement, each one being planned for a particular purpose. All office rooms and the smaller enclosures, however, are located along the exterior walls, thus leaving the rest of the floor unobstructed except for columns. This is shown in the plan of the laboratories of the warehouse, located on the tenth floor.

The boiler plant, which is shown in the basement plan, consists of four Babcock & Wilcox water-tube boilers, generating steam at about 100 pounds pressure. The steam is carried from the boilers through heavy 8-inch copper bends to the top of a 14-inch drum, to which the different supply pipes are connected as shown in the figure. Two are used to supplement the exhaust for heating purposes, and three supply the larger machinery of the plant, the pumps and heater, the elevator machinery and the proposed electric-lighting engines. The pipes for these are 6, 8 and 10 inches in diameter respectively, and the future engine supply is cross-connected by an 8-inch pipe with the supply to the electric machinery. The two heating mains are 6 inches in diameter and lead to separate pressure-reducing valves in which the pressure is reduced to 60 pounds. Eight-inch pipes carry the steam at this pressure, and the two pipes unite to divide later into two 8-inch branches in each of which a reducing valve is connected. These serve to reduce the pressure of the steam to that necessary for the heating system, and two 10-inch pipes uniting in a single 10-inch pipe are connected with the heating main, 16 inches in diameter. It will thus be seen that the reduction of pressure occurs in two stages, and that should one valve fail to work, its mate may be used. The exhaust pipes from the pumps, elevator engines and other steam machinery connect with the heating main, and are all provided where necessary with oil extractors. The heating main connects with two horizontal pipes in the freight elevator well, one leading to a 14-inch exhaust riser, provided with a back-pressure valve for use as an outboard exhaust, and the other to the foot of a 10-inch heating riser. Other smaller connections, as shown in the basement plan, carry the steam along the ceiling of the basement to connections supplying radiators in the basement and on the first floor.

Both of the large risers, the heating pipe and the free exhaust, extend through the large central elevator shaft, the heating main to the ceiling of the tenth floor, and the exhaust to the roof, as indicated on the tenth floor plan. Offsets for expansion are provided at the tenth

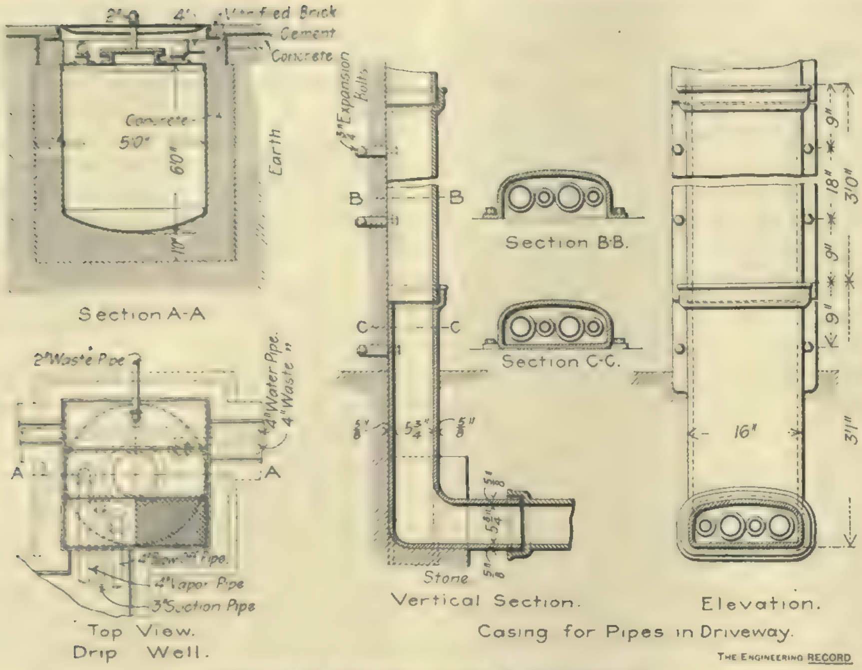


Basement Plan.

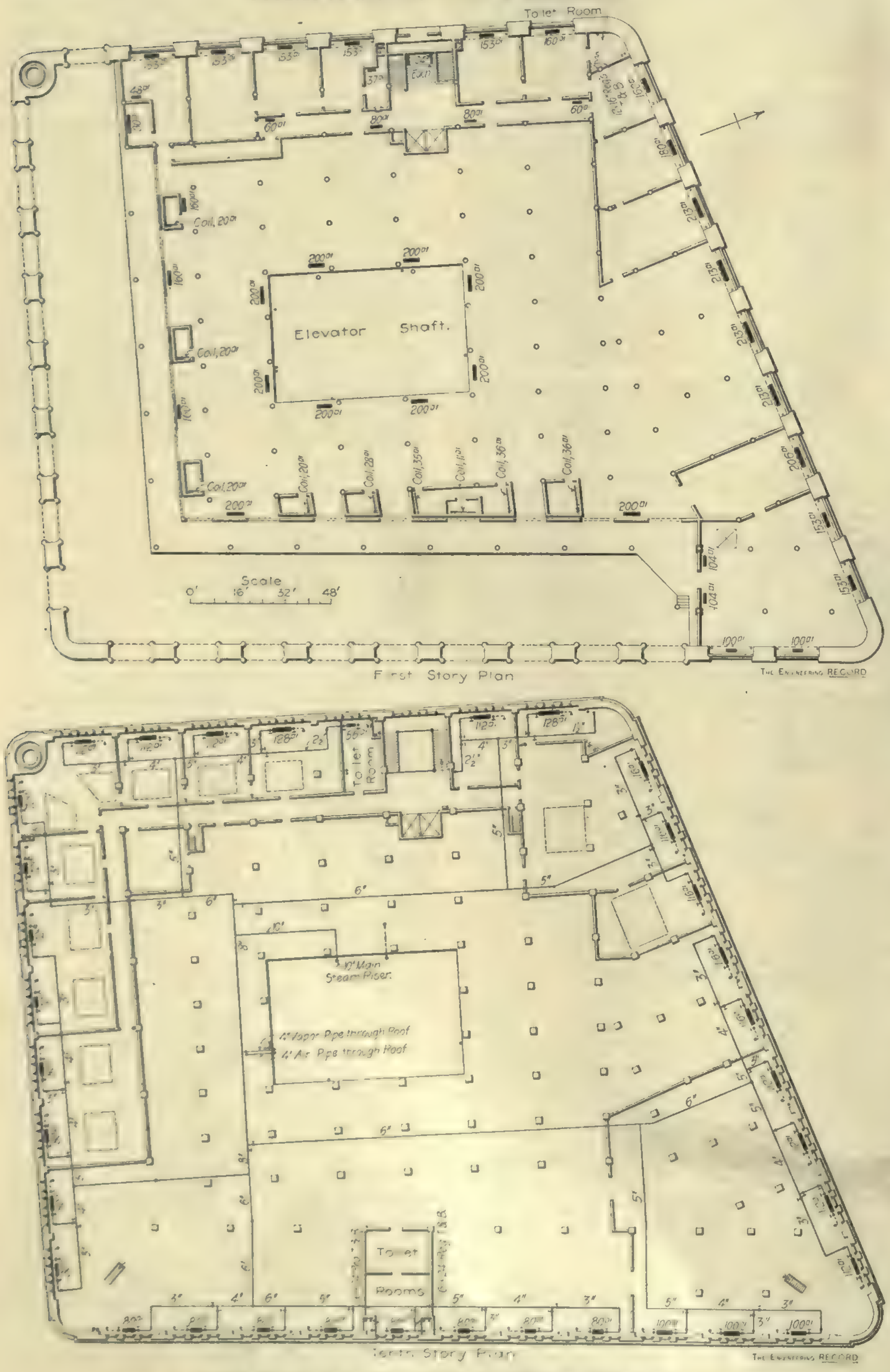
THE ENGINEERING RECORD

HEATING PLANT OF THE U. S. APPRAISERS' WAREHOUSE, NEW YORK.

JAMES KNOX TAYLOR, ARCHITECT; HENRY ADAMS, ENGINEER; G. A. SUTER & CO., CONTRACTORS.



DETAILS OF HEATING PLANT IN WAREHOUSE.



FLOOR PLANS, U. S. APPRAISERS' WAREHOUSE, NEW YORK.

floor, as shown, and the top of the heating riser connects with the network of mains which lead to the steam pipes descending on the outside walls. These supply radiators in the manner already mentioned. The horizontal flow and return connections to the radiators are about four or five feet long, and besides this, allowance is made for the variations in length of the long steam and return pipes by expansion loops about six feet long on the ceiling of the fifth floor.

Air and water of condensation are removed from the system by the suction of a vacuum pump, the Webster system being used. Drips from the risers, as well as the returns from the radiators, are provided with thermostatic valves, which permit the passage of water, but close against steam. The return risers and the drips from the steam risers pass to the basement, where they unite in several systems of return mains, each of which drops at some convenient point to a trench below the basement floor. The water is delivered by the pump into a return tank, from which it is automatically pumped into the boilers.

The only portions of the building with a special provision for a fresh air supply are the boiler and engine rooms in the basement. Air enters directly in a blower room from Washington Street and is forced through a duct suspended near the ceiling and opening into the two rooms, as shown in the basement plan. The blower was made by the B. F. Sturtevant Company, and is five feet in diameter; designed to discharge at a speed of 150 revolutions per minute about 360,000 cubic feet of air per hour, a quantity sufficient to change the air of the rooms once every ten or twelve minutes.

All the toilet rooms of the building are ventilated by flues, which rise to the roof, where they are capped with special covers. Steam risers extend through the flues to furnish the necessary aspirating effect. Two registers, of equal size, at the top and the bottom of each of these rooms, connect with the flues.

One of the interesting details of the heating plant is the provision made for the drips and returns which pass down the outside walls on Barrow and Greenwich Streets, where the driveway is located, and which demand protection, not only to prevent injury from passing vehicles, but to resist climatic conditions. An elevation and section of the cast-iron casings devised for this purpose are shown in an accompanying drawing. At every pier, two return risers and drips are brought together at the level with the first floor ceiling, and drop inside the casing, crossing under the driveway to the basement wall, where they continue in the trenches, as shown in the cut of the basement. The space in the casings around pipes is filled with mineral wool.

The trenches for carrying the pipes below the basement level are constructed of eight-inch brick walls, laid on eight-inch concrete foundations and plastered inside and out with ½-inch of Portland cement. The cover plates are of cast-iron, diagonal channeled on top, and laid flush with the basement floor on border plates. These plates are connected together and anchored by 6 x 6-inch wrought-iron angles, eight inches long and spaced at intervals of about three feet. At the corners, special castings are substituted for the angles.

The construction of the drip well to take care of waste water is shown in the accompanying drawings. The well is formed of concrete one foot thick, and is five feet in diameter, with a concave bottom six feet below the trenches. The pipes from the trenches are connected as shown to a head cemented in place at the top of the well, and in the center of the head is a manhole, 18 inches in diameter. The well and connections are covered with diagonal channeled cover plates, flush with the basement floor, and similar to those used on the trenches.

TRADE PUBLICATIONS.

A neat morocco-bound memorandum book, handy for vest-pocket use, is being distributed to the furnace and boiler trade, on application, by the International Heater Company, Utica.

The Ideal Manufacturing Company, Detroit, Mich., has prepared a preliminary catalogue of 96 well illustrated pages describing its large line of water closets and traps, including the "Ideal" centrifugal trap, which is now made adjustable and adapted to a wide range of fittings.

The Mietz & Weiss gas and kerosene engine is described in a pamphlet, which may be obtained from August Mietz, 128-132 Mott Street, New York. It contains an account of the characteristic features of the engine, lists of sizes and dimensions, views of works in which it is used and testimonials as to its value.

Lead pencils assume at the present time an astonishing variety of forms and grades. At the works of the Joseph Dixon Crucible Company in Jersey City over 700 different styles are produced for artists, schools, architects, draftsmen and the counting room. The company has recently issued a pamphlet called "Pencilings," describing the uses of some of these grades, including colored crayons for artists' use, which are also employed extensively by architects and engineers in laying out work for draftsmen.

The number of firms distributing wall calendars this year is unusually small. The Youngstown Iron & Steel Roofing Company, Youngstown, have a large one, ornamented with a reproduction of Bisson's famous picture entitled "The Bride." Another, almost as large, has been received from the American Laundry Machine Company, Cincinnati. The Gurney Heater Manufacturing Company, Boston, has ornamented its calendar with an engraving of a hot-water heater and furnished it with a particularly legible set of date slips. The Buffalo Pitts Company, Buffalo, has retained its former attractive pattern, measuring 6x8 inches, and a still smaller size, which fits nicely in the back of a roll-top desk, is issued by Tippett & Wood, Phillipsburg, N. J.

SOCIETY AFFAIRS.

The American Society of Civil Engineers held its annual business meeting at the society house January 18. The officers elected were as follows: President, Desmond FitzGerald, Boston; vice-presidents, Robert Cartwright, Rochester, and Robert Moore, St. Louis; treasurer, John Thomson, New York; directors, John A. Bensel, L. W. Buckholz and Samuel Whinery, New York; Edmund K. Turner, Boston; Palmer C. Ricketts, Troy, and James D. Schuyler, Los Angeles. Reports from the various standing committees were read, and the award of the following prizes announced: Normal Medal, to B. F. Thomas for his paper on "Movable Dams;" Rowland Prize, to Henry Goldmark for his paper on the "Power Plant, Pipe Line and Dam of the Pioneer Electric Power Company, Ogden, Utah."

The report of the board of directors shows the society now has a total membership of 2,124, an increase of 44 over the number a year ago, but nowhere near the figure it should be. The announcement that the resources of the library will probably be made available to non-resident members shows that the directors have adopted the plans for increasing the society's usefulness which Secretary Hunt has been working to perfect for some years past. The finances of the organization are in a creditable condition, with a permanent loan of but $85,000 at 4½ per cent., and the new quarters are visited by an increasing number of members, who are apparently just beginning to appreciate its advantages properly.

In accordance with the usual custom, the meeting was supplemented by more entertaining features than the business session provided by the constitution. There were excursions to the East River Bridge, the river front improvements, the Crescent shipyards at Elizabethport, the Brooklyn Navy Yard and the new Croton dam, on January 18, 19 and 20. A reception was held during one of the evenings, and Mr. E. Wegmann delivered an illustrated lecture on the old Roman aqueducts on another. The attendance throughout the sessions was unusually large, and the arrangements for the members' comfort and entertainment reflect much credit on Messrs. Bensel, Freeman and Hunt, the local committee in charge, and Mr. Breuchaud, of Coleman, Breuchaud & Coleman, the contractors for the Croton dam.

Mr. Alfred Stone, Providence, has been elected to fill the position on the board of directors of the American Institute of Architects formerly held by Mr. W. C. Smith, who has gone to Manila. The board has made plans for increasing the membership of the institution and for collecting materials and data of professional interest at the Octagon House, Washington, the permanent headquarters of the institution.

The Western Society of Engineers elected the following officers on January 3: President, Onward Bates; vice-presidents, N. O. Whitney and T. L. Condron; secretary, Nelson L. Litten; treasurer, C. W. Melcher; trustee, August Ziesing. The society now has 452 members and an income of about $20,000.

The Canadian Society of Civil Engineers has elected the following officers: President, W. T. Jennings, Toronto; vice-presidents, R. W. St. George, Montreal; K. W. Blackwell, Montreal; E. H. Keating, Toronto; treasurer, H. Irwin, Montreal; secretary, C. H. MacLeod, Montreal; librarian, W. MacNab, Montreal; council, G. H. Duggan, John Kennedy, Thomas Monro, H. N. Ruttan, C. H. Rust, G. A. Mountain, D. MacPherson, C. E. W. Dodwell, St. George Boswell, W. B. Boswell, E. Marceau, Willis Chipman, J. Galbraith, Stewart Howard, and E. A. Wilmot.

PERSONAL AND OBITUARY NOTES.

Dr. Coleman Sellers announces the removal of his offices to 1301 Stephen Girard Building, Philadelphia.

Mr. George Bowers was unanimously re-elected city engineer of Lowell, Mass., at a recent meeting of the board of aldermen.

Mr. George A. Wetherbee has been appointed city engineer of Malden, Mass., and Mr. Frank H. Carlisle, street commissioner.

Mr. Charles R. Felton has been elected city engineer of Brockton, Mass., a position recently held by Mr. Benjamin R. Chapman.

Mr. H. H. Farnum, M. Am. Soc. C. E., has been appointed chief engineer of sewers of the Borough of the Bronx, New York City.

Messrs. Charles G. Darrach and J. W. Ledoux of Philadelphia have been testing the capacity of the artesian well system of Camden, N. J.

Mr. John H. Enright has been appointed city engineer of North Adams, Mass., an office he held previous to his recent term as commissioner of public works.

Mr. H. A. Cook has been re-elected water-works superintendent of Salem, Mass.; Mr. Philip Holmes, city electrician, and Mr. D. N. Cook, street commissioner.

Mr. F. Sodemann, for several years assistant engineer of the Jackson Architectural Iron Works, has resigned to open an office as consulting engineer at 160 Fifth Avenue, New York.

Mr. John P. Prichard has been re-elected superintendent of streets of Somerville, Mass. He will be remembered by many readers of this journal as the author of one of its prize essays on road construction.

Mr. F. H. Mills has been re-elected city engineer of Woonsocket, R. I.; Mr. George Batchelor, commissioner of highways; Mr. Alphonse Gaulin, water commissioner, and Mr. F. E. Holden, sewer commissioner.

Mr. Sylvester Baxter has been appointed park commissioner of Malden, Mass., an office he has held for some time, and Mr. Clarence A. Perkins has been elected water commissioner of the same city for a term of three years.

Mr. Lewis E. Fischer has been appointed city engineer of Paris, Ill., which is about to construct a sewerage system. He was graduated from the University of Illinois and has been assistant city engineer of Kewanee for some time.

Mr. George W. Harrison has been elected president of the Atlanta Water Board, succeeding Judge George Hillyer, who remains a commissioner, however. The two new members of the board are Messrs. L. Bloodworth and N. McCullough, the former being vice-president.

Mr. W. B. Upton has resigned as principal assistant engineer of the Capital Traction Company, Washington, and resumed office practice at the Washington Loan & Trust Building in that city, making a specialty of open conduit electric railway system, power stations and building engineering.

Mr. Francis L. Hills, who has been appointed a government engineer in Porto Rico, was graduated from the West Point Military Academy in 1866, and served for four years in the artillery. After his resignation he practiced as a civil engineer at Wilmington, Del., and has lately been chief engineer of the Wilmington & Northern Railroad.

Mr. F. Herbert Snow, Assoc. M. Am. Soc. C. E., has been re-elected sewer commissioner of Brockton, Mass., for three years. Mr. Snow was the designer of the well-known sewage disposal system of this place, and it is fortunate that the city has been able to retain his services as a commissioner to supervise its operation in a general way.

Mr. Charles H. Hudson has resigned the office of chief engineer of the Southern Railway Company, which he has held about four years. Soon after he was graduated from the Lawrence Scientific School at Harvard University he began his career as a railway and bridge engineer and manager, and was general manager of the East Tennessee, Virginia & Georgia system at the time he accepted the office he has just resigned.

Mr. James Duane, son of the late Gen. James C. Duane, died in New York on January 12. After he was graduated from the Rensselaer Polytechnic Institute he was engaged for a number of years in Government service, with the lighthouse bureau and on dredging work in the Gulf of Mexico. For 23 years he was connected with the water-works of New York and was recognized as an authority in matters relating to water mains.

Lieut.-Col. Edward Burr, Second Volunteer Engineers, has been ordered to relieve Major Thomas H. Hanbury at St. Louis, who takes the place of Lieut.-Col. Milton B. Adams at Detroit. Colonel Adams is transferred to Nashville to relieve Major Daniel C. Kingman of the duties transferred to him by Lieut.-Col. John Biddle. Lieut.-Col. Harry F. Hodges, First Volunteer Engineers, has been assigned to the inspection of fortifications in Porto Rico.

Mr. John Caulfield has been re-elected secretary of the St. Paul water board, and the local papers are congratulating the city that it will not lose his services. When the works were owned by a private corporation he was their secretary, and when they were purchased by the city in 1882 he was asked to retain his office. He has seen the plant develop from next to nothing into an investment of nearly $4,000,000, its business all passed through his hands for years, and the city is certainly the gainer by retaining his services for a longer period.

CONTRACTING NEWS

OF SPECIAL INTEREST TO

CONTRACTORS, BUILDERS, ENGINEERS, AND MANUFACTURERS

OF ENGINEERING AND BUILDING SUPPLIES.

For Proposals see page ix.

WATER.

Baltimore, Md.—It is stated that bids are wanted Jan. 30 by the Tuxedo & Embla Parks Water & Light Co. for water-works. D. G. Adelsberger, Engr.

Oto, Ia.—It is stated that bids are wanted March 1 for water-works. B. F. Colby, Engr., Onawa, Ia.

Duncansville, Pa.—An election will be held Feb. 23 to vote on the question of securing a water supply. The Council has voted to employ an engineer to select the most available supply.

Braddock, Pa.—The Pennsylvania Water Co. has asked permission to lay pipes in the Fourth Ward.

Long Island City, N. Y.—Local reports state that the Montauk Water Co. has filed plans for the erection of a steel water tower on Borden Ave., at a cost of $11,500.

Lockport, N. Y.—F. P. Van Denbergh, President of the Crystal Springs Water Co. of Buffalo, has made a proposition to the Common Council offering to furnish a supply of pure water.

Branchville, N. J.—It is stated that Lewis Van Duyne of Boonton, N. J., has completed surveys for the proposed water system.

Lasalle, Ill.—It is stated that the Superintendent of Water-Works recommends the extension of mains.

Fayetteville, Tenn.—Walter G. Kirkpatrick, Jackson, Miss., is preparing plans for a system of water-works, the supply to be from Mountain springs, with gravity flow to masonry distributing reservoir. Cast-iron mains will be used.

Brewton, Ala.—It is stated that $15,000 water and light bonds will be sold Jan. 16.

St. Johns, Mich.—The Council has under consideration the extension of water mains. C. C. Vaughn, Clk. of Bd.

Chattanooga, Tenn.—The City Council on Jan. 10 adopted the report of the special committee recommending that the city secure authority from the Legislature to hold a special election to decide whether or not $650,000 bonds be issued for the purpose of either buying or building municipal water-works.

Pawtucket, R. I.—L. G. Ladd, Commr. of Pub. Wks., writes that the $12,000 appropriation recently made for 1899 will be used for supplies and maintenance for the Water Department, but that no supplies will be required at present.

Tullylake Park, Pa.—It is stated that a water plant is to be built to supply the hotel, cottages and grounds. F. J. West, Vice-President of the Tullylake Park Association.

Springboro, Pa.—It is stated that a vote will be taken on the proposition to build a water system, at a cost of $8,000.

Wilmington, Del.—It is stated that the Water Commissioners propose to build a new water tower near Mt. Salem Church; cost, $10,000.

Laurel, Md.—It is stated that D. G. Adelsberger, C. E., of Baltimore, has prepared plans and estimates for a water-works system, to cost $30,000.

Waverly, Ia.—It is stated that the question of an additional water supply is being considered.

Worcester, Mass.—Local reports state that the question of reconstructing the dam at the Paxton reservoir is under consideration. Estimated cost, about $60,000.

Barnesville, O.—The Board of Improvement has reported to the Council recommending the construction of a municipal water-works plant. Engineers will probably be asked, at once, to estimate the cost of construction.

Pittsburg, Pa.—The Common Council has passed the ordinance awarding to The T. A. Gillespie Co., Pittsburg, Pa., the contract for a 48-in. riveted steel force main to the reservoir in Highland Park, for $74,940.

Evergreen, Ala.—The citizens have under consideration the construction of water-works and an electric light plant.

Sacramento, Cal.—Mayor William Land, in his annual message, recommends that a 10,000,000-gal. pump replace the old Stevens pump.

Boston, Mass.—Bids are wanted Jan. 25 for 5,500 tons of cast-iron water pipes, as advertised in "The Engineering Record."

Superior, Wis.—According to local press reports, President Merriam of the Water, Light and Power Co., states that plans are now being prepared for the new filtration system to be built in the spring.

Bemidji, Minn.—It is stated that water-works bonds to the amount of $7,000 have been sold.

Norfolk, Va.—It is stated that E. Tatterson of Suffolk has secured the contract for a filter house for the city water plant for $23,000.

Allison, Ia.—H. C. Parsons, City Clk., writes that it was voted on Jan. 9 to build water-works.

Traverse City, Mich.—Mayor W. W. Smith writes that the committee appointed to investigate and report on the question of purchasing or constructing water-works has not yet come to any conclusion. Bids will probably be asked next summer for a plant to cost about $100,000. H. F. Northrup, City Engr.

Oswego, N. Y.—Reports state that improvements are to be made at the city water-works in the spring. Estimates prepared call for 2,500 ft. of pipe with special castings.

Kankakee, Ill.—The Kankakee water-works have been sold, and it is stated that improvements are to be made at once.

Mayville, N. D.—It is stated that a public vote has authorized the Council to take preliminary steps for the construction of a water-works and electric light plant. Cost, $16,000 to $20,000.

Winnipeg, Man.—Water-works bonds to the amount of $650,000 have been purchased by R. Wilson-Smith, of Montreal.

Berea, O.—Mayor T. J. Quayle has been empowered to appoint a Board of Water-Works Commissioners to have charge of the water-works construction.

Schenectady, N. Y.—The City Attorney has been directed to prepare a bill authorizing the city to issue bonds to the amount of $30,000 to provide for extending the water and sewer mains.

Richmond, Va.—The Committee on Water has ordered new mains to be laid in Seventh St.

Brooklyn, N. Y.—The Board of Estimate and Apportionment has authorized the issue of $250,000 bonds for new water mains in Brooklyn.

Nashville, Tenn.—An ordinance is before the Council providing for the submission to the people of the question of issuing $150,000 bonds for extending the water plant.

Roanoke, Va.—The Mayor's message contains a recommendation that a committee be appointed to look into the advisability of municipal acquisition of water and light plant.

Evanston, Ill.—Mayor William A. D. Dyche in his annual message states that during the present year it will be necessary to purchase a battery of boilers at a probable cost of $4,500. The Mayor also recommends the construction of a new intake pipe, which will probably cost $100,000.

West Union, W. Va.—Local reports state that the following bids were received for a system of water-works: Wm. B. Oshorn, Clarksburg, $6,272.75; Joseph A. Fuccy, Weston, $6,276; G. R. Miner, Salem, $7,450. Bonds to the amount of $6,000 have been sold.

Britton, S. D.—It is stated that a company has been formed to sink an artesian well and establish a water-works system.

Kansas City, Mo.—The Board of Public Works has authorized the construction of a 16-in. water main on 17th St., to cost $9,200.

Farmington, Me.—It is stated that the village corporation will petition the present Legislature for a charter to own and operate municipal water-works.

De Land, Fla.—The City Council has under consideration the extension of the water-works.

Vailsburg, N. J.—Local reports state that contracts for furnishing material for water-works plant have been awarded as follows: To M. J. Drummond & Co., New York City, for pipes and specials, and to the Rensselaer Valve Co., Troy, N. Y., for hydrants and valves. Total estimated cost of work, $13,000.

SEWERAGE AND SEWAGE DISPOSAL.

Elkhart, Ind.—Bids are wanted Jan. 26 for a sewer in Middlebury St. Kit McKean, City Clk.

Cumberland, Md.—Bids are wanted Jan. 23 for sewers in South Cumberland. H. T. Mullin, Chmn. Street and Alley Com.

Toledo, O.—Bids are wanted Jan. 30 for cylindrical pipe sewers. Lem P. Harris, City Clk.

Aiken, S. C.—Sewer bonds to the amount of $25,000 have been sold.

Anamosa, Ia.—According to press reports Engineer M. Tschirgi, Jr., of Dubuque, Ia., has been engaged to prepare plans and specifications for a sewer system.

Baltimore, Md.—An appropriation of $2,000 has been made for a sewer in Burgundy Alley.

York, Pa.—The West End Sewer Co. has been incorporated, with a capital of $5,000.

East Cleveland, O.—The following bids for a section of the sewerage system were opened Jan. 14 by H. B. Chapman, Village Clk.: Ford P. Beers, Cleveland, O., $10,524.47; R. H. Gray, Cleveland, O., $10,531.47.

Independence, Mo.—Local reports state that $15,000 worth of the $75,000 sewerage bonds have been sold.

Dayton, O.—The report of the Sewer Committee, recommending the construction of a sanitary sewer on Grafton Ave., has been adopted by the Board of City Affairs.

Mattoon, Ill.—A. C. Loomis, City Engr., writes that it is proposed to build about 1½ miles of relief sewer, to cost about $3,000.

Lead, S. Dak.—A resolution has been passed for the construction of a sewer.

Brooklyn, N.Y.—The Local Board of the 7th District has recommended to the Board of Public Improvements, N. Y. City, the construction of Huron St. sewer. Total cost, $175,000.

Schenectady, N. Y.—See "Water."

Dalles, Ore.—It is stated that a committee has been appointed to report necessary steps for improving the sewer system.

Ridley Park, Pa.—Frank D. Kane, Clk. of the Council, writes that C. H. Ladomus, C. E., of Chester, Pa., is the engineer in charge of sewer extension. Estimated cost, $5,000.

Rochester, N. Y.—An ordinance has been passed providing for the construction of a sewer in East Ave. Estimated cost, $35,000.

Salem, O.—It is stated that bids are wanted Jan. 23 for sewers and street work. Geo. Holmes, City Clk.

Ottawa, Ont.—It is stated that bids are wanted Feb. 6 for 1,916 ft. of 6 ft., 6,016 ft. of 5 ft., 2,980 ft. of 4 ft. brick sewers, and 1,322 ft. of 2x3 ft. egg shaped sewer. John Galt, City Engr.

Little Falls, N. Y.—It is stated that bids are wanted Jan. 27 by the City Clerk for pipe sewers in the south side.

East Grand Forks, Minn.—Bids are wanted Feb. 7 for a sewer. Henry Harm, City Recorder.

Albany, N. Y.—Street Commissioner Woolverton recommends that old sewers in several streets be replaced by new sewers.

Lawrence, Mass.—The Aldermen on Jan. 9 voted to employ an expert to supervise the further construction of the Shanty pond sewer.

Hartford, Conn.—Bids are wanted Feb. 1 for constructing 3,600 ft. of tile sewer and 1,500 ft. of brick and tile sewers, as advertised in "The Engineering Record."

Boston, Mass.—The City Council has under consideration the loan order of $1,000,000 for sewers, which has been passed by the Board of Estimate and Apportionment.

San Francisco, Cal.—The Board of Supervisors has passed resolutions to construct a 16-in. pipe sewer in Waller St. and a 2 ft. 6 in. x 3 ft. 9 in. brick sewer in 8th Ave.

Cleveland, O.—The Council has passed a resolution declaring the necessity for a sewerage and drainage system for Drake Ave.

Norwood, O.—The Sewage Committee has instructed the engineer to prepare plans and estimates for sewers in certain streets.

Winton, Pa.—The Jessup Sewage-Drainage Co. has been incorporated, with a capital of $9,000.

Greensburg, Ind.—It is stated that the matter of constructing a sewerage system is under consideration.

Kearney, N. J.—An ordinance has been passed to provide for the construction of lateral pipe sewers in the southwesterly section of the township. James F. Kelly, Township Clk.

Buffalo, N. Y.—The following bids for 12,420 ft. of 10-in. to 5 ft. 4 in. pipe and brick sewers and 46 manholes were opened Jan. 11 by R. G. Parsons, Secy. Bd. of Public Wks.: Geo. Moore, $32,494; L. Ritzmann, $29,363; Ritzmann & Miller, $28,607; G. & T. Dark, $28,350; J. Mumm, $27,000; C. Smith, $28,900; Brown & Stobell, $29,878; John Harrer, $26,450; Wm. Franklin, Jr., $29,900; P. McNaughton, $30,900; A. Beaser, $26,700; W. G. Smith, $30,500. Bidders all of Buffalo.

St. Louis, Mo.—The following bids were opened Jan. 16 for building sewers in Branch St., Sewer Dist. No. 36: Patrick McIntyre, $1,289.50; Harry F. Heman, *$1,279.15; Robt. Wycoff, $1,452.90; McMahon & Cooney, $1,348.50; Fruin-Bambrick Construction Co., $1,318.22; Heman Con. Co., $1,462; G. Eyerman, Jr., $1,416; Skrainka Construction Co., $1,537.90. Bidders all of St. Louis.

*Contract awarded.

Rochester, N. Y.—It is stated that the following bids were opened Jan. 10 for sewers: a, Jay St.; b, North St. Paul St.: Brayer & Albraugh, a, *$5,901.05. Chambers & Casey, a, $6,147.20, b, $4,624. William H. Jones & Co., a, $6,222.25; b, $5,211. H. N. Cowles, a, $6,472; b, *$3,903. Thomas Holahan, a, $6,813.75. F. A. Brotsch, a, $7,015; b, $5,099. Laurer & Hagaman, b, $4,249.66. James Kearns, b, $5,428.70.
*Contract awarded.

Foxboro, Mass.—Louis W. Hodges, Town Clk., writes: "A bill has passed the Legislature to allow the town to construct a sewerage system and the town has accepted the act, but no action has been taken toward the construction of the plant, and we do not anticipate any action the present year."

BRIDGES.

Cleveland, O.—Bids are wanted Feb. 4 for constructing the steel and iron superstructure of Center St. bridge over Cuyahoga River. Geo. R. Warden, Dir. Pub. Wks.

Nebraska City, Neb.—Bids are wanted Feb. 9 for constructing bridges for 1899. H. R. Christy, Co. Clk.

Shreveport, La.—Bids are wanted March 2 for a bridge in Ward 1 over Cow Hide Bayou. P. Youree, Pres. of Jury.

Buffalo, N. Y.—Bids are wanted Jan. 26 for constructing the necessary bridges, paving approaches, dredging, etc., of Buffalo River between Hamburg St. and the east city line; and of Cazenovia Creek between its junction with the Buffalo River and Cazenovia St. R. G. Parsons, Secy. Bd. Pub. Wks.

Coraopolis, Pa.—A charter has been granted to the Coraopolis & Swickley Bridge Co., to build an iron bridge over the Ohio River. Capital, $200,000. A. P. Kirkland, Pres.; S. L. Brock, Secy., W. T. Wallace, Treas., all of Pittsburg.

Hamilton, O.—The Toledo Bridge Co., Toledo, O., is stated to have received the contract for repairing the High and Main St. bridge, at $4,500. $4,500.

Rockford, Tenn.—It is reported that the construction of a steel bridge over Little River is contemplated.

Buffalo, N. Y.—The City Council has passed a resolution authorizing the Engineering Bureau to include in its estimates for 1899 $7,000, for a bridge over Scajaquada Creek, at Cambridge Ave.

Cleveland, O.—It is stated that George W. Kittridge, Ch. Engr. of the Cleveland, Cincinnati, Chicago & St. Louis Ry., has submitted plans for an iron bridge over the tracks of the railroad at the junction of Ridge Ave., Chestnut Ridge Road and Denison Ave.

Reading, Pa.—It is stated that the City Engineer has prepared estimates for constructing a bridge at Spring St.

Albany, Mo.—Press reports state that a bridge is to be built across Grand River, at Greenwell Ford.

McMinnville, Tenn.—The County Court has authorized the construction of two bridges over Collins River. Bridge Committee, J. C. Biles, Frank Rust and Frank Hill.

Detroit, Mich.—Press reports state that the Michigan Central, Wabash, Grand Trunk and Canadian Pacific Railroads have agreed to build a bridge across the Detroit River, to cost $3,000,000.

Saginaw, Mich.—The City Engineer has been ordered to prepare plans and specifications for a bridge at Genesee Ave.

Chamberlain, S. D.—A bill has passed the Senate, authorizing the construction of a bridge across the Missouri River.

Arcadia, Wis.—The Clinton Bridge & Iron Wks., Clinton, Ia., is stated to have received the contract for a steel bridge across Trempealeau River, for $3,000.

Templeton, Ind.—The bridge across Pine Creek is stated to be unsafe; the Commissioners are contemplating the construction of a new bridge.

South Omaha, Neb.—Plans have been prepared for both an overhead structure across the tracks of the Union Pacific R.R. at N St., and an underground passage.

Norfolk, Va.—See "Railroads."

Chicago, Ill.—Bids are wanted March 15 for one railroad bridge and two highway bridges, to cross the Desplaines River in Joliet, as advertised in "The Engineering Record."

New York, N. Y.—Mayor Van Wyck on Jan. 17 signed the ordinance approving the appropriation of $100,000 for preliminary work on the two proposed East River bridges.

Frumet, Mo.—It is stated that bids are wanted Feb. 6 by the County Commissioners for a steel bridge with a 200-ft. span.

Rensselaer, N. Y.—Robert H. Strong, Albany, N. Y., is stated to have received the contract for improving Washington St. for $5,088.51, work to include the construction of an iron bridge across Wilbur's Creek.

Hinton, W. Va.—The New River Bridge Co. has been granted a charter to construct a bridge across the New River. Capital, $50,000. Incorporators: James L. McCreery, James H. Miller, A. R. Heflin and others.

Ogden, Utah.—C. R. Hollingsworth, County Auditor, writes all bids for the construction of a bridge over Weber River have been rejected. New bids will be received Feb. 2.

Evansville, Ind.—It is stated that bids are wanted Jan. 28 by the County Commissioners for constructing an abutment of the bridge over Little Pigeon Creek.

Rockland, Mich.—Bids are wanted Jan. 23 for a steel bridge across the Ontonagon River and removal of the present structure. M. McKay, Township Clk.

Chatham, Ont.—It is stated that bids are wanted Jan. 24 for a steel truss bridge, with a 220-ft. span, over the Thames River. J. C. Fleming, Co. Clk.

Providence, R. I.—Plans for the New York, New Haven & Hartford R.R. bridge over the Sakonnet River, for which the State of Rhode Island appropriated $20,000, have been approved at Washington.

Iowa City, Ia.—A petition has been presented to the Board of Supervisors for a bridge across the Iowa at Holland's ferry.

Kansas City, Mo.—The plans prepared by City Engineer Wise, for the proposed steel bridge over Belt Line tracks at Kansas Ave., have been approved by the Board of Public Works. Estimated cost, $4,000.

Kankakee, Ill.—It is stated that the City Council is considering the rebuilding of Washington Ave. bridge at an estimated cost of $4,000. The City Engineer has submitted plans for a steel and cement bridge.

Wilmington, Del.—Local press reports state that the Baltimore & Ohio R.R. has under consideration the construction of a bridge across its tracks at West 4th St.

Grand Haven, Mich.—It is stated that the proposition to spend $25,000 in building three bridges over the Grand River will be submitted to the people by the Board of Supervisors.

Henderson, Minn.—Bids are wanted Jan. 25 for rebuilding approaches to the Minnesota River bridge. Camille Bisson, City Clk.

Lorain, O.—L. A. Farrow, City Engr., writes that the County Commissioners have voted to accept the bid of the King Bridge Co., of Cleveland, for a swing bridge at the mouth of Black River, for $145,000. At a meeting of the City Council, held Jan. 16, a resolution was passed condemning the action of the Commissioners in disregarding the wishes of the people of Lorain in the matter of building a bob-tail swing bridge, and the City Solicitor was instructed to enjoin the Commissioners.

Boston, Mass.—The following bids for building abutments, 150 ft. wide at base and 79 ft. at top, for bridge on Boston St., over the N. Y., N. H. & H. R.R., were opened Jan. 16 by William Jackson, City Engr.: Holbrook, Cabot & Daly, *$17,450; Collin & Ham, $18,429; Ross & Fowler, $23,600; Thomas A. Rowe, $20,642; D. F. O'Connell, $20,800; Norcross Bros., $24,400; Cyrus Barton, Lowell, $22,000; W. H. Keyes & Co., $19,893; W. L. Miller, $20,445; George M. Bacon, $29,700; J. J. McCarty & Co., $20,600; Coleman Bros., $22,000; Nawn & Brock, $20,773; Daniel O'Connell, Jr., & Co., $21,500; Bell & Co., $22,252. Address of bidders Boston unless otherwise stated.
*Contract awarded.

PAVING AND ROADMAKING.

Fayetteville, Ark.—Bids are wanted Feb. 1 for macadamizing about 2,700 ft. on College Ave. J. L. Cravens, Chmn. Improvement Bd.

Lansdowne, Pa.—Bids are wanted Jan. 27 for $15,000 highway improvement bonds. H. L. Warren, Secy. of Council.

Buffalo, N. Y.—See "Bridges."

Buffalo, N. Y.—It is stated that bids are wanted Jan. 24 for paving Ohio St. R. G. Parsons, Secy. Bd. Pub. Wks.

Vevay, Ind.—It is stated that bids are wanted Feb. 6 for paving two roads in Pleasant Township with macadam. Joseph E. Harte, Co. Aud.

Appleton, Wis.—It is stated that bids are wanted Feb. 1 for $50,000 street improvement and building bonds. M. K. Gochnauer, City Clk.

Long Island City, N. Y.—It is stated the contract for building an asphalt bicycle path from the ferry, L. I. City, to Hoffman Boulevard, at Woodside, has been awarded to T. H. Borman, of Long Island City, for $17,706.

St. Louis, Mo.—Bids are wanted Feb. 14 for paving portion of several streets with brick pavement. Robt. E. McMath, Pres. Bd. Pub. Wks.

Louisville, Ky.—Bids are wanted Jan. 23 for paving several alleys with brick. Charles F. Grainger, Chmn. Bd. Pub. Wks.

Eau Claire, Wis.—Local reports state that bids will be received Jan. 30 for brick paving contracts.

Hamilton, Ont.—City Engineer Barrow has asked local manufacturers of engines and road machinery for prices at which they will supply an engine and crusher for the Board of Works.

Allegheny, Pa.—The Committee on Finance has authorized the issuing of $63,628 bonds for the improvement of California Ave.

Portsmouth, O.—Local reports state that Gallia St. will be paved as soon as the $30,000 bonds are sold.

Topeka, Kan.—Resolutions have been adopted to pave Fillmore and Thirteenth Sts.

St. Paul, Minn.—The City Engineer has been directed to prepare plans and estimates for paving Sherburne Ave. with asphalt and macadam.

Rochester, N. Y.—The Common Council has adopted an ordinance to pave Bartlett St. with asphalt, at an estimated cost of $9,700.

Darby, Pa.—The Clerk has been instructed to advertise for bids for macadamizing Pine St.

Camden, N. J.—Mayor Hatch has signed the contract recently awarded by the City Council to Aaron Ward for the paving of Broadway, Federal St. and Kaighn Ave. with sheet asphalt.

Selmer, Tenn.—Local reports state that Selmer and Pittsburg Landing are to be connected by a $20,000 macadamized road.

Crosswicks, N. J.—The Board of Freeholders has been petitioned to construct a macadam road 16 ft. wide from White Horse to Crosswicks.

Ambler, Pa.—A vote will be taken Feb. 21 on the question of issuing $18,000 bonds for street improvements.

Atlantic City, N. J.—The County Board of Freeholders has ordered a driveway 30 ft. wide to be built from Atlantic City to Longport. Cost about $20,000.

New York, N. Y.—The Board of Public Improvements on Jan. 11 passed the resolution for the repaving with asphalt of Sixth Ave. from Carmine St. to 13th St.

Jersey City, N. J.—The Barber Asphalt Paving Co., N. Y. City, has secured a contract for the paving of Clendenny Ave. at 99½ per cent. of the standard price of $1.75 a sq. yd.

Kansas City, Mo.—The upper house of the Council has decided in favor of the opening of a new boulevard 80 and 100 ft. wide, to be known as Admiral Ave. Estimated cost, $125,000.

Hamilton, O.—Local reports state that the David Folz Paving Co., of Cincinnati, will in the spring establish a $20,000 plant in Hamilton.

Painesville, O.—Property owners have under consideration the paving of Mentor Ave. with either bricks or asphalt.

Jersey Shore, Pa.—A vote will be taken at the next election on the proposition to issue $13,000 bonds for street paving.

Cleveland, O.—Bids are wanted Feb. 15 for paving several streets with brick. George R. Warden, Dir. Pub. Wks.

Albany, N. Y.—Street Commissioner Woolverton in his annual report recommends that streets in the southern part of the city be repaired with granite block.

Philadelphia, Pa.—Chief Engineer Vogdes has reported to the Fairmount Park Commissioners the following recommendations for 1899: Completing the work of widening East River Drive, including macadamizing and laying of asphalt walks, $30,000; macadamizing Lincoln Drive to Walnut Lane, $16,000; continuing 34th St. Drive from its present terminus to Callowhill St., $25,000.

Kansas City, Mo.—The Board of Park Commissioners propose to build a boulevard in the Westport Park district.

Danville, Ky.—Boyle Co. turnpike bonds to the amount of $46,000 have been sold.

Houston, Tex.—Local reports state that the lowest bids received for paving Main St., with five-year guarantee, were as follows: On American cement and broken stone, Hipp & Key, $40,842; on Portland cement and broken stone, Ayres Asphalt Paving Co., $42,856; on American cement and gravel, Louisiana Improvement Co., $39,987; on Portland cement and gravel, Louisiana Improvement Co., $42,647.

Cleveland, O.—The Board of Control has been requested to prepare plans and specifications for grading, draining and paving with brick Beaver St.

Oskaloosa, Ia.—The following bids for paving, were opened Jan. 10, by Samuel Ver Veer, City Eng.

Bidders.	Excess Grading 500 Yards.	Brick Paving, 15,600 Yards.	Cement Curb, 8 900 Feet.	Total.
George H. Carlon & Son, Oskaloosa, Ia.	$ .14	$1.29	$ .33	*$23,131.00
P. T. Walsh, Davenport, Ia.	.20	1.32	.32	23,540.00
Smith, Moss & Brown, Chicago, Ill	.25	1.36½	.33	24,356.00
J. W. Campbell, Des Moines, Ia	.19	1.33⅞	.34	24,785 50
Magden & Sheeley, Des Moines, Ia	.25	1.36¼	.33¾	21,194.75
Peter Nelson, Oskaloosa, Ia	.20	1.32⅛	.35	23,885 00

*Contract awarded.

POWER PLANTS, GAS AND ELECTRICITY.

Pearl City, Ill.—The Council is stated to have been petitioned for a franchise for an electric plant.

Tipton, Ind.—It is reported that the municipal ownership of the electric light plant is being agitated.

Newport, N. Y.—The Newport Electric Light & Power Co. has been incorporated; capital $15,000. Directors: Wm. D. Grant, B. K. Brown and Henry H. Dexter, of Newport.

Chester, Pa.—The question of constructing an electric light plant is stated to be under consideration by the Council.

Golden, Colo.—The Denver Power & Irrigation Co. is stated to have applied to the County Commissioners for a franchise to erect poles along the county road from Platte Cañon to Denver.

Chanute, Kan.—It is stated that an election will be held Feb. 14 to vote on issuing $3,000 bonds for a gas plant.

Pinckney, Mich.—There is talk of constructing an electric light plant here.

Sherman, N. Y.—The Sherman Electric Light Co. has been incorporated; capital, $5,000. Directors: Chas. E. Cobb, F. D. Cornish, Chas. H. Corbett and others, of Sherman.

Cambridge, O.—Nathan H. Barber writes that on Jan. 15 the City Council granted him a franchise to construct an electric light plant.

Woodford, O.—Bids are wanted Feb. 1 for an electric light plant. Geo. P. Dorr, Corporation Clk.

York, Pa.—Bids are wanted Feb. 10 for lighting the city. Joseph Parkhurst, Chmn. Light Com.

Laconia, N. H.—Bids are wanted Jan. 30 for lighting the streets with electricity or Welsbach lights for a period of five years. S. C. Frye, City Clk.

Johnstown, N. Y.—It is stated that bids are wanted Feb. 6 by the City Clerk for lighting the city with electricity.

Niagara Falls, N. Y.—John Birkenbine, Philadelphia, is reported to have prepared plans for the development of 35,000 h. p. at the Whirlpool Rapids; the estimated cost of the plant is given as about $2,000,000. Heavy rock excavation is contemplated.

Bloomville, O.—It is stated that an election will be held Jan. 31 to vote on issuing $8,000 bonds for an electric light plant.

Sturgis, Mich.—John Farrow, City Clerk, writes that the contract for an electric light plant has been awarded to the Chase Construction Co., of Detroit, Mich., for $15,000.

Grand Rapids, Minn.—A charter has been granted to the Grand Rapids Water Power & Boom Co., capital, $50,000. Incorporators: Daniel M. Gunn, Hubert D. Powers, and others.

Pottstown, Pa.—The Pottstown Light, Heat & Power Co. is stated to have received the contract for lighting the city by electricity for five years, at $75 per light per year for arc lights of 1,200 c. p., and $29 for incandescent lights of 32 c. p.

Evanston, Ill.—It is stated that the Evanston Electric Illumination Co. proposes to place its wires in conduits and to expend $35,000 in the purchase of additional machinery.

Bellevue, O.—A charter is stated to have been granted to the Bellevue Gas Co., with a capital of $40,000.

Johnstown, N. Y.—W. F. Lansing, of Little Falls, is stated to have received a franchise for an electric light plant.

Spring City, Pa.—It is stated that Samuel H. Egolf, the purchaser of the Spring City Gas Works, intends to form a corporation and in the spring build a new gas plant.

Bozeman, Mont.—An ordinance has been passed granting P. E. Hall, Jr., permission to construct a gas plant. George D. Pease, City Clk.

Zeeland, Mich.—A committee is stated to have been appointed to investigate the question of constructing an electric light plant.

Chicago, Ill.—A charter has been granted to Unity Power Co., capital, $10,000. Incorporators: Anthony T. Galas, T. Kiser, and C. Forsberg.

Portland, Ore.—The Water Committee is stated to have adopted a resolution providing for the construction of a municipal electric light plant.

Stewartstown, Pa.—The Adams County Construction Co. is stated to have received the contract for the construction of an electric light plant, to cost $11,000.

Minier, Ill.—It is stated that there is an ordinance before the Council for the establishment of an electric light plant.

Duluth, Minn.—The Water Board is said to be considering the purchase of a gas generator.

Corunna, Mich.—The Corunna Electric Light Co. has been incorporated; capital, $30,000. Incorporators: Clarence Holly, Dexter Holly, and others.

York, Pa.—The Martic Electric Power Co. is stated to have applied for permission to operate in this city.

Buffalo, N. Y.—The Directors of the Public Library are stated to have appointed a committee to investigate matter of installing an electric light plant. Joseph P. Dudley, Chmn. Com.

Wilmington, Del.—The Street Commissioners are said to be considering the matter of constructing an electric light plant on the Brandywine Creek.

Trenton, N. J.—The Air Power Co. has been incorporated with a capital of $7,000,000, to manufacture and deal in compressed air, electric machinery, locomotives, cars, etc., and to manufacture electric and compressed air motor power. Incorporators: Robert McKinstry, Joseph H. Hoadley, of New York, Edwin Glenn, of Philadelphia, and others.

Wheeling, W. Va.—The Governor in his message recommends the construction of an electric light plant for the use of the Capitol and Governor's mansion.

South Bend, Ind.—The Committee on Gas and Street Lights is stated to have been instructed to investigate the question of establishing an electric light plant. Present contract expires Jan., 1900.

Columbus, Ga.—M. M. Moore, Clk. of the Council, writes that the contract for 115 arc lights of 2,000 c. p. each, has been awarded to the Columbus Railroad Co., at $85 per light, per year.

Bedford City, Va.—The Town Council is said to be considering the purchase of the electric light plant. If the plant is purchased, new machinery will be put in.

Danville, Ill.—The Danville Gas, Electric Light & St. Ry. Co. is stated to have received the contract for lighting the city for 5 years, at $30 per light per year.

Pleasantridge, O.—Bids are wanted Jan. 30 for lighting for one or more years. J. B. Hayden, Village Clk.

Richmond, Ky.—The Council is stated to have passed an ordinance granting permission to the Richmond Electric Co. to construct an electric light plant. John W. Crooke, Secy.

Mayville, N. D.—See "Water."

Rochester, N. Y.—The Supervisors are stated to have decided to purchase an electric light plant for the penitentiary, the cost not to exceed $2,000.

Winton, Pa.—A charter has been granted to the Seymour Electric Light, Heat & Power Co., with a capital of $6,000.

Canton, N. Y.—The Canton Electric Light & Power Co., proposes to put in an engine of 150 h. p., to run in connection with a dynamo having a capacity of 1,500 lights. L. Bailey, Supt. W. E. Hemenway, Engr.

Toledo, O.—The citizens will probably be asked to vote at the spring election on the question of constructing an electric light plant.

Trenton, N. J.—Bids are wanted Feb. 7 for lighting the streets with gas and gasoline or naphtha. C. Edw. Murray, City Clk.

Palo Alto, Cal.—C. E. Moore, C. E., of Santa Clara, writes that bids will be asked about March 1 for an incandescent electric light plant, to be built in connection with the water works, at a cost of about $15,000.

Thibodaux, La.—It is stated that bids are wanted Feb. 9 for an electric light plant. G. U. Borde, Consulting Engr., Liverpool & London and Globe Bldg., New Orleans.

Marshfield, Wis.—Bids are wanted Feb. 1 for lighting the streets with electricity for a period of 5 years. Jno. A. Thomas, City Clk.

Pawhuska, O. T.—Bids are wanted Feb. 13 for a gasoline gas plant at the Osage boarding school. William J. Pollock, U. S. Indian Agent, Osage Agency.

Mt. Vernon, Ind.—The following bids for lighting the city for a period of 10 years were opened Jan. 17 by Edward E. Highman, Chmn. Light Com. of the Common Council, price given per arc light per year: Ford & McGregor, Mt. Vernon, Ind., $88; Humphreys & Co., Columbus, O., $72; Wm. Gonnerman & Co., Mt. Vernon, Ind., *$69.75.
*Contract awarded.

ELECTRIC RAILWAYS.

Spirit Lake, Ia.—W. F. Ryan, Peoria, Ill., Engr. of the Spirit & Okoboji Lakes Rapid Transit Co., writes that about Feb. 10 material and equipments will be required for 7 miles of electric railway.

Rockville, Md.—It is stated that the Washington & Rockville Electric Ry. Co. will extend its road to this place.

Whitinsville, Mass.—The Worcester & Blackstone Valley St. Ry. Co. is stated to have petitioned for a franchise.

New Castle, Ind.—The New Castle Electric St. Ry. Co. is stated to have secured a right of way to Cadiz and Knightstown.

Boston, Mass.—It is stated that bids are wanted Jan. 24 by the Boston Elevated Ry. Co. for constructing the Dudley St. terminus.

Belleville, Ill.—The Belleville Electric Ry. Co. is stated to have received permission to extend its line.

Cleveland, O.—A charter has been granted to the Cleveland & Warren St. Ry. Co. to build an inter-urban railway from Cleveland to Warren; capital, $10,000. Incorporators: Martin Dodge, C. A. Thorpe, and others.

Lockland, O.—The Millcreek Valley St. Ry. Co. is stated to have received a franchise to extend its line.

Providence, R. I.—The City Council is stated to have passed an ordinance granting permission to the Union Ry. Co. to construct an electric railway on certain streets.

Grayslake, Ill.—The Chicago & Fox Lake Electric Ry. Co. is stated to have received a franchise.

Washington, D. C.—The Hevner Construction Co., of Philadelphia, is stated to have received the contract to build and fully equip, ready for the cars, the Washington & University R.R.

Belleville, Ill.—The Mississippi Valley Trust Co., of St. Louis, is stated to have secured a franchise for an electric line to connect East St. Louis with Edwardsville, Collinsville, Alton, Granite City, Madison, Venice and Brooklyn.

New Haven, Conn.—It is reported that the Winchester Avenue R.R. Co. will issue about $200,000 bonds about March 1, as a preliminary to further improvements and extensions.

Lansdale, Pa.—The Borough Council is stated to have passed an ordinance granting a franchise to the Inland Traction Co.

Princeton, N. J.—The Princeton & Trenton Traction Co. has been incorporated, to build a trolley road between Trenton, Princeton and Lawrenceville; capital, $200,000. Incorporators: Geo. O. Vanderbilt, Princeton; Julius Garst, Worcester, Mass; Charles W. Shippee, Boston, and others.

Pittsburg, Pa.—A charter is stated to have been granted to the Ohio Valley Ry. Co., with a capital of $200,000, to construct an electric railway to connect Pittsburg and Beaver Falls. A. P. Kirkland, Pres.; S. L. Brock, Sec.

Syracuse, N. Y.—The East Side Traction Co. has been incorporated, to operate an electric road 10 miles long in this city; capital $400,000. Directors: Wm. G. Tracy, Geo. D. Chapman, and others.

Irwin, Pa.—The Greensburg, Jeanette & Pittsburg Electric Ry. Co. is stated to have received a franchise.

Kansas City, Mo.—It is stated that the Metropolitan St. Ry. Co. will petition the Council for a right of way on Holly St.

Delaware, O.—It is stated that the County Commissioners will be petitioned for a franchise for an electric railway. E. D. Sullivan, a contractor of Columbus, is reported to be interested.

RAILROADS.

Marshalltown, Ia.—It is stated that the Marshalltown & Dakota R.R. Co. contemplate constructing a railroad about 36 miles long.

Morgantown, W. Va.—A charter has been granted to the Morgantown & Kingwood R.R. Co. to construct a railroad between Morgantown and Kingwood; capital, $200,000. Incorporators: D. H. Gowing, of Syracuse, N. Y.; George C. Sturgis, of Morgantown; Thos. E. Davis, of Grafton, and others.

Springfield, Ill.—The Metropolitan West Side Elevated Co. has been reorganized, with a capital of $16,500,000, and will extend its line to Cicero, Proviso, Lawndale and Leyden. Directors: Addison L. Gardner, of Chicago; Howard M. Carter, of Evanston; Geo. Higgenson, Jr., of Winnetka, and others.

Rutland, Vt.—Bids are wanted Jan. 31 for grading, masonry and tracklaying on about 50 miles of railroad, as advertised in "The Engineering Record."

Ligonier, Pa.—H. E. Marker, an attorney, of Greensburg, is said to be securing a right of way for a railroad from Ligonier to Lynn's Run.

Jefferson City, Mo.—The Jefferson City, Fort Scott & Southwestern R.R. Co. has been incorporated, with a capital of $4,000,000, to build a standard gauge railroad 300 miles long. Directors: R. L. Dewey, St. Albans, Vt.; John E. Frost, of Topeka; Wm. C. Gunn, of Ft. Scott, and others.

Fanwood, N. J.—It is reported that the Central Railroad of New Jersey is preparing plans for a branch line from the main line at Fanwood to the Murray Hill Station of the D., L. & W. R.R., in New Providence Township.

South Glens Falls, N. Y.—Frank Myers, of Wilton, representing the Saratoga Northern R.R., is said to be asking for a right of way through here.

St. Louis, Mo.—It is reported that the new owners of the St. Louis, Kansas & Southwestern R.R. Co., have secured a charter for an extension of their line.

Topeka, Kan.—A charter has been granted to the Topeka, Westmoreland & Waterville R.R. Co. with a capital of $3,000,000, to build and operate a standard gauge railroad 150 miles long. Directors: C. S. Gleed, of Topeka; Thos. Norton, of Chicago; R. Spring, of Boston, and others.

Vincennes, Ind.—The contract for constructing 204 miles of railroad for the Vincennes, Vevay & South Atlantic branch of the Black Diamond R.R. Co. is stated to have been awarded to Col. Albert E. Boone, of Zanesville, O., for $10,000,000.

Lumberton, N. C.—A charter has been granted to the Carolina Northern Ry. Co., to construct a railroad from Lumberton, N. C., to Marion, S. C., 45 miles; capital, $500,000. Alfred A. Sparks, Pres.; George Wersten, Sec. The principal office to be at Lumberton.

Norfolk, Va.—Right of way is stated to have been secured and surveys made by the Norfolk & Western R.R. Co. for about 8 miles of new road near Radford. The cost of tunneling, grading and bridging the new line is estimated at $1,000,000.

NEW DEPOTS.

Wilmington, Del.—It is stated that plans have been prepared and approved for a new depot to be erected on Fourth St. for the Philadelphia, Wilmington & Baltimore R.R. Co.

New Castle, Pa.—The Pittsburg & Lake Erie, Pittsburg & Western and the Pennsylvania Railroad officials are said to be making arrangements for the erection of a union station.

PUBLIC BUILDINGS.

Chillicothe, Mo.—The County Commissioners are stated to be considering the erection of a $40,000 infirmary.

Homestead, Pa.—It is stated that the congregation of the St. Matthew's P. E. Church will build a $20,000 edifice in the spring. Rev. W. J. White, Pastor.

Auburn, Ind.—The question of building a new court house in De Kalb County is said to be under consideration.

Lincoln, Ill.—Jacob A. Harman, Engineer of the Asylum Board, is said to be preparing plans for an extension to the institute for feeble minded children. An appropriation of $200,000 will be asked.

Pittsburg, Pa.—W. A. Thomas, Carnegie Bldg., Pittsburg, is said to be preparing plans for remodeling the Church of the Holy Rosary; estimated cost, $20,000. Rev. D. J. Malady, Pastor.

Janesville, Wis.—It is stated that the congregation of St. Mary's R. C. Church will erect a $25,000 edifice. Rev. W. A. Goebel, Pastor.

Philadelphia, Pa.—Baily & Truscott, 421 Chestnut St., have been selected to prepare plans for the new P. E. Church of St. John Chrysostom, on 28th St. and Susquehanna Ave.

Buckhannon, W. Va.—Bids are wanted Feb. 16 for a court house. R. A. Darnall, Chmn. Co. Commrs.

Washington, D. C.—It is stated that Andrew Carnegie has offered to give $250,000, to be used in the construction of a building for the Washington Public Library, if Congress will furnish a suitable site for the building and maintain the library after its erection.

Dartford, Wis.—The Supervisors are stated to have decided to erect a $25,000 court house and a $10,000 jail and sheriff's house. Wm. Waters, of Oshkosh, is the architect.

Philadelphia, Pa.—The trustees of the Episcopal Hospital are said to be considering the matter of erecting a home for nurses, to cost about $100,000.

Calumet, Mich.—The Council is stated to have accepted the plans of C. K. Shand for a $25,000 opera house.

Baltimore, Md.—Henry Smith & Sons, 116 Regester St., Baltimore, are stated to have received the contract for the new Camden Station warehouse for the Baltimore & Ohio R.R. Co.; estimated cost, $250,000.

Baltimore, Md.—Bids are wanted Feb. 1 for the installation of the elevator plant in the new court house. Henry D. Harlan, Chmn. Sub. Com. Bldg. Com. of the New Court House.

New Haven, Conn.—Architect Allen is stated to be completing plans for a $30,000 edifice for the Plymouth Church.

Braddock, Pa.—E. J. Carlisle & Co., of Pittsburg, are preparing plans for a brick building 60x117 feet for the First Presbyterian Church.

Philadelphia, Pa.—The Building Committee of the Trustees of the Philadelphia Museums, at a meeting Jan. 17, authorized the architects of the Exposition buildings, Wilson Bros. & Co., Drexel Bldg., to proceed with the preparation of detailed plans of the buildings, and secure estimates of the cost, so that bids for the construction can be obtained within a short time. Justus C. Strawbridge, Chmn.

Peru, Ind.—The plans of the Pauly Jail Building Co., of St. Louis, Mo., are stated to have been accepted for a jail and sheriff's residence, to cost about $25,000.

Bradford, England.—It is stated that competitive plans are wanted April 14 for a building for the Cartwright Memorial Hall and Art Gallery; estimated cost, $190,000. George McGuire, Town Clk.

St. Thomas, Ont.—It is stated that bids are wanted Jan. 25 for hot water heating and plumbing in the Court House. K. W. McKay, Co. Clk.

Augusta, Mont.—It is stated that bids are wanted Feb. 1 for a jail. Chas. J. Clark, Clk.

Chicago, Ill.—It is stated that bids are wanted Jan. 25 for a building for the Graham & Morton Transportation Co., to cost about $35,000. Geo. Beaumont, Arch., 115 Dearborn St.

Lafayette, Ala.—Bids are wanted Jan. 26 for a court house. R. J. Driver, Judge and Probate.

Many, La.—It is stated that bids are wanted about April 3 by the police jury for a court-house.

Balsam Lake, Wis.—The following bids for a court house, jail and residence were opened Jan. 3 by H. P. Burdick, Secy. Co. Commrs.: Libby & Co., St. Paul, Minn., $21,250; Chas. Skoglum, St. Paul, Minn, $19,975; Donlin & Cullen, Superior, Wis., $19,984; McLeod, Campbell & Smith, Duluth, Minn., $19,375; Fred C. Norlander, St. Paul, Minn., *$17,487; N. P. Franzen & Co., St. Paul, Minn., $19,850; A. Brown, New Richmond, Wis., $17,955; H. F. Cowdin, St. Paul, Minn.; $25,000; P. H. Donovan & Son, St. Paul, Minn., $25,291. For heating, Allen, Black & Co., Minneapolis, Minn., *$1,295.

*Contract awarded.

NEW INDUSTRIAL PLANTS.

The Titusville Iron Co., Titusville, Pa., is erecting a 418x80-ft. iron and brick machine shop and store-room, in connection with its radiator works.

The Star Knitting Works, Grand Rapids, Mich., will put in a 60 h. p. boiler and 30 h. p. engine.

The Moline Plow Co., Moline, Ill., will put up a 150x200-ft. foundry, and will put in a 150 h. p. power plant and two continuous-process cupolas.

Mottu, de Witt & Co., Norfolk, Va., have organized the Norfolk Silk Co., with a capital stock of $400,000, taken by local, New York, Baltimore and Richmond parties. Plans for the plant, which will be located at Lambert's Point on a tract of about 2 acres, have not yet been finished, but it will have from 350 to 500 silk looms.

BUSINESS NOTES.

The Twin City Iron Works, Minneapolis, are putting up a 40x100-ft. erecting shop.

The Hancock Inspirator Co., Boston, will be represented at Havana, Cuba, by M. J. Martinez, M. Am. Soc. M. E.

President J. W. Duntley, of the Chicago Pneumatic Tool Co., reports several large pneumatic outfits have been sent to India and one to the African diamond fields. The success of these tools on American and British railways has also resulted in a recent large order from an Egyptian railway.

BUILDING INTELLIGENCE.

NEW YORK, N. Y.

387-389 E 10th st, 2 br stores and flats; cost, $50,000 all; o, J B Simpson; a, M Bernstein.

535-537 5th st, br stores and flats; cost, $35,000 all; o, Simon Jacobs; a, Nathan Sanger.

539 5th st, br store and flat; cost, $23,000; o, Simon Jacobs; a, Nathan Sanger.

541-543 5th st, 2 br stores and tenements; cost, $30,000 all; o, Henry Agne; a, J Bockell & Son.

723-725 5th ave, 2 br dwellings; cost, $80,000 all; o, W W Astor; a, Clinton & Russell.

132 W 28th st, br store and tenement; cost, $18,000; o, Robert L Askey; a, Pollard & Steinam.

525-531 W 38th st, br stable; cost, $12,000; o, McDermott & Callahan; a, John L Jordan.

N s 89th st, 200 e 2d ave, 6 br stores and flats; cost, $120,000 all; o, J & G Schreiner; a, John Hauser.

S s 89th st, 250 e 2d ave, 4 br stores and flats; cost, $80,000 all; o, John & Geo Schreiner; a, John Hauser.

N s 90th st, 200 e 2d ave, 4 br stores and flats; cost, $80,000 all; o, John & Geo Schreiner; a, John Hauser.

1 E 73d st, br and stone dwelling; cost, $35,000; o, Mrs N F Palmer; a, Palmer & Hornbostel.

S s 63d st, 250 e West End ave, 6 br tenements; cost, $108,000 all; o, Walter S Evans; a, Samuel Sass.

1861 7th ave, br flat; cost, $250,000; o, Seaboard Realty Co; a, H B Milliken.

N s 118th st, 200 w 5th ave, 4 br flats; cost, $108,000 all; o, Sebastian Sanders; a, Schneider & Herter.

44 W 120th st, br flat; cost, $35,000; o, Jas Everard; a, Jas W Cole.

2485 2d ave, n w cor 127th st, br stores and flats; cost, $26,000; o, Leopold Hellinger; a, Nathan Langer.

W s Eagle ave, 372 n Westchester ave, 2 br flats; cost, $24,000 all; o, Margaret Mullhall; a, M J Garvin.

N s 155th st, 100 e Courtlandt ave, 2 br flats; cost, $28,000 all; o, Schmuck & Montag; a, Edw Wenz.

Wendover ave, n w cor Bathgate ave, br flat; cost, $28,000; o, John Fox; a, Edw Wenz.

E s 3d ave, 50 n 166th st, 3 br flats and stores; cost, $55,000 all; o, Schmuck & Montag; a, Edw Wenz.

Washington ave, n w cor Gouverneur pl, br flat; cost, $22,000; o, August Jacob; a, John Hauser.

S s 183d st, 100 w Webster ave, 5 frame dwellings; cost, $160,000 all; o, Ernest Wenegmann; a, W C Dickerson.

N s Wendover ave, 25 w Bathgate ave, 4 br flats; cost, $40,000 all; o, Edwin H Aube; a, Samuel Sass.

S s 141st st, 405 e Alexander ave, br flat; cost, $22,000; o, John D Hassenger; a, W C Dickerson.

ALTERATIONS.

228-230 Front st, electric elevator, front wall removed, girders and columns placed as stated, rear wall rebuilt; cost, $10,000; o, Wm M Fleiss, exr estate T E Gebert; a, F Friend.

572 5th ave, raised 1 story, cast-iron columns and girders substituted for present longitudinal partition, fire-proof elevator, etc; cost, $20,000; o, Robert Lee Morrell; a, H J Hardenbergh.

W s Boston road, bet 175th and Woodruff sts, repair damage by fire and br extension; cost, $40,000; o, Union Railway Co; a, A Pasquini.

MISCELLANEOUS.

Barre, Mass.—High school; cost, $25,000; a, Andrews, Jaques & Rantoul, Boston.

Birmingham, Ala.—First ave, bet. 18th and 19th sts; store and offices; cost, $40,000; o, Maybury & Watson; a, Chas Wheelock.

Macon, Ga.—Br and stone bldg; cost, $30,000; o, Rev J Winklerled; a, N J Clayton & Co, Galveston, Tex.

Newport News, Va.—33d st; br church; cost, $20,000; o, Presbyterian Congregation, Rev E T Wellford, pastor; a, C W Bolton, Philadelphia.

Northampton, Mass.—Hotel; cost, $50,000; o, Joseph Herbert; a, Bailey & Goodrich, Hartford.

Reading, Pa.—Mineral Spring road, 2 story suburban house; cost, $12,000; o, Mr. Davis; a, not chosen.

PROPOSALS OPEN.

WATER-WORKS.

Bids Close.		See Eng. Record.
Jan. 21.	Cheboygan, Mich	Dec. 31
	Adv., Eng. Record, Dec. 31 to Jan. 14.	
Jan. 23.	Canton, O	Jan. 7
Jan. 24.	Canby, Minn	Dec. 31
Jan. 24.	Bonds. Wamego, Kan	Dec. 31
Jan. 25.	Phœnix, A. T	Dec. 24
Jan. 25.	Bonds. McConnelsville, O	Dec. 31
Jan. 25.	Orangeburg, S. C	Jan. 7
	Adv., Eng. Record, Jan. 7.	

Jan. 25. Pipe, Boston, Mass .... Jan. 21
Adv., Eng. RECORD, Jan. 21.
Jan. 26. Washington, D. C .... Dec. 31
Adv., Eng. RECORD, Dec. 31, Jan. 7, 14.
Jan. 27. Cylinders, etc., Cleveland, O. .... Dec. 31
Jan. 28. Bonds, Cincinnati, O. .... Jan. 7
Jan. 28. New Albany, Ind .... Jan. 14
Adv., Eng. RECORD, Jan. 14.
Jan. 30. Baltimore, Md .... Jan. 21
Jan. 31. Bonds, Alliance, O .... Jan. 14
Feb. 1. Tuskegee, Ala .... Dec. 31
Feb. 6. Bonds, Berea, O .... Dec. 31
Feb. 7. Bonds, Huntsville, Ala .... Jan. 14
Feb. 7. Bonds, Columbus, Miss .... Jan. 14
Feb. 13. Bonds, Reno, Nev .... Dec. 24
Feb. 21. Honolulu, Hawaiian Is .... Jan. 14
Adv., Eng. RECORD, Jan. 14, 21.
Mar. 1. Oto, Ia .... Jan. 21
Mar. 15. Belem, Para, Brazil .... Nov. 26

SEWERAGE AND SEWAGE DISPOSAL.

Jan. 23. Sewer pipe, etc., New London, Conn. Dec. 24
Jan. 23. South Bend, Ind .... Jan. 14
Jan. 23 Yuma, Ariz .... Jan. 14
Jan. 23. Cumberland, Md .... Jan. 21
Jan. 23. Salem, O .... Jan. 21
Jan. 24. East Liverpool, O .... Jan. 14
Jan. 25. Phœnix, A. T .... Dec. 24
Jan. 26. Elkhart, Ind .... Jan. 21
Jan. 27. Little Falls, N. Y .... Jan. 21
Jan. 30. Toledo, O .... Jan. 21
Feb. 1. Hartford, Conn .... Jan. 21
Adv., Eng. RECORD, Jan. 21.
Feb. 3. Spartanburg, S. C .... Jan. 14
Adv., Eng. RECORD, Jan. 14.
Feb. 3. Norristown, Pa .... Jan. 14
Feb. 6. Bonds, Glenville, O .... Jan. 14
Feb. 6. Ottawa, Ont .... Jan. 21
Feb. 7. Bonds, Columbus, Miss .... Jan. 14
Feb. 7. East Grand Forks, Minn .... Jan. 21
Feb. 20. Bonds, Cleveland, O .... Jan. 14

BRIDGES.

Jan. 23. Rockland, Mich .... Jan. 21
Jan. 24. St. Thomas, Ont .... Dec. 24
Jan. 24. Waverly, Ia .... Jan. 7
Jan. 24. Chatham, Ont .... Jan. 21
Jan. 25. Henderson, Minn .... Jan. 21
Jan. 26. Buffalo, N. Y .... Jan. 21
Jan. 28. Evansville, Ind .... Jan. 21
Jan. 31. Bonds, Jackson, Miss .... Dec. 24
Jan. — Hastings, Neb .... Dec. 10
Feb. 1. Helena, Mont .... Jan. 14
Feb. 2. Ogden, Utah .... Jan. 21
Feb. 4. Superstructure, Cleveland, O .... Jan. 21
Feb. 6. Frumet, Mo .... Jan. 21
Feb. 9. Nebraska City, Neb .... Jan. 21
Feb. 20. Chicago, Ill .... Dec. 31
Adv., Eng. RECORD, Dec. 31.

Mar. 1. Quebec, Que .... Jan. 7
Mar. 2. Shreveport, La .... Jan. 21
Mar. 15. Chicago, Ill .... Jan. 21
Adv., Eng. RECORD, Jan. 21.
Apr. 1. Substructure, St. Joseph, Mo .... Jan. 7
—— Spring Lake, N. J .... Jan. 7

PAVING AND ROADMAKING.

Jan. 23. Louisville, Ky .... Jan. 21
Jan. 24. Buffalo, N. Y .... Jan. 21
Jan. 26. Buffalo, N. Y .... Jan. 21
Jan. 27. Bonds, Lansdowne, Pa .... Jan. 21
Jan. 30. Kokomo, Ind .... Jan. 7
Jan. 30. Eau Claire, Wis .... Jan. 21
Feb. 1. Appleton, Wis .... Jan. 21
Feb. 1. Fayetteville, Ark .... Jan. 21
Feb. 1. Bonds, Shreveport, La .... Jan. 14
Feb. 1. Jamestown, N. Y .... Jan. 14
Adv., Eng. RECORD, Jan. 14.
Feb. 6. Toledo, O .... Jan. 14
Feb. 6. Vevay, Ind .... Jan. 21
Feb. 14. St. Louis Mo .... Jan. 21
Feb. 15. Cleveland, O .... Jan. 21
Feb. 16. Decatur, Ind .... Jan. 14
Feb. 27. Yonkers, N. Y .... Dec. 3

POWER, GAS AND ELECTRICITY

Jan. 23. Sea Isle City, N. J .... Jan. 14
Adv., Eng. RECORD, Jan. 14.
Jan. 25. Baltimore, Md .... Jan. 7
Adv., Eng. RECORD, Jan. 14, 21.
Jan. 25. Orangeburg, S. C .... Jan. 7
Adv., Eng. RECORD, Jan. 7.
Jan. 28. Gas lamps, Cleveland, O .... Jan. 7
Jan. 30. Laconia, N. H .... Jan. 21
Jan. 30. Pleasantridge, O .... Jan. 21
Feb. 1. Richmond, Va .... Jan. 7
Feb. 1. Tuskegee, Ala .... Dec. 31
Feb. 1. Menahgo, Minn .... Dec. 31
Feb. 1. Woodford, O .... Jan. 21
Feb. 1. Marshfield, Wis .... Jan. 21
Feb. 6. Johnstown, N. Y .... Jan. 21
Feb. 7. Woodsfield, O .... Jan. 14
Feb. 7. Trenton, N. J .... Jan. 21
Feb. 9. Thibodeaux, La .... Jan. 21
Feb. 10. York, Pa .... Jan. 21
Feb. 13. Gas plant, Pawhuska, O. T .... Jan. 21
Mar. 1. Sault Ste. Marie, Mich .... Dec. 24
Mar. 1. Spartanburg, S. C .... Jan. 14
Adv., Eng. RECORD, Jan. 14, 21.
Mar. 31. Telephone, Shanghai, China .... Nov. 19
—— Pleasantville, O .... Dec. 24

GOVERNMENT WORK.

Jan. 23. Stone, etc., New London, Conn .... Dec. 24
Jan. 24. Batteries, Fort Monroe, Va .... Dec. 24
Jan. 30. Beacons, Mobile, Ala .... Jan. 7
Jan. 31. Dry dock, Boston, Mass .... Dec. 31
Jan. 31. Wharf, Atlanta, Ga .... Jan. 14
Feb. 1. Duluth, Minn .... Jan. 7
Adv., Eng. RECORD, Jan. 7 to 21.

Feb. 2. St. Louis, Mo .... Jan. 21
Adv., ENG. RECORD, Jan. 21.
Feb. 3. Dredging, Duluth, Minn .... Jan. 7
Feb. 13. New Orleans, La .... Jan. 14
Adv., Eng. RECORD, Jan. 14, 21.
Feb. 16. Duluth, Minn .... Jan. 21
Adv., Eng. RECORD, Jan. 21.
Feb. 21. Wreck, Boston, Mass .... Jan. 21

BUILDINGS.

Jan. 21. Washington, D. C .... Dec. 24
Jan. 23. New Orleans, La .... Jan. 7
Jan. 23. School, Mt. Pleasant, Ia .... Jan. 21
Jan. 24. School bonds, Bellefontaine, O ...... Jan. 21
Jan. 24. School bonds, Mt. Vernon, N. Y .... Jan. 7
Jan. 25. Dormitory, etc., Phœnix, A. T. .... Dec. 24
Jan. 25. Heating, etc , St. Thomas, Ont. .... Jan. 21
Jan. 25. Chicago, Ill .... Jan. 21
Jan. 26. Lafayette, Ala .... Jan. 21
Jan. 30. Oshkosh, Wis .... Jan. 7
Jan. 30. School, Chattanooga, O .... Jan. 14
Jan. 31. School bonds, Jackson, Miss .... Dec. 24
Jan. —. Superstructure, Newport, R. I .... Nov. 19
Feb. 1. School, Peoria, Ill .... Dec. 3
Feb. 1. Owatonna, Minn .... Jan. 7
Feb. 1. Alexandria, La .... Jan. 14
Feb. 1. Elevator, Baltimore, Md. .... Jan. 21
Feb. 1. Augusta, Mont .... Jan. 21
Feb. 4. Ventilating, etc., Cleveland, O ...... Jan. 14
Feb. 6. Ventilating, etc., school, Burlington, Vt ..... Jan. 21
Feb. 10. Keyser, W. Va .... Nov. 5
Feb. 11. School, Cleveland, O .... Jan. 21
Feb. 13. Rock Springs, Tex .... Jan. 14
Feb. 16. School, Ellendale, N. D .... Jan. 7
Feb. 16. Buckhannon, W. Va .... Jan. 21
Feb. 25. Douglass, Ga .... Dec. 31
Mar. 1. Arkadelphia, Ark .... Jan. 14
Apr. 3. Many, La .... Jan. 21
Apr. 14. Plans, Bradford, England .... Jan. 21

MISCELLANEOUS

Jan. 24. Tunnel, London, England .... Nov. 5
Jan. 24. Garbage disposal, Chicago, Ill ..... Jan. 7
Jan. 24. El. Ry., Boston, Mass .... Jan. 21
Jan. 25. Conduit material, Baltimore, Md ... Jan. 14
Adv., Eng. RECORD, Jan. 14, 21.
Jan. 26. Washington, D. C .... Dec. 31
Adv , Eng. RECORD, Dec. 31.
Jan. 26. Dredging, Buffalo, N. Y .... Jan. 21
Jan. 27. Wharves, Philadelphia, Pa .... Jan. 21
Jan. 31. R. R. work, Rutland, Vt .... Jan. 21
Adv., Eng. RECORD, Jan. 21.
Feb. 1. Wharves, etc., Honolulu, Hawaiian Is ...... Jan. 14
Feb. 1. Crane, Townsville, Australia .... Dec. 17
Feb. 6. Levee work, Pointé a la Hache, La. Jan. 14
Feb. 15. Canal, Albuquerque, N. Mex .... Jan. 21
Feb. 20. Newark, N. J .... Jan. 21
Adv., Eng. RECORD, Jan. 21.
Mar. 15. El. Ry., Shanghai, China .... Nov. 19

NEW SCHOOLS.

Shelby, Ia.—John Sallman writes that in March the Independent school district will vote on the issue of bonds for building an addition to the school.

Syracuse, N. Y.—The Board of Education is stated to have adopted a resolution declaring in favor of issuing $250,000 bonds for a new high school.

Chicago, Ill.—The Council is stated to have passed an ordinance for a 22-room addition to the Springer School and a 12-room one for the Doré.

Moline, Ill.—At the school election in April the citizens will vote on the issue of $25,000 bonds for a school. C. H. Boman, Chmn. Bldg Com.

Wheaton, Minn.—The School Board is said to be considering the erection of a $14,000 high school.

Ellsworth, Minn.—The citizens are stated to have voted to erect a $10,000 school.

Merrill, Wis.—The School Board has decided to ask for an appropriation of $20,000 for a high school.

Charles City, Ia.—The question of erecting a $25,000 school is said to be under consideration.

Wilmington, Del.—All bids received Jan. 9 for the high school have been rejected and the architect directed to revise specification so that the building can be erected for $100,000.

Bellefontaine, O.—Bids are wanted Jan. 24 for $12,000 school bonds. F. R. McLaughlin, Clk. Bd. of Education.

Mt. Pleasant, Ia.—Bids are wanted Jan. 23 for rebuilding the Willowbank school. H. E. Snider, Secy. School Bd.

Burlington, Vt.—Bids are wanted Feb. 6 for ventilating and heating the Burlington high school. H. O. Wheeler, Supt. Bd. School Commrs.

Cleveland, O.—Bids are wanted Feb. 11 for an addition to the Sowinski School. H. Q. Sargent, School Dir.

STREET CLEANING AND GARBAGE DISPOSAL.

Philadelphia, Pa.—The contract for cleaning the streets in the Fifth district has been awarded to David McMahon & Co., Germantown, Pa., for $81,889.

New York, N. Y.—The Board of Estimate has authorized the issue of $569,399 bonds for the Street Cleaning Department.

East Liverpool, O.—The Board of Health has under consideration certain propositions for the construction of a garbage crematory. J. Cross Kerr, Chmn. of Com.

Norfolk, Va.—The Local Board of Improvements has advertised for bids for the removal of garbage, etc., for 1 year from Feb. 1.

GOVERNMENT WORK.

St. Paul, Minn.—The following bids for furnishing American Portland cement were opened Jan. 12 by Maj. Frederic V. Abbot, Corps. of Engrs., U. S. A., as advertised in "The EngineeringRecord": H. E. Carpenter, Minneapolis, Minn., $2.05, "Wayland Portland," f. o. b. Wayland, N. Y.; Sandusky Portland Cement Co., Sandusky, O., $1.90, "Medusa," f. o. b. Bay Ridge, O.; Commercial Wood & Cement Co., Philadelphia, Pa., $1.64, "Saylor's," f. o. b. Copley, Pa.; Garden City Sand Co., Chicago, Ill., $1.64, "Star," f. o. b. Seigfried, Pa.; Kelly Island Lime & Transport Co., Cleveland, O., $1.75, "Lehigh Portland," f. o. b. Omrod, Pa.; Northwestern Lime Co., St. Paul, Minn., $1.75, "Atlas," f. o. b. Northampton, Pa.; $2.47, "Atlas," f. o. b. St. Paul, Minn., or Ashland, Wis.

Akron, O.—The following bids were opened Jan. 19 by the Superv. Archt., Treas. Dept., Washington, D. C., for heating and ventilating apparatus in the Post Office building, as advertised in "The Engineering Record": Chafer & Becker, Cleveland, O., $3,497; The Smith & Oly Co., Cleveland, O., $3,969; L. L. Lord, Meadville, Pa., $3,432; Edward Joy, Syracuse, N. Y., $4,500; E. Rutzler, New York City, $5,100; W. F. Porter & Co., Minneapolis, Minn., $3,242; Fitzpatrick & Hoffman, Columbus, O., $4,315; Kram, Kern & Co., Akron, O., $4,596; Saunders & Esswein, Columbus, O., $4,800; Geo. Schisler, Mansfield, O., $3,659; Pittsburg Heating Supply Co., Pittsburg, Pa., $3,643; Borger Bros. & Co., Columbus, O., $3,420; Gaylord & Eitapenc, Binghamton, N. Y., $3,300.

Duluth, Minn.—Bids are wanted Feb. 16 at the U. S. Engineer Office for setting in place concrete footing blocks and building concrete superstructure on south pier, also building and piling concrete footing blocks for north pier, Duluth Ship Canal, as advertised in "The Engineering Record."

Pottsville, Pa.—The following bids were opened Jan. 19 by the Superv. Archt., Treas. Dept., Washington, D. C., for heating and ventilating apparatus in the Post Office building, as advertised in "The Engineering Record": Chafer & Becker, Cleveland, O., $2,537; Prescott, Buckley & Callahan, Keesville, N. Y., $3,190; L. L. Lord, Meadville, Pa., $2,545.20; Edward Joy, Syracuse, N. Y., $3,000; E. Keeler Co., Williamsport, Pa., $3,260; Gaylord & Eitapenc, Binghamton, N. Y., $2,200; Pittsburg Heating Supply Co., Pittsburg, Pa., $2,336; Broomell & Schmidt Co., York, Pa., $2,405; Borger Bros. & Co., Columbus, O., $2,242; E. Rutzler, New York City, $3,370; Thomas & Smith, Chicago, Ill., $2,769; David R. Burns, Philadelphia, Pa., $3,198; Charles B. Scott, Scranton, Pa., $2,843.07.

Annapolis, Md.—Local reports state that the lowest bid received by the Navy Department for the power house at Annapolis Naval Academy was from Grace, Hyde & Co. of New York City for $111,000.

Duluth, Minn.—The following bids were opened Jan. 10 by Major Clinton B. Sears, Corps of Engrs., U. S. A., for furnishing 12,000 bbls. of Portland cement for the concrete superstructure for piers for Duluth Ship Canal, as advertised in "The Engineering Record," price give per barrel: *Northwestern Lime Co., St. Paul, Minn., "Atlas," $2.19; Empire Portland Cement Co., Chicago, Ill., "Empire," $2.50; Garden City Sand Co., Chicago, Ill., "Star," $2.30; Sinclair & Babson, New York, "Alsens," $2.89; Kelley Island Line & Transport Co., Cleveland, O., "Lehigh," $2.30.

*Contract awarded.

Washington, D. C.—Superintendent Hills, of the Treasury Department, on Jan. 13 let the contract for gas fixtures in the new city post office to the Cassidy & Son Manufacturing Co., New York City, for $18,760.

Boston, Mass.—Bids are wanted Feb. 21 for the removal of wrecked schooner J. M. Eaton, in entrance channel to Pigeon Cove Harbor. Col. Chas. R. Suter, Corps Engrs., U. S. A.

St. Louis, Mo.—Bids are wanted Feb. 2 by the Superv. Archt., Treas. Dept., Washington, D. C., for the new isolation ward and disinfecting annex at the U. S. Marine Hospital, as advertised in "The Engineering Record."

MISCELLANEOUS.

Jersey City, N. J.—Local press repor state the Pennsylvania R.R. Co. pr poses to build a spur to the foot Morgan St. and three large piers f docking purposes.

Duluth, Minn.—Local reports state th the American Steel Barge Co., of Ne York City, proposes to build a dry do 606 ft. long and 110 ft. wide. Estimat cost, $200,000.

Buffalo, N. Y.—See "Bridges."

Newark, N. J.—Bids are wanted Fe 20 by the Essex County Park Commi sion for the construction of stone hea to subways Nos. 1 and 2, under the driv way at Branch Brook Park, as adve tised in "The Engineering Record."

Albuquerque, N. Mex.—Bids are want Feb. 15 for constructing a canal about miles long from a point near San Feli to a point near Albuquerque. P. E. Ha roun, Ch. Engr. of the Albuquerque La & Irrigation Co.

Chicago, Ill.—The contract for work Section No. 13 of the drainage chann has, according to local press repor been awarded to Gahan & Byrne of Ch cago for $199,000. The work includes building lock No. 1 at Joliet, raising bridges and deepening and widening t channel near the mouth of Desplain River.

Galion, O.—Press reports state th plans for the building of a $40,000 tunn under the Erie R.R. tracks on East Ma St. have been approved.

Philadelphia, Pa.—Bids are want Jan. 27 for repairing Hanover and Po lar St. wharves. Frank M. Riter, D Dept. Pub. Safety.

Fall River, Mass.—Local reports sta that plans have been agreed upon f the abolition of grade crossings with the city limits. Probable cost, $1,500,0

PROPOSALS.

TREASURY DEPARTMENT, OFFI Supervising Architect, Washington, D. January 12, 1899.—Sealed proposals will received at this office until 2 o'clock P. on the 2d day of February, 1899, and t opened, for the new isolation ward and d infecting annex at the U. S. Marine Hos tal, St. Louis, Mo., in accordance with drawings and specification, copies of wh may be had at this office or the office of Custodian, at St. Louis, Mo. JAMES KN TAYLOR, Supervising Architect.

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TABLE OF LEADING ARTICLES.

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THE U. S. SUPREME COURT ON THE RIGHTS OF A PRIVATE WATER COMPANY.

The legal questions involving the rights of private water companies rarely go to the Supreme Court of the United States, and it is therefore worth noticing that the case of the City of Walla Walla v. the Walla Walla Water Company was recently the subject of a particularly interesting decision by this body.

The facts of the case are substantially as follows: The act of incorporation of the city gives it power "to provide a sufficient supply of water," and "to grant the right to use the streets of said city for the purpose of laying gas and other pipes intended to furnish the inhabitants of said city with light or water; to any persons or association of persons for a term not exceeding 25 years, provided always, that none of the rights or privileges herein granted shall be exclusive, nor prevent the council from granting the same rights to others." It is further provided: "No water-works shall be erected by the city until a majority of the voters, who shall be those only who are free holders in the city, or pay a property tax therein on not less than $500 worth of property, shall at a general or special election vote for the same. Said city is hereby authorized and empowered to condemn and appropriate so much private property as shall be necessary for the construction and operation of such water-works, and shall have power to purchase or condemn water-works already erected, or which may be erected, and may mortgage or hypothecate the same to secure to the persons from whom the same may be purchased the payment of the purchase price thereof." There were certain other provisions which it is unnecessary to review, as they will be found stated at length in 19 Sup. Ct. Rep. 77.

In March, 1887, the city council passed an ordinance "to secure a supply of water for the city of Walla Walla," by which it granted under certain restrictions to the Walla Walla Water Company for the period of 25 years from the date of the ordinance, "the right to lay, place and maintain all necessary water mains, pipes, connections and fittings in all the highways, streets and alleys of said city, for the purpose of furnishing the inhabitants thereof with water." The ordinance provided that the supply of water must be ample and wholesome, and sold at reasonable rates. It was further provided: "This contract shall be voidable by the city of Walla Walla so far as it requires the payment of money, upon the judgment of a court of competent jurisdiction, whenever there shall be a substantial failure of such supply, or a substantial failure on the part of the company to keep or perform any agreement or contract on its part, herein specified or in said contract contained. But accident or reasonable delay shall not be deemed such failure. And until such contract shall have been so avoided, the city of Walla Walla shall not erect, maintain or become interested in any water-works except the one herein referred to, save as hereinafter specified. Neither the existence of said contract nor the passage of this ordinance shall be construed to be or be a waiver of or relinquishment of any right of the city to take, condemn, and pay for the water rights and works of said or any company at any time, and in case of such condemnation, the existence of this contract shall not be taken into consideration in estimating or determining the value of said water-works of the said Walla Walla Water Company."

The water company accepted this ordinance, made a formal contract with the city, and substantially complied with its terms and conditions. This contract has never been avoided by the city or by the courts. After it had been in force for some six years, an ordinance was passed on June 20, 1893, "to provide for the construction of a system of water-works" for the purpose of supplying the city and its inhabitants with water; to authorize the purchase and condemnation of land for that purpose, and the issue of $160,000 of bonds to provide the necessary funds. Pursuant to the provisions of this ordinance an election was held, and the proposition carried by a sufficient majority of the legal voters. The city claimed that the contract between the company and itself was not binding, so far as it forbade the erection of any system of water-works other than that of the company, and the litigation which has arisen over this claim was taken into the United States Supreme Court on the ground that it involved the construction of the constitution of the country.

The decision, written by Mr. Justice Brown, is in nine sections. The first section, legally of great importance, concerns the right of the company to carry the case into this court. The city's counsel argued that the action of the city in contracting with the water company in 1893 was not a legislative act. They claimed that the council in this case was simply the trustee for the citizens, and stood in the same relation to them as the directors to the stockholders in a private corporation. On this ground they said that neither the State nor the city, as its agent, could be charged either with the making or the impairing of the original contract; that for these reasons the Constitution of the United States had no application to the case, the federal court had no jurisdiction, and the bill presented only a violation by a citizen of the State of its contract with another citizen, and the company was therefore bound to resort to the State court for its remedy. The decision states, however, that the cases wherein the charter of such companies have been treated as falling within the constitutional provision are altogether too numerous even to justify citation, and this particular claim of the city's counsel was therefore overruled.

The argument was also made in behalf of the city, that the Supreme Court was without jurisdiction in the case, because the complaint was devoid of facts which vest jurisdiction. The court ruled, however, that it sufficiently appeared that were the city to erect competing water-works, the value of the company's plant would be materially impaired, if not practically destroyed. To require the company to demonstrate specifically how the establishment of competing water-works would injure the value of its property, or deprive it of the rent agreed by the city to be paid, was to demand that it should set forth facts of general knowledge and within the common observation of men. "That which is patent to anyone of average understanding need not be particularly averred." The objection of the city's counsel that a court of equity had no jurisdiction because the plaintiff had a complete and adequate remedy at law was held to be equally untenable. The company obviously had no present remedy at law, because the city had done nothing in violation of its covenant, and the water company had suffered as yet no damage.

The case upon its merits was found by Judge Brown to depend largely upon the power of the city under its charter. The ordinance authorizing the contract, which purports to have been passed in pursuance of this charter, declared that, as before stated, until the contract should be avoided by a court of competent jurisdiction, the city should not in any way become interested in any water-works, except the plant established by the company, while the ordinance of June, 1893, provided for the immediate construction of municipal water-works. There was a plain conflict on the face of the two ordinances; the latter clearly impaired the obligation of the former. The city claimed that the council exceeded its powers in authorizing its contract with the water company for a continuous supply of water and the payment of rentals for 25 years, and that the contract was particularly obnoxious in its stipulation that the city should not construct works of its own during the life of the contract. Four specific objections were raised by counsel for the city; the first was that the contract created a monopoly, and was therefore void as against public policy; the second was that it was void as an attempt to contract away a part of the governmental power of the city council; the third ground for claiming that the contract was void was that it created an indebtedness in excess of the charter limits, and the fourth was that it violated an expressed provision of a general statute of Washington.

As for the first objection, the court ruled that as the contract in question was expressly limited to 25 years, and as no attempt was made to grant an exclusive privilege to the water company, the city acted within the strictest limitation of the charter.

The argument that the contract was void as an attempt to barter away the legislative power of the city council rested on the assumption that contracts for supplying a city with water are within the police power of the city, and may be controlled, managed or abrogated at the pleasure of the council. The Supreme Court ruled, however, that where a contract for a supply of water is innocuous in itself, and is carried out with due regard to the good order of the city and the health of its inhabitants, the aid of the police power cannot be invoked to abrogate or impair it.

Neither did the court consider the contract objectional for stipulating that the city should not erect water-works of its own during the life of the agreement. There was no attempt made to create a monopoly by granting an exclusive right to this company, and the agreement that the city would not erect works of its own was accompanied by the reservation of a right to take, condemn and pay for the water-works of the company at any time during the existence of the contract. The sections of the ordinance relating to this subject, according to the court, amounted simply to this: That, if the city should desire to establish water-works of its own, it would do so by condemning the property of the company, and making such changes in its plant or such additions thereto as it might deem desirable for the better supply of its inhabitants, but that it would not enter into a direct competition with the company during the life of the contract. As such competition would be almost necessarily ruinous to the company, it was little more than an agreement that the city would carry out the contract in good faith.

"An agreement of this kind was a natural incident to the main purpose of the contract—to the power given to the city by its charter to provide a sufficient supply of water, and to grant the right to use the streets of the city for the purpose of laying water pipes to any persons or association of persons for a term not exceeding 25 years. In establishing a system of water-works, the company would necessarily incur a large expense, in the construction of a power house and the laying of its pipes through the streets; and, as the life of the contract was limited to 25 years, it would naturally desire to protect itself from competition as far as possible, and would have a right to expect that at least the city would not itself enter into such competition. It is not to be supposed that the company would have entered upon this large undertaking in view of the possibility that in one of the sudden changes of public opinion to which all municipalities are more or less subject, the city might resolve to enter the field itself—a field in which it undoubtedly would have become the master—and practically extinguish the rights it had already granted to the company. We think a disclaimer of this kind was within the fair intendment of the contract, and that a stipulation to that effect was such a one as the city might lawfully make, as an incident of the principal undertaking."

The contention that the indebtedness created by the contract exceeded the amount authorized by the charter raised a serious question. The charter limit of indebtedness was $50,000, and when the contract was made with the water company the city's debt already exceeded $16,000. The hydrant rental of $1,500 a year for 25 years amounts to $37,500, which, added to the $16,000, would create a debt exceeding the statutory limit. It is unnecessary to review the decision on this subject at any length; it refused to consider such annual rentals as an indebtedness within the meaning of the charter.

The objection to the contract on the ground that it violated a general statute of the Territory of Washington, enacted December 1, 1881, was overruled. This section authorized all cities to contract for a term not exceeding 25 years with private water companies, but provided that before entering into any such a contract, its terms should be submitted to a vote of the taxpayers at a special election. No such election was held in this case, but the Supreme Court ruled that the general act of 1881 was, so far as it applied to Walla Walla, superseded by the charter of November, 1883.

As a final argument, it was claimed that the company had failed to comply with its contract to furnish an ample supply of good and wholesome water, that the pressure in the mains was not sufficient for fire protection, domestic purposes, the irrigation of lawns, or satisfactory use in the second stories of buildings, and that several of the additions to the city were higher than the reservoir, and could not be supplied from it. The court ruled, however, that these claims could not be set up as a defense in this action. One of the sections of the contract was expressly devoted to the statement of the conditions under which it was voidable; this has already been mentioned in this review. "Had the city failed to pay its quarterly rentals," the decision reads, "we should have no doubt that, in an action to recover the same, it might set up the failure of the company to perform its contract. Perhaps it might itself institute an action for that purpose, but we do not think it within the power of the city to constitute itself the judge and to proceed to erect water-works of its own upon the theory that the company had failed to carry out its contract, without obtaining the judgment of a court of competent jurisdiction to that effect. As the section provides the manner in which the failure of the company shall be legally established, we think the city was bound to pursue this course before taking steps to erect water-works of its own. We have already held that so long as the contract remained in force the city had no right to establish water-works, but the failure of the company to furnish a sufficient supply did not of itself avoid the contract. It rendered the contract voidable, not void. The city was bound to procure its nullity before the courts could treat it as void."

THE ERECTION OF THE ATTOK BRIDGE, INDIA.

The work of the civil engineer in India has been so vividly described by Rudyard Kipling that it is unnecessary to introduce this article with any reference to the trying conditions under which the public undertakings are carried on there. It is such a short time since his story of the "Bridge Builders" appeared, in which the Indian engineer's trials and triumphs are vividly sketched, that the following brief account of the methods, strange enough to Americans, of erecting a large bridge over the River Indus, is presented as a sort of supplement to that gifted author's tale.

This particular structure, known as the Attok bridge, has five spans, three of 250 feet and two of 300 feet, which are set on pyramidal iron piers, each having four double columns. The 250-foot side spans over the slopes down to the river were easily erected on a falsework of iron bents, connected by queen-post trusses on which the working platforms were laid.

With the 300-foot center spans the work was much more difficult. The river was subject to 70-foot floods, and the channel could not be obstructed by falsework, so to provide a clear waterway and avoid danger from the numerous rafts, boats and drift in the stream a system of fan-shaped falsework was constructed, as shown in the accompanying engravings. These were two sets of inclined struts in parallel vertical planes 19 feet apart, connected by horizontal transverse struts. These joined the intersections of the inclined struts with the horizontal longitudinal struts, which were 12 feet apart vertically. Timber X braces were also put in each panel of the inclined planes between the pairs of main struts. Across the tops of the main struts were longitudinal transverse stringers, composed of pairs of 12 x 12-inch timbers, breaking joints. Four rails were laid transversely across these beams at the head of each strut to carry the 12 x 15-inch traveler stringers and track rails.

The main struts were timbers 12 inches square, and of an average length of about 22 feet; they were spliced with wooden side plates and stirrup irons with screw ends, so as not to require boring. The center struts were made of three pieces 12 inches square. The horizontal struts, both transverse and longitudinal, were made of pairs of 6 x 12-inch pieces, running across the faces of the main struts, and bolted to them through continuous iron washer straps. The ends of the horizontal struts were secured to the permanent piers by U-shaped iron straps embracing the columns and bolted on each side of the struts. The inclined struts were erected successively from the piers to the center of the span, and temporarily supported by the horizontal struts attached to the columns of the piers, and acting as back stays. In the horizontal planes of all the struts above the fourth tier were diagonals of 1-inch chains, adjusted by screw couplings.

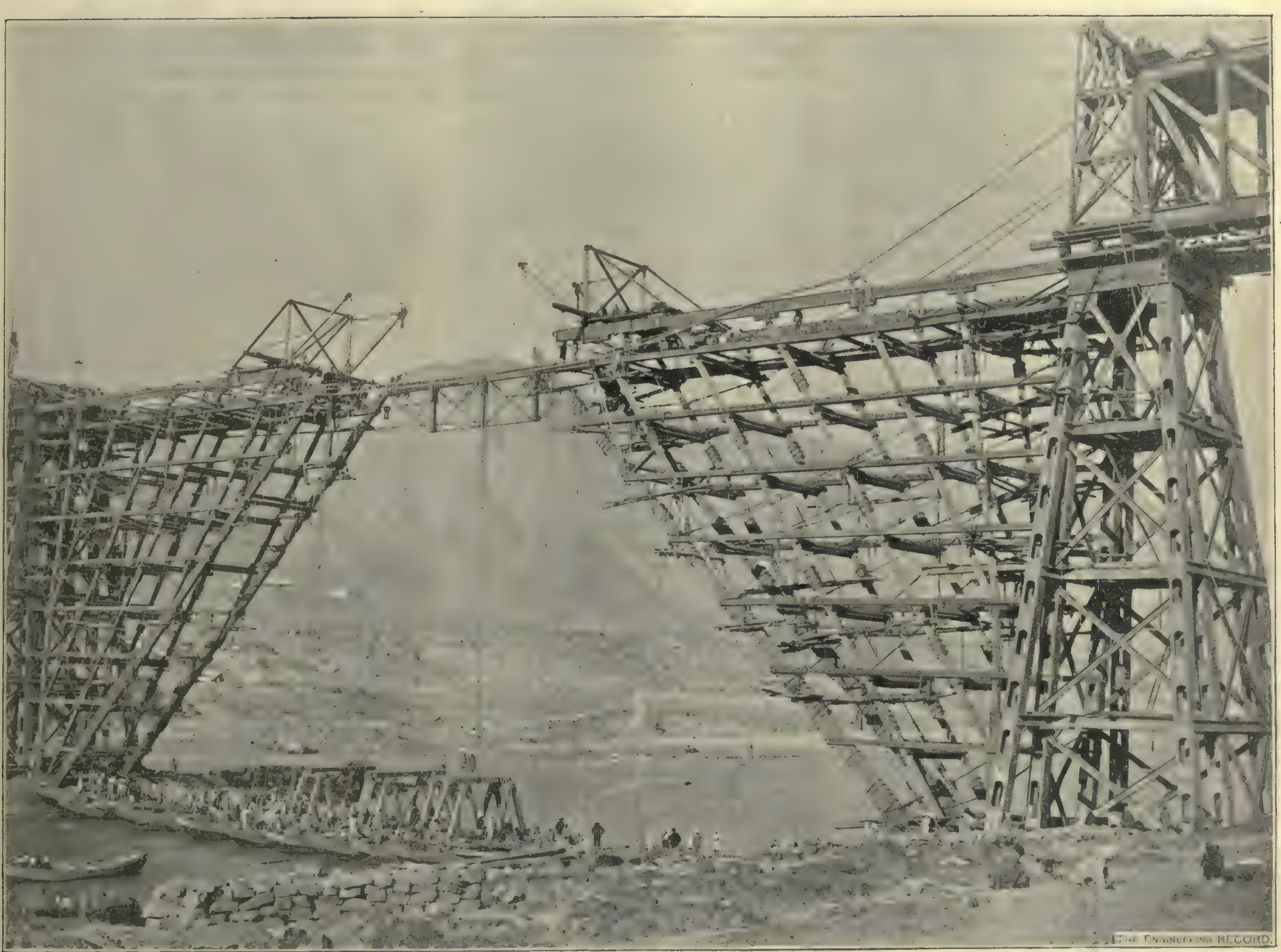
After the two center inclined struts of each side were set, their upper ends were connected by the top chord of a 63-foot queen-post truss 10 feet deep, having 2-inch round-iron bottom-chord bars. These trusses were assembled and floated into position on boats, then raised bodily and dropped into position, with the cast-iron sockets at the ends of their top chords engaging the tops of the inclined struts. The falsework materials and center trusses were handled by fixed tackles attached to two pairs of 2¾-inch manila cables, which were anchored to the completed shore spans and passed over a pyramidal tower of wooden sleepers piled up on top of the center pier. The maximum deflection of the falsework under the 600-ton load of bridge span was 1⅛ inches, and it took about four months to build it. The falsework was securely guyed by lines up and down stream, and the cableways were rigidly guyed down by anchor ropes at several places, and by attachment to the falsework.

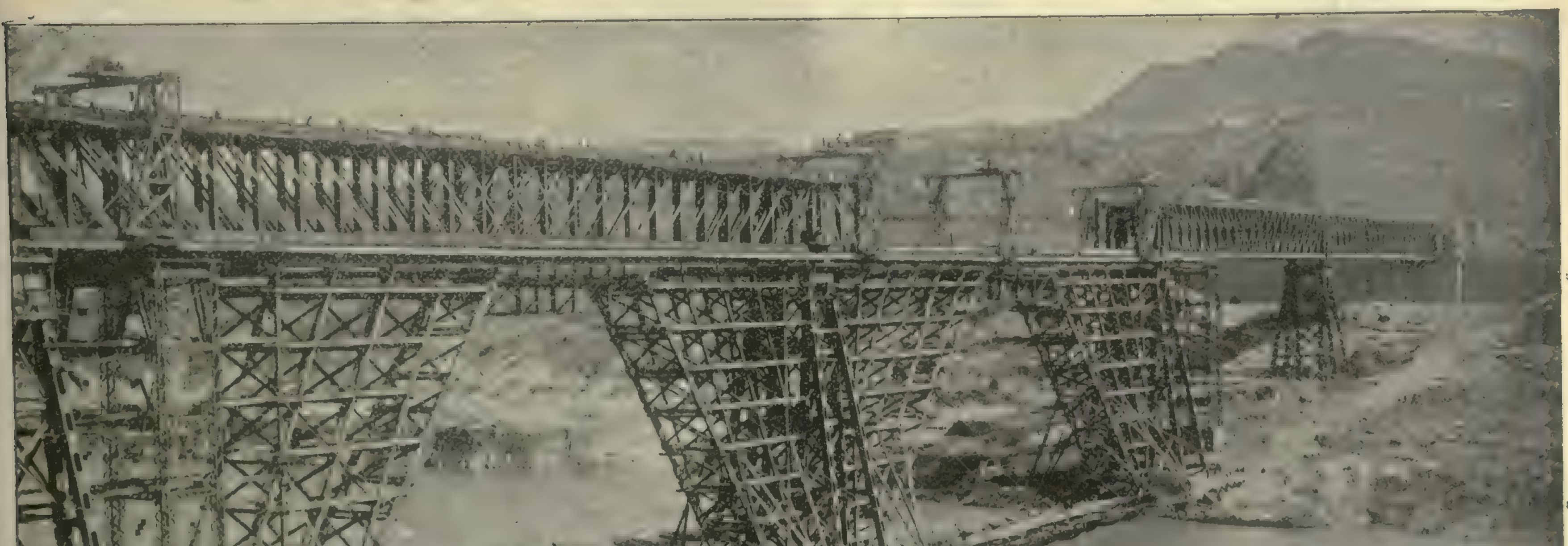
The material for the permanent trusses was delivered by a narrow-gauge railroad track on top of the falsework, and was assembled by small traveling girder cranes strident of the spans, and by traveling boom derricks, both operated by hand. The truss connections were riveted, and a large part of the work was done by native workmen. In one of the 300-foot spans the waterway did not extend quite to the side pier, and the dry land thus available was utilized to receive a falsework tower of iron column sections, which served to reduce the length of that span of fan-shaped falsework.

This bridge was built by Mr. F. L. O'Callaghan, chief engineer of the Punjab Northern State Railway, and was mentioned by Sir Guilford Molesworth, K.C.I.E., M.I.C.E., in his lectures on railway construction before the Corps of Royal Engineers. Acknowledgment is made to him for the above facts, and for photographs from which the accompanying illustrations were prepared.

Water Rights were recently before the Supreme Court of Pennsylvania in the case of Phillipsburg Water Company v. Citizens' Water Company, 41 Atl. Rep. 979. It was decided that where a water company appropriating water from a stream has never condemned the stream, or any portion of it, its rights, as against another company seeking to appropriate water from the stream nearer its source, are merely those of a lower riparian owner.

Interesting Subaqueous Pipe Laying was carried out some time ago at New Haven, Conn., under the direction of Mr. Albert B. Hill, M. Am. Soc. C. E., who states that the work involved running about 700 feet of 16-inch gas pipe and the same length of 24-inch water pipe across an estuary where the tidal movement is about 6 feet, and the water is from 2 to 4 feet deep at low tide. The bottom is harbor mud for a depth of 15 to 23 feet below low water, and then from 2 to 8 feet of sand and gravel intervene before rock is reached. The Federal requirement was that no part of the mains between the bulkhead lines should be less than 15 feet below mean low water; they were actually placed a trifle lower. It was necessary to lay the gas main at a grade which would allow it to drain into a sump located at one shore end. As the depth at which it was decided to lay the mains left some of the mud beneath them, and in order to insure a true grade, they were placed for most of the distance on a pile foundation, with two piles in each bent driven to the rock, the bents being 12 feet apart on centers. A trench was first dredged to a little below the required depth of the mains, the piles were next driven and cut off by a submerged saw, and the caps were finally put on and doweled by a diver. The mains are cast-iron flanged pipes, which were generally bolted up on shore in three-pipe sections, with a Falcon flexible joint on every third pipe, except where the pipes curved up near the ends, where each joint was a flexible one. The pipes were floated out in sections, sunk, and when in position the flexible joints were bolted up by Mr. Falcon and secured by chocks spiked on the caps. On the final test, the gas main was absolutely tight at 80 pounds pressure. The water main leaked but very slightly, the rate being about 8 gallons per hour. The work cost about $16,000 and was done in a satisfactory manner by Mr. Joseph G. Falcon, of Chicago.





THE ERECTION OF THE FALSEWORK AND SPANS OF THE ATTOK BRIDGE, INDIA.

MR. FRANCIS LANGFORD O'CALLAGHAN, M. INST. C. E., C. S. I., C. I. E., ENGINEER.

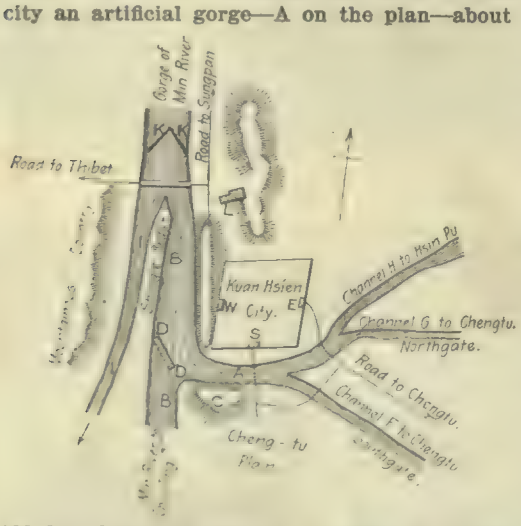
IRRIGATION IN THE CELESTIAL EMPIRE.

An entertaining account of one of the oldest engineering undertakings still in regular service, the Kuan Hsien irrigation system in China, recently appeared in the columns of "The Engineer," of London. It was written by Mr. S. J. L. Litton, of the British consular service, and is so good it is reproduced below, verbatim.

"The works at Kuan Hsien on the west edge of the plain—120 li from the west gate of Chengtu—deserve for their ingenuity and simplicity and utility to be ranked among the first public works of China. A reliable tradition ascribes the commencement of the work to Li Ping, the first "t'ai shou," or hereditary governor of Chengtu, who was appointed by the Ch'in, after they had overthrown the aboriginal kingdom of Shu, and the completion of the work to Li Ping's son. It is satisfactory that the Kuan Hsien irrigation is not attributed to the great Yü, about whom so many fabulous stories are current in the province, and who is popularly worshipped as the Lord of the Waters; for we could not but be reluctant to accept stories about a man who was born in three places and died in as many more.

"The objects which the ancient engineer seems to have set before himself were, (1) to prevent an excessive rush of water down the west of the plain; (2) to irrigate the north and center of the plain; (3) to effect this by connecting the watersheds of the Min and Lü rivers by streams across the plains.

"The city of Kuan Hsien is situated at the point where the Min River issues from a magnificent gorge on to the plain. The west bank of the river is fringed by high mountains, and the east bank is separated from the west wall of the city by a high bluff, which runs south beyond the city into the plain for about 200 yards. Just under the southwest corner of the city an artificial gorge—A on the plan—about



100 feet deep, has been cut through the living rock. Through this gorge a copious stream, about 40 yards broad, has been diverted eastwards at right angles from B, the main stream of the river; the tail of the cliff C has thus been left like an island, surrounded to the north and west by water, and the east and south by the plain. The plain dips down to the east and south—though this is not perceptible to the naked eye; thus a part of the water of B, foiled in its effort to go south partly by the cliff C and partly by the big dyke D, forms a whirlpool under the cliff, and then rushing out of the gorge A, runs like a mill race past the south gate E. Both sides of the channel are strongly bunded with stones packed in bamboo baskets. Just east of the south gate this stream is artificially divided into two channels, one of which, F, flows across the plain to the south gate of Chengtu, and the other, G, navigable in summer for timber rafts, flows to the north gate, and is connected with F by the navigable stream which flows under the east wall of Chengtu. The high road from Kuan Hsien to Chengtu thus passes between the two channels F and G. Between Kuan Hsien and P'i Hsien—22 miles—these two streams are connected by two minor channels flowing from F to G, i. e., from south to north across the high road, but the bulk of the water that comes through the gorge is diverted past the east gate of the city, and away to the northeast—channel H on the plan—passing between the cities of P'eng Hsien and Ch'ung Ning Hsien, each 20 miles from Kuan Hsien, to the north-northeast and northeast respectively. Flowing across the whole of the plain, and irrigating it as it goes, this important channel joins the upper waters of the Lü River at the city of Hsin Tu, twelve miles to the northeast of Chengtu, thus connecting two distinct watersheds. The channels near Kuan Hsien are certainly artificial, but further to the east advantage has probably been taken of natural watercourses. I may add that the latest map of China—Bretschneider—has got these streams all wrong.

"Li Ping bequeathed to posterity as the principle of regulating the waters the two sentences, 'Shen t'ao t'an, ti tso yen,' i. e., 'dig the channels deep and make the dykes low,' that is, keep the water at its natural level—a principle which, if it had been applied to the Yellow River, would have saved untold misery and loss.

"Just below the point where the Min issues from the mountains it sends off a subsidiary stream I. Advantage is taken of this to construct a movable barrier K, consisting of a series of tripods, each made of three saplings 15 feet high, lashed together at the tops fixed in the bed of the river. These are then filled up with bamboo baskets full of large stones; the great dyke D is of a similar character; this is thrown slantwise across the main stream at the mouth of the gorge A, with the object of driving the water into the gorge. In the month of November, when the water is sufficiently low, the Shui Li Fu, or prefect of the waterways, who is resident at Kuan Hsien, and has direct control of the works, sets to work to make the western half of the barrier K. This shuts off the water from the subsidiary channel I. I is then dug out for a distance of three-quarters of a mile, and the stonework is pulled to pieces and carefully restored. The west half of the barrier K is then removed, and the eastern half is constructed. This turns the water back to I, and shuts it off from the main channel B, and in consequence from the gorge and its three channels, F, G, H. All the channels B, F, G, H, are then carefully dug out for a distance of about three-quarters of a mile. From 5 feet to 6 feet of gravel and sand, the accumulation of the year, is removed. In the middle of the gorge are three iron pillars placed flat on the bottom of the stream; one is dated Hsien Feng, one is of the Ming dynasty, and one has now vanished altogether. The object of these pillars is to mark the proper level of the stream, and the workmen have to dig down to them and no further. The great dyke D is repaired, and the stone bunds along the various channels are entirely removed and replaced as strongly as possible. Thus year after year for 2,000 years has Li Ping's motto been carried out.

"By the month of March, when water is required for the paddy fields, all is ready, and the *deus ex machina* in the person of the Taotai from Chengtu appears upon the scene. He solemnly receives a present of 200 taels from the two magistrates of Chengtu for his expenses; then he performs ceremonial devotions at Li Ping's temple—L on the plan; and then he orders the barrier K to be removed.

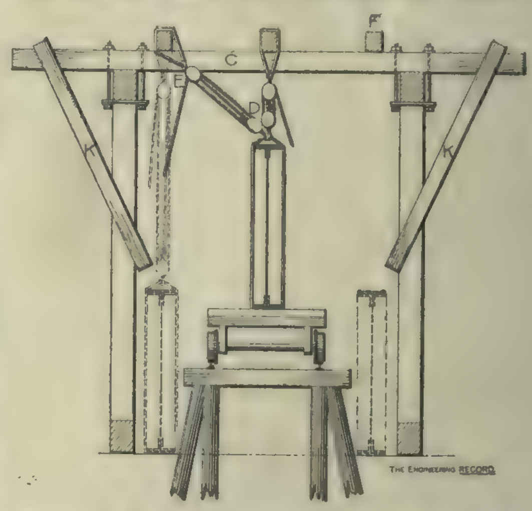
"At this juncture his attendants are supposed to dash at the water and urge it forward with strokes of the bamboo; the Min, thus hastened in its course, rushes back into its main channel, and the gorge A, with all its channels—F, G and H—are at once filled with the fertilizing stream, which is poured over the whole plain.

"The object of the great bund D is to secure a sufficient supply of water through the gorge. If the water rises very high it flows over the barrier and down to the south; a gauge is cut in the rock in the middle of the gorge, and it can be seen at a glance if too much or two little water is coming in. But a hitch very rarely occurs.

"The Viceroy, Ting Pao Cheng, the predecessor of the notorious Lui, got into trouble by making the big dyke too high when he repaired it, with the result that too much water came through the gorge, and the plain was flooded."

REPLACING A 122-FOOT BRIDGE.

In replacing a single-track Howe truss bridge on the Rome, Watertown & Ogdensburg Railroad across the Oswegatchie River, the track was first supported on trestle bents set up in the river bed, and then the old trusses were temporarily braced transversely and the top and bottom lateral systems removed. At each end two long 12x12 inch timber caps C were placed side by side on top of and across the top chords and clamped to them so as to overhang on opposite sides, one overhanging end of each cap being clamped loosely and the other end tightly.



Planks K K were fastened to the truss and the cap to serve as knee braces and keep the trusses vertical. The temporary braces were removed and the old trusses jacked apart, sliding along on the abutment until they were 18 feet center to center, as shown, when the loose clamps were tightened up and made the structure stable and rigid. Then two three-part tackles E and D were hung over the center of the girder line and the center of the tracks respectively, and one of the new plate girders, 122 feet 6 inches long, 10 feet 6 inches deep, and weighing 46 tons, was run across the river on its cars as shipped, lifted by a tackle D at each end and lowered by two other tackles E to its required position. Tackle D was then shifted to position F over the center line of the girder, tackle E was shifted to D, and the other girder was brought in and similarly unloaded. After this the new bridge was completed and the old one and the trestling was removed. The entire work was quickly and economically accomplished without steam power by 10 men. Hoisting was done by two pairs of crabs anchored to the track and arranged to pull directly against each other. At one end of the bridge, 50 or more feet away from the river, two long timbers were placed across the track and fastened to the rails at right angles with their centers, underneath them and 4 or 5 feet apart. On the other ends of these timbers, on each side of the track, were built small platforms, and a crab was fastened to each. In the same manner two crabs were set on the opposite bank of the river, thus making a connecting strut of the section of track between them, and at the same time affording an excellent anchorage to fasten ropes to the cross timbers for guying the gallows frames if it had been desired to use them instead of the lifting caps described.

This work was done by the Elmira Bridge Company, Mr. A. H. Hamilton being in charge.

THE WATER-WORKS OF PLYMOUTH, ENG.

The water-works system of Plymouth is the oldest in England which was constructed by a municipality and kept continuously within its control. Sir Francis Drake secured an Act of Parliament some time between 1580 and 1590, empowering the Corporation of Plymouth to construct a system taking water from the River Meavy. In December, 1590, an open channel built of wood and called a leat was begun, which was completed the following April. It was 18½ miles long, although the direct line between the two ends was only 10½ miles, and conducted water to a system of conduits laid through the town. This served without any additions for over two centuries, and it was not until between the years of 1880 and 1893 that the sides and bottom of the leat were replaced with granite walls and a concrete floor, defining a channel 7 feet wide and 2 feet deep. In 1828 the first service reservoir was built within the town, at a height of 146 feet above sea level. A second reservoir 1½ miles up the valley and 316 feet above sea level was opened in 1860. A third, still higher, followed, and in 1886 the fourth and largest, called the Roborough reservoir, was built at an elevation of 547 feet. Between the highest and lowest sections of Plymouth there is a difference of level of about 600 feet, and the different elevations were supplied from the four separate reservoirs. But the combined capacity of these reservoirs was only about 16,000,000 gallons, which became inadequate as the city increased in size. In 1881, and again in 1891, violent snowstorms closed the leat, and water famines resulted, until it was opened by a force of military and laborers. In addition to this, the ill effect of the surface drainage and the drinking of cows from the leat were causing trouble.

After the famine of 1891 Mr. Edward Sandeman, M. Inst. C. E., was appointed water engineer to investigate an extension of the system. At this time the population of the city was 89,800, and the average total consumption per day was 6,300,000 gallons, or an average per head of about 70 gallons. This was considered excessive. The city was divided into districts and each supplied with a waste-recording apparatus. By this means the total consumption was reduced to 4,800,000 gallons per day, or an average per head of about 52 gallons. In figuring on a new supply, the population was assumed to increase in 25 years from 89,800 to 130,676, and the consumption per capita was assumed as 70 gallons. After much discussion the site of a new reservoir, called the Burrator reservoir, was finally selected at a distance of about 10 miles from Plymouth, and covering the site of the weir originally built by Sir Francis Drake.

The drainage area of the reservoir is between 8 and 9 square miles. The average annual rainfall is quite variable. At the northern boundary it is 80 inches, while at the southern boundary it is but 59 inches, and it is probable that in some places it is not more than 50 inches. The average for the whole area may be taken as 65 inches. The total yield on the basis of the average rainfall of three successive dry years is more than 14,400,000 gallons per day, and on the basis of a single dry year, such as 1887, it is more than 9,000,000 gallons per day. As the consumption at present is but 4,800,000 gallons per day, it is seen that the city will have a plentiful supply of water for a number of years to come.

The new reservoir is about 1¼ miles long, with a greatest width of ½ mile, and an area of 116 acres. Its greatest depth is 80 feet, and it has a capacity of 786,000,000 gallons. In order to store this amount of water two dams were necessary; one at the outlet of the southern end, called the Burrator dam, and one at a low place on the eastern side, called the Sheepstor dam. The latter will be described first.

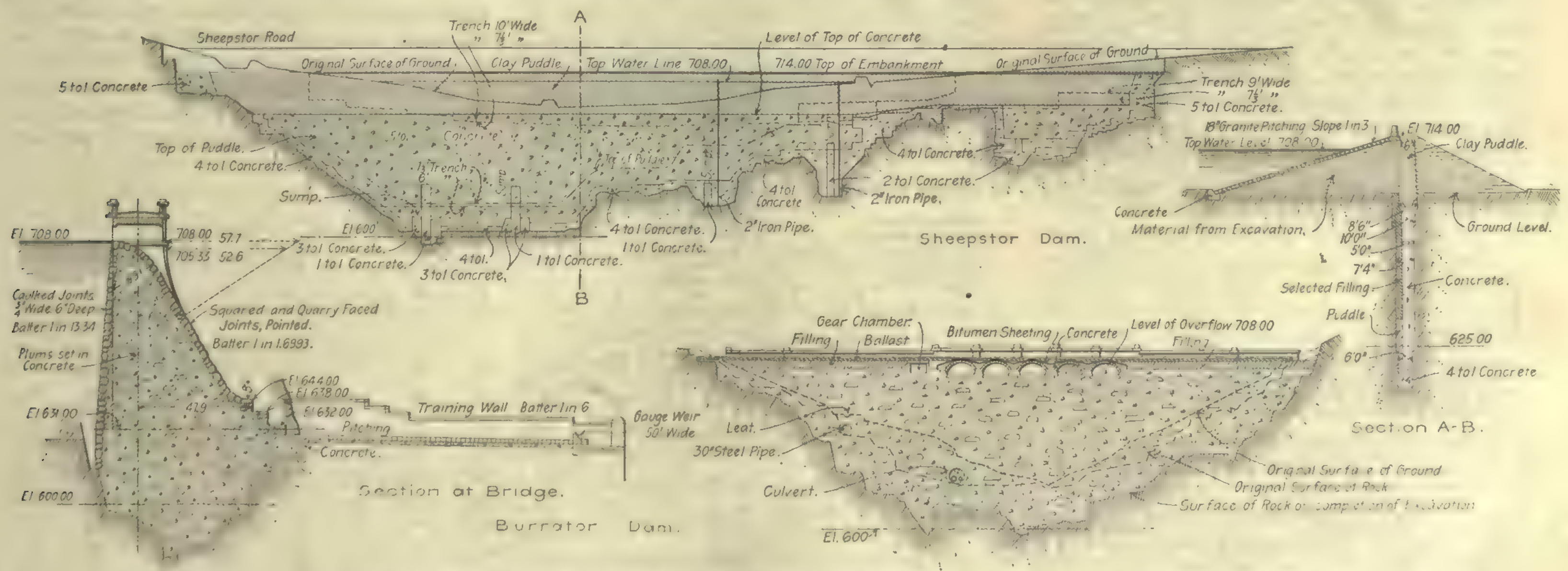
The Sheepstor Dam.—This is but 30 feet high above the ground, and were it not for the foundations would have been a comparatively simple affair. The site of the whole reservoir is covered to a considerable depth with decomposed granite, resting on solid rock. Through the decomposed granite are a large number of veins of hard rock, granite or quartz, varying in width from 1 inch to 3 feet, with cross-veins of smaller size. These veins are much like a close fitting rubble wall with joints through which the water could pass. At the site of the Sheepstor dam they ran at an angle of 45 degrees with the dam, and in some cases to a depth of 100 feet or more. The removal of these veins and of the solid rock was done by manual labor, without any blasting, as the use of an explosive would have aggravated the trouble. In order to remove all of this loose matter and get a solid rock foundation it was necessary to go to a great depth, in one case to 105 feet below the surface. From the bottom of the trench to the top of the embankment measures 118 feet, and the work of excavation alone took 15 months.

Large quantities of water ran into the trench, principally from the veins of loose rock, and for nearly two years from 480,000 to 600,000 gallons were pumped every 24 hours. The trench at the bottom was 6 feet wide, and was filled with a concrete wall 5 feet thick to a height of 70 feet. From this point to the top was a puddle wall of clay, around which was built the embankment, of material from the excavation. On the water side of the concrete wall 18 inches of puddle was tightly packed to a considerable height and then selected material was used to the surface of the ground. The concrete used in the trench was made in different proportions, varying, according to the number of fissures found, between one to one and five to one. The dam is 700 feet long, 10 feet wide on top, and the depth of water at the toe is 18 feet.

The Burrator Dam.—This is said to be the third largest stone dam in England, and the only one constructed of granite. It is 80 feet thick at the foundation, 62 feet at the level of the river bed, and 20 feet on top. From the foundation to the coping of the parapet walls is 143 feet. Two fissures of great depth were found in the rock, and running at right angles to the bank. These were excavated and filled with rubble concrete. About 35,000 cubic yards of material were removed to get in the foundations, which in places were carried down 50 feet below the bed of the river. In the course of the work it was necessary to divert the flow of the River Meavy, which was done at first by means of a temporary timber conduit or launder. Afterwards this was replaced by a culvert 10 feet in diameter, made through the dam at about the level of the old river bed. Later on two pipes were placed in this. When the time came to fill the reservoir, the upper end of the culvert was closed with an iron door and the inside filled with a solid mass of concrete. About 100 feet away and at a different level a 30-inch steel pipe was put in, which furnishes a supply of water to the leat, but will ultimately be connected with the pipes which supply the town.

The materials used in the dam were granite, in the form of ashlar and rubble work, and Portland cement concrete. The hearting is of large blocks of granite, some of them weighing over two tons, placed close together, but without touching. Each stone was carefully washed and scraped, then bedded in cement, beaten down by heavy mauls, and run around with concrete. The joints between the blocks on the water face of the dam were cut out to a depth of 6 inches and a width of ¾ inch, and these spaces were filled with neat Portland cement carefully calked. About 45,000 cubic yards of masonry and concrete were used in the construction of the dam.

Particular care was taken with the cement used in the work. It was taken from the storehouse and spread out in the airing shed. After being thoroughly aired it was spread successively on three floors, being transferred from one to the next by a mechanical device. From the last floor it was dropped into a hopper and carried to the site of the work, where it was tested. Concrete made with this cement withstood a



THE BURRATOR AND SHEEPSTOR DAMS, PLYMOUTH WATER WORKS.

MR. EDWARD SANDEMAN, M. INST. C. E., CORPORATION WATER-WORKS ENGINEER; MR. JAMES MANSERGH, M. INST. C. E., CONSULTING ENGINEER.

pressure of 500 pounds per square inch, and had an average weight of 150 pounds per cubic foot. In making the concrete a spiked rammer, designed by Mr. Sandeman, was used to pierce the concrete, and thus allow the escape of any air which might be retained between the stones.

Running lengthwise through the dam is a tunnel 2 feet 6 inches wide by 6 feet high, which allows of an easy internal inspection. The waste way is in the center of the dam, and a roadway is carried over it by five arches of 25 feet span each. At the bottom of the dam are three steps, on which the waste water from over the crest strikes and then passes to a channel leading to a pool, and then to a weir. The law requires that an amount of water equal to 480 gallons per minute shall be returned to the river. This water is taken from the overflow and measured by passing over a weir, and is then turned into the old channel. It is proposed to use the water which comes over the crest to work two hydraulic rams for pumping water to the village of Yelverton, which is supplied directly from the Burrator reservoir by a 7-inch pipe. At present the water reaches only to the lower portions of the village, and these hydraulic rams are to be used in forcing it to the highest portions.

From the Burrator reservoir there is a line of 25-inch cast-iron pipe to the Roborough reservoir. The line is as nearly direct as possible, and has a capacity of 12,000,000 gallons per 24 hours when the reservoir is full, and 9,000,000 gallons per 24 hours when there is a head of 2 feet on the inlet pipe. The thickness of the pipe varies from 13/16 to 1¼ inches. It was tested with oil to a pressure varying from 260 to 300 pounds per square inch, while the maximum working pressure is but 150 pounds. Air valves were put in at all high points, and blow-offs at all low points, and, in addition to these, sluice valves with 6-inch by-passes were put in every half-mile. Where the line passes under two rivers, riveted steel pipe with flanged joints were used. It also passes under a railroad in a subway 7½ feet in diameter, and then over a hill 200 feet high; as an extra precaution this section is of riveted steel ½ inch thick and has flanged joints. The pipe line is 4½ miles long and cost about £23,000.

There is yet to be built at the head of the valley a third dam of small dimensions, to prevent stones, timber and débris of all kinds from getting into the reservoir in time of floods.

At low places in the city, where the direct pressure would be too great, reducing valves were put in. One of these reduces the pressure from 135 to 85 pounds, and governs the supply for 20,000 people.

The work of building this reservoir covered five years' time, and was done entirely by day labor under the direction of Mr. Edward Sandeman, M. Inst. C. E., the water-works engineer to the Corporation. Mr. James Mansergh, M. Inst. C. E., was consulting engineer. The total cost of the reservoir and pipe line was about £175,000. These facts and illustrations have been compiled from "The Engineer" and "Engineering."

THE FINE GRINDING OF PORTLAND CEMENT.

Among recent articles on the subject of Portland cement, one of the most interesting is a discussion of the effect of fine grinding on the strength of Portland cement, which was contributed to the "Selected Papers of the Institution of Civil Engineers," by Mr. David B. Butler. In view of the general interest in this subject it is reprinted practically in full.

The experiments described in this paper were instituted by the author in the first instance to investigate the generally accepted theory as to the inertness of the coarser particles of Portland cement, the results of which suggested the subsequent series as to the effect of fine grinding. As a preliminary experiment, the coarser particles of cement A, Table I., were separated into

Table I.—Preliminary Experiments with Coarse Material.

No. of Cement.	Size of Particles. Passed.	Held by	Tensile Strength. Lbs. per square inch. 6 months.	12 months
A	....	50-mesh	150	160
A	50-mesh	70-mesh	200	200
A	70-mesh	120 mesh	250	330
B	....	50-mesh	95	120
B	50-mesh	70-mesh	110	160
B	70-mesh	120-mesh	175	200
C	....	50-mesh	90	120
C	50 mesh	70-mesh	140	170
C	70-mesh	120-mesh	190	280
D	. ...	50-mesh	90	140
D	50-mesh	70 mesh	115	197
D	70-mesh	120-mesh	192	200
E	50 mesh	70-mesh	. .	180
E	70-mesh	120-mesh	190	292
E	120-mesh	180-mesh	330	420

three degrees of coarseness, viz., those which would not pass through a sieve having 50 meshes per lineal inch, those which passed a 50-mesh sieve and were retained on a 70-mesh, and those which passed a 70-mesh sieve and were retained on a 120-mesh, and briquettes formed from the grit thus obtained. To insure that the cohesive strength developed was actually due to the cementitious value of the coarse particles themselves, and not the fine cement dust adhering to them, each lot was thoroughly washed by shaking it briskly with water in a bottle, decanting the turbid fluid, adding fresh water, and repeating the operation until the water was no longer turbid; about ten changes of water sufficed for this purpose. The washed substance was then immediately filled into a briquette mold of 1 square inch section, lightly shaken, without ramming, to eliminate any air-bubbles, and placed under water. On examination a day or two afterward the mass was found to have hardened considerably, and in a few days, according to the size of the grit, it was sufficiently hard to bear removal from the molds. The briquettes thus formed were tested for tensile strain at the end of 6 months and 12 months respectively, with the results given in Table I. As the 6 months' test indicated clearly that the coarse particles thus treated had a certain value, a set of experiments was instituted with four other cements, B, C, D and E. The results corroborated those obtained in the first instance, as will be seen on reference to the same table.

The coarse residue has hitherto been considered inert, and by some authorities has been even regarded as an adulterant, but the above results conclusively demonstrate that such is by no means the case. The author therefore proceeded to ascertain more exactly the relative value of the particles of different sizes, and also whether their total removal from the cement affected the strength of the material. If, after a considerable lapse of time, the coarser particles had a certain value, it seemed possible that the extreme fine grinding of cement might not be such an unmixed advantage as was generally supposed, but that it simply enabled the cement to attain its greatest strength more quickly, by reason of the water being able to more readily combine with fine than with the coarse particles. In that case the ordinary 7-day or 28-day tests with very fine cements were more or less delusive, for though a finely ground cement would show to greater advantage within such limited periods, the coarser cement would ultimately be equally strong; in other words, the "growing" power of cement, or its property of increasing in strength with age, was largely due to the gradual incorporation of the coarser particles. The following experiments, though supporting this theory to a certain extent, conclusively demonstrate the advantages of finely ground cement.

In order to procure a fair representation of English cements, samples were obtained from the principal manufacturers in the four chief centers of the industry, viz., cement F from the Lias districts of Warwickshire, cement G from the Northfleet shore of the Thames, cement H from the Grays shore of the Thames, and cement I from the Medway district. Comparative tests were made of each sample under the following conditions: (1) As received from the manufacturer; (2) reground in the author's mill so as to practically all pass a 180-mesh sieve; (3) all particles removed that would not pass a 180-mesh sieve, and an equal quantity of grains of sand of exactly the same size substituted. The value of each cement thus treated was ascertained by determining its tensile strength in the ordinary way at 7 days, 28 days, 3 months, 6 months, and 12 months, both neat and with three parts of standard sand, and the results of this series of tests are given in Table II.

Referring first to cement F it will be seen that the effect of grinding it extremely fine is that when gauged neat it is slightly stronger than the original cement at 7 days, but shows very little increase at 28 days, and then gradually falls off, being 22 per cent. weaker at the end of 12 months than the original cement. The 3-to-1 sand briquettes, on the other hand, are 89 per cent. stronger at 7 days than similar briquettes made with the original cement, and continue to increase, till, at the end of three months, they are actually stronger than the neat briquettes, while at the end of 12 months they are not only 32 per cent. stronger than the sand briquettes of the original cement, but are within 3 per cent.

Table II.—Tests of Cement of Different Sizes, Mixed Neat and With Standard Sand.

Cement.	How Treated.	Fineness-residue per cent. on Sieves of Meshes per Lineal Inch. 180	76	50	Setting Properties. Initial Set. Mins.	Set Hard Mins	Percentage of Water used for Gauging Briquettes. Neat.	Sand.	Tensile Strength in Lbs. per Square Inch. Neat Cement. 7 Days.	28 Days.	3 Mons.	6 Mons.	12 Mons.	3 parts Sand to 1 part Cement. 7 Days.	28 Days.	3 Mons.	6 Mons.	12 Mons.
F	As received from manufacturer	33 0	16.0	4.0	15	90	21.66	7.81	483	572	623	662	653	183	276	383	440	482
"	Reground extremely fine	2.5	Nil	Nil	4	60	25.00	9.38	498	541	538	531	506	347	452	564	599	637
"	All particles not passing 180 sieve removed and sand of similar size substituted	....	....	....	......	......	18.33	7.81	418	456	567	596	650	153	210	272	337	386
G	As received from manufacturer	35 0	20.0	8.0	10	90	20 00	7 81	495	618	622	694	759	187	245	334	377	392
"	Reground extremely fine	1.0	Nil	Nil	1	4	25.00	8.13	540	474	560	466	477	282	363	494	595	617
"	All particles not passing 180 sieve removed and sand of similar size substituted	....	....	....	......	......	18.33	7.81	403	448	602	678	714	158	209	303	348	378
H	As received from manufacturer	28.0	11.0	4 0	8	60	19 16	7.81	445	493	584	663	706	167	230	312	373	399
"	Reground extremely fine	0.8	Nil	Nil	2	5	26.66	8 13	433	501	514	482	535	287	364	508	585	599
"	All particles not passing 180 sieve removed and sand of similar size substituted	....	....	....	......	......	18.33	7.81	367	453	604	669	692	145	212	271	348	405
I	As received from manufacturer	39.0	15.0	2.5	20	120	20.00	8.59	592	639	736	791	751	240	297	389	425	410
"	Reground extremely fine	0.8	Nil	Nil	2	10	30.17	11.26	417	394	459	476	498	387	465	560	585	618
"	All particles not passing 180 sieve removed and sand of similar size substituted	....	....	....	......	......	18.33	7.42	470	565	653	698	754	200	246	312	382	380

of the strength of the original cement gauged neat.

The effect of substituting sand for the coarser particles is to weaken both the adhesive and cohesive power of the cement, especially at the earlier dates, although at 12 months the neat briquettes thus prepared appear to have nearly caught up to the original cement. The results obtained with cements G, H and I corroborate cement F fairly well, and although in some instances the substitution of particles of sand for the coarse particles of cement does not seem to affect the result to the same extent, in every case the extreme fine grinding decreases its cohesive power, but immensely increases its adhesive power or cementitious value. These results demonstrate clearly that in testing cement, to determine its constructive value, the neat test alone may be altogether delusive. It will be seen that in each case the fine cement is far inferior to the coarse one when tested neat, yet its cementitious value, as indicated by its power of cementing together particles of sand, is immensely superior. Until recently the author was strongly adverse to the adoption of the sand test, inasmuch as it first involved the testing of the sand, thus adding a further element of error; but when it is found that a very finely-ground cement, with more than 30 per cent. greater cementitious value, gives inferior results when tested neat, there is no doubt as to which is the truer test of the two. Moreover, in the course of recent researches as to the effect of admixtures of Kentish ragstone upon Portland cement, the author found that it was possible, in some cases, to add as much as 20 to 30 per cent. of finely ground sand to a cement without materially affecting its strength when tested neat, although when tested as a mortar with 3 parts of standard sand the adulteration was immediately detected.

The coarse residue separated from each of the foregoing samples was divided into different grades, and was washed and treated in an exactly similar manner to samples A, B, C, D and E, with the results given in Table III. Although

Table III.—Second Set of Experiments with Coarse Material.

No. of Cement.	Size of Particles. Passed.	Held by	Tensile Strength. Lbs. per square inch. 6 months.	12 months.
F		50-mesh	95	130
F	50-mesh	76-mesh	120	170
F	76-mesh	120-mesh	245	300
F	120-mesh	180-mesh	310	360
G		50-mesh	47	70
G	50-mesh	76-mesh	105	165
G	76-mesh	120-mesh	175	300
G	120-mesh	180-mesh	185	410
H		50-mesh	92	145
H	50-mesh	76-mesh	132	235
H	76-mesh	120-mesh	[illegible]	385
H	120-mesh	180-mesh	280	[illegible]
I		50-mesh	47	85
I	50-mesh	76-mesh	80	145
I	76-mesh	120-mesh	122	225
I	120-mesh	180-mesh	280	430

the method adopted to avoid the possibility of fine dust adhering to the particles was severe, the results show that at all events in wet situations, where water is able to act upon them, the coarser particles of cement have a distinct value, and that this value is, roughly speaking, inversely proportional to the diameter of the particles. A miscroscopic examination of a section of a briquette composed wholly of such coarse particles shows that each particle is surrounded and cemented together by a white deposit of a crystalline nature; this deposit, in briquettes composed of residue on a 50-mesh sieve of cements C and D, was separated mechanically as far as possible, and proved on analysis to consist as follows:

	C.	D.
Carbonic acid	11.80	14.00
Water	24.90	20.60
Insoluble residue	trace	trace
Silica	8.12	6.42
Alumina and oxide of iron	9.22	8.47
Lime	43.47	48.57
Magnesia	0.99	0.59
Sulphuric acid	1.35	1.11
Alkalies and loss	0.15	0.24
	100.00	100.00

A noteworthy feature of its composition is that the percentage of alumina is considerably greater than that of silica, thus reversing the composition of the cement proper, in which the amount of silica is generally about double that of the alumina, and indicating that the crystals consist largely of the more soluble aluminate of lime.

(To be Continued.)

THE NEW PLANT OF THE COPLAY CEMENT COMPANY.

The works of the Coplay Cement Company were described at length in "The Engineering Record" of December 18, 1897, by Mr. Frederick H. Lewis, M. Am. Soc. C. E. Since that article was written the company has begun the construction of a new plant, designed by Mr. Charles M. Saeger, its general manager, who furnishes the following particulars concerning its general arrangement. Its capacity will be from 1,200 to 1,400 barrels a day.

The raw materials will be procured from the present quarries, which are close by, and are handled by a narrow-gauge track system, which includes four locomotives with a large number of cars. The dimensions of the buildings are as follows: Boiler house, 110 x 65 feet; engine house, 185 x 50 feet; kiln building, 170 feet square; stone house, 85 x 50 feet; drying house, 50 feet square; raw stone grinding mill, 170 x 60 feet; clinker grinding mill, 170 x 50 feet; cement storehouse, 250 x 100 feet; cooper shop, 100 x 50 feet. The raw and clinker grinding mills will be two stories in height, all the others one story.

The boiler house contains four Stirling water-tube boilers of 300 horse-power each, making a total of 1,200 horse-power. Each boiler will have an independent iron chimney 50 feet high. This room also contains the necessary feed water pumps, heater, etc. The engine room contains two 600 horse-power Buckeye cross-compound condensing engines, speeded at 130 revolutions. They will be arranged to be run either single or compound, condensing or non-condensing. Two Wheeler surface condensers will be used in connection with these engines. The condensing water will be discharged into a cooling pond 300 x 100 feet, and about 6 feet deep. This water will then be used over and over again in the condensers. The maximum power of the engines will be 800 horse-power each. This room will also contain two smaller engines to drive fans, dynamos, etc.

The drying room will contain two McCully crushers and two rotary dryers for drying all the raw material. The raw stone grinding mill contains five ball mills and three tube mills.

The kiln building contains eight rotary cylinders, each 60 feet long, for burning the raw materials to clinker. The fuel used is bituminous gas coal, ground to a fine powder, and injected into these kilns with air blast. These cylinders have a capacity of 150 to 175 barrels of clinker per day. This building also contains all the necessary elevators and conveyors, coolers, etc. The clinker grinding mill is almost a dupicate of the raw grinding mill, also containing five ball mills and three tube mills. The clinker is here ground to 95 per cent. to pass No. 100 mesh sieve.

The finished cement is then conveyed across the railroad tracks to the cement storehouse, where it is stored in a large number of bins, with a total storage capacity of 50,000 barrels. This building also contains automatic weighing and packing machinery. Adjoining this building is the cooper shop, which contains barrel machinery made by L. M. Reed, of Cleveland, O. This shop will have a capacity of 900 barrels per day.

All buildings will be of steel and brick construction with corrugated galvanized iron sides and roofs. The Shiffler Bridge Company, of Pittsburg, has the contract for the structural iron work; Eli Seiger, of Coplay, Pa., the corrugated iron work. All concrete foundations are being constructed by the company under the direction of Mr. Saeger. This plant is expected to be in operation during the coming month of July.

A RUSSIAN MILITARY HIGHWAY.

Among the delegates to the Geological Congress at St. Petersburg some time ago was Mr. Marsden Manson, M. Am. Soc. C. E., a member of the California Highway Department. During his stay in Russia he visited one of the famous military roads of the country, which he describes substantially as follows in the department's latest report:

Of modern Russian roads the great highway over the Caucasus is an enduring example of energy and power. This road occupies the historic pass known as Darial Pass, which for time immemorial has been an important line of travel between Asia Minor and Southeastern Europe. The Caucasus Mountains skirt the northeastern shore of the Black Sea and from thence run southeasterly to the Caspian. They are in many respects analogous to the Sierras, but are larger, broader and longer. Mount Elbruz, reaching an altitude of some 18,000 feet, is over 3,000 feet higher than the highest peaks of the Sierras. Up to the conquest of the Caucasian regions by Russia, only a narrow, badly graded and rough road existed. Portions of it can be seen on the northern approach in the canyon of the Tirek River, and some 15 to 20 miles south of the Vladikavkaz, the northerly terminus of the road. Recent deposits of debris in the bed of the river have brought the flood plane above the ancient roadbed.

An interesting section of this road skirts beneath a rocky bluff on the right bank of the Tirek. The road lies in a shelf hewn into the solid rock, and at some places columns of rock were left to support the overhanging bluff. A large slide from the glacial slopes of Kasbek covered this road for some miles in 1890. A temporary road was built around the slide, and so well was it fitted against the precipitous bluff that the Rusisan engineers have marked it by painting the adjacent rocks white so that the traveler may note the skill and care given to road work. The sub-structures of this great road are principally stone; one or two bridges are of steel.

In a few instances snow sheds have been built. These structures rest upon massive stone walls with well braced wooden roofs sheathed with iron. On the outside a summer road is constructed, each road being about 22 feet wide. The grades of the road are light and have been accurately fitted to the topography; the maximum grades rarely exceed 8 or 9 per cent. The roadbed is thoroughly drained and well macadamized, and piles of broken rock are abundant for prompt repairs. The rock used varies with the formation—limestone, trap and the harder volcanic and metamorphic rocks being preferred. The only machinery observed on the entire road was a heavy and clumsy road roller. The following data and measurements were taken: Length of frame over all, 18 feet; width, 7½ feet; tongue interchangeable; small rollers on each end; brakes operated by screws check the roller on heavy grades; boxes for wet sand ballast on each end, 6 feet 6 inches by 2 feet 8 inches by 1 foot 10 inches, lined with No. 18 galvanized iron; estimated gross weight, 11 tons.

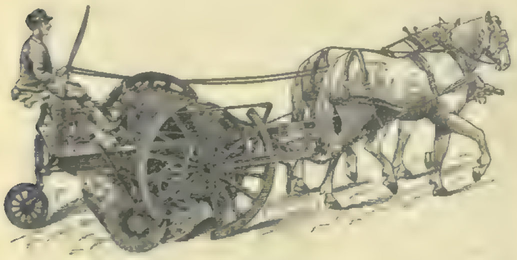
The traffic is depended upon to pack the rock during repairs. Laborers are distributed along the road, but the variations in travel, climate, rainfall, etc., are so great that the force is very variable. On the southern end the road has been blocked at many places by immense quantities of debris brought down from tne tributaries of the Arangua; and at several places large forces of laborers were engaged in rebuilding the road, and in constructing debris diverting and retaining works. It was a readily noted fact that the greatest damage was done by

those tributaries from the water-sheds of which the timber has been cut away, and a close observer could readily determine whether a tributary water-shed was timbered or not by the amount of damage done by the summer rains.

The Russian engineers deserve great credit for the skill with which they have constructed and are maintaining this road. Its northern end is in the cold temperate regions around Vladikavkaz; its summit reaches 8,000 feet and is subject in winter to Arctic conditions. The southern end is in the sub-tropical climate of Tiflis. The northern slope of the Caucasus is dry, rugged and precipitous; the growth is coniferous. The southern slope is more gentle and characterized by rounder mountain forms, with broader and more extensive deposits at the base. Summer rains give deciduous trees on the south slope, and if conifers ever existed there they have long since disappeared. Thus the physical features and conditions are of great range, and tax the engineer to meet them in their varying phases.

THE MONARCH PICK-UP STREET SWEEPER.

A street sweeping machine, operated much after the fashion of a carpet sweeper, has recently been built at Pittsburg. Its general appearance, as indicated by the accompanying cut, is like that of the usual types, except in having a drum running across the frame in front of the driver. The broom has steel wires instead of brass, and these are fastened in such a way that it is easy to replace them when worn out. It is driven by gearing from the main axle, and can be raised and lowered by a lever on the platform. The broom throws the sweepings into a casing, where they are caught by chain scrapers and carried into the drum, which has a capacity of nearly a cubic yard. It will be seen from the illustration that the apron hanging from the casing in front of the broom prevents the spread of dust in a large measure.



When the drum has been filled, which occurs after sweeping about four or five blocks of asphalt or Ligonier stone, under the conditions ruling in Pittsburg and Allegheny, the sweeper is stopped, the broom raised, a door in the casing opened by throwing a lever, and the drum turned over. This dumps the sweepings on the road in a pile about 18 inches high, ready for the carts which carry them away. The whole process is stated to be a rapid one, and does not involve disconnecting the gearing of the machine. Further information concerning the sweeper may doubtless be had from Mr. Joseph C. Kane, German National Bank Building, Pittsburg.

Garbage Cremation in Memphis seems to be a success. There are two Dixon furnaces of 60 tons combined capacity, built in central portions of the city at a cost of about $7,000 each, exclusive of land. Dr. Herbert Jones, president of the local board of health, states that the cost of cremation for the six months it has been carried on was probably between 25 and 30 cents a ton, which is less than the cost of hauling the refuse to the river. The plants are surrounded by dwellings and shops, but no complaints have yet been made concerning them.

THE MISSISSIPPI FLOODS, THEIR CAUSE AND PREVENTION.

The floods of the Mississippi River present some of the most important and complicated problems in American engineering. The enormous business losses they cause, the hindrance they are to the development of many naturally rich sections of the country, the intricate questions of river hydraulics involved in their study, combine to make them an attractive study from whatever standpoint they are viewed. The engineering literature of the subject is already of considerable amount, yet it is believed there has always been a vacant place for such a brief general study as that recently prepared after many months of investigation and consultation with engineers by the Committee on Commerce of the United States Senate. In sending a copy of this report to "The Engineering Record," Senator Nelson, chairman of the committee, disclaims any intention on its part of preparing an engineering document, yet it is certainly of much value to engineers as a clear presentation of the leading features of the problems involved, and as such is reprinted nearly in full:

Causes of the Floods.—The principal territory submerged or affected by the floods of the Mississippi River before the construction of levees, and in part since, consists of certain basins or bottoms along the banks of the river between Cairo and Forts Jackson and St. Phillip. These basins, from Cairo down, are as follows: The St. Francis Basin, on the right bank of the river, extending from Cairo to Helena, near the mouth of the St. Francis River, and embracing an area of about 6,706 square miles; the White River Basin, on the same side of the river, extending from Helena to near the mouth of White River, and embracing about 956 square miles; the Yazoo Basin, on the left bank of the river, extending from a short distance below Memphis to a point near the mouth of the Yazoo River, and embracing in all about 6,648 square miles; the Tensas Basin, on the right bank of the river, extending from near the mouth of the Arkansas River to near the mouth of the Red River, and embracing an area of 5,370 square miles; the Atchafalaya Basin, on the same side of the river, extending from the junction of the Red and Atchafalaya Rivers to Fort Jackson, and embracing 8,109 square miles; and the Ponchartrain Basin, on the left bank of the river, extending from Baton Rouge to Fort St. Phillip, and embracing an area of 2,001 square miles.

The aggregate area of all these basins is 29,790 square miles, or 19,065,600 acres. Ever since the immediate valley of the river below Cairo has been settled there has been a constant struggle to reclaim these basins and to protect them against overflows and floods. The problem has been in part accomplished, chiefly by means of levees, but much still remains to be done.

The Mississippi River at Cairo is composed of the waters of the Ohio, the Upper Mississippi and Missouri Rivers. The Ohio and its chief tributaries have their sources in the western slopes of the Allegheny Mountains and their spurs. The Upper Mississippi and its principal tributaries have their sources in numerous lakes in that plateau of land between the Red River of the North and Lakes Michigan and Superior, and the Missouri has its source in the upper eastern slopes and foothills of the Rocky Mountains. The White and the St. Francis Rivers, with sources in the Ozark Mountains, in southern Missouri and northwestern Arkansas, and the Arkansas and the Red Rivers, with their sources in the lower eastern slopes of the Rocky Mountains, contribute considerable volumes of water to the Mississippi River within the basins subject to overflow.

The annual normal rainfall in the different river basins varies greatly. In the Ohio it is 44.2 inches; in the Upper Mississippi, 31.9; in the Missouri, 19.4; in the Arkansas, 29.6; in the Red, 39.1, and in the central valley of the Mississippi, including the White and the St. Francis, 51.4 inches. In the Upper Mississippi and the Missouri the rainfall is, as a rule, greatest in May and June. In the Ohio and the central valley it is greatest in January, February and March.

The greatest and most destructive floods have generally come from the Ohio. This was the case with the great floods of 1882, 1883, 1884 and 1897, and these floods culminated in February or March. Of the total amount of water passing Cairo during these floods the Ohio contributed 69 per cent. in 1882, 70 per cent. in 1883, 85 per cent. in 1884, and 76 per cent. in 1897. These great floods from the Ohio River, like all similar floods, came from excessive rains in the basin of the Ohio and its tributaries. The Ohio floods, after passing Cairo, are frequently largely reinforced by floods from the White and St. Francis Rivers and other streams in the central valley. Occasionally the floods from the Missouri and Upper Mississippi are, to a limited extent, a factor in extending or prolonging the flood on the lower river, but this applies rather to the May and June freshets of the Ohio than to the earlier and more extensive ones.

In Park Morrill's report to the Weather Bureau the cause of the Mississippi floods is thus summarized: "It is, of course, conceivable that a flood should occur in the Lower Mississippi from heavy precipitation over any of the great tributary basins. In the floods of the past quarter century we do not, however, find the western tributaries playing an important part. The great source of floods is the Ohio Basin, with its steep slopes from the crest of the Alleghanies, upon which falls the heaviest rains of spring at a time when the normal rise of the Lower Mississippi brings the river almost to the danger line from Cairo to the Gulf. In the greatest floods we also find that heavy rainfall over the great swamp region that extends along the Mississippi from the mouth of the Ohio to the Gulf of Mexico is an important factor. Third in importance as a factor in producing floods is the Upper Mississippi, which, while never discharging a volume sufficient to produce of itself a flood, yet, rising later than the Ohio, serves to prolong the high water and thus to increase the overflow."

Reservoirs.—There are five reservoirs constructed at the head waters of the Upper Mississippi. These reservoirs repress to some extent the floods in the river bottoms above Lake Pepin and improve the navigation of the river in low water down to that point, but have no material effect upon the floods or navigation of the river below that point. The evidence discloses no other points on the Upper Mississippi available for reservoir purposes. On the Missouri the only point where sufficient holding ground could be found for a reservoir of any magnitude is on a reach of the river above Great Falls. Such a reservoir, if constructed high enough to bring the waters of the Missouri River into the Milk River Valley, would be valuable for purposes of irrigation, but would have no material bearing on the floods in the Mississippi River nor on the navigation of the Missouri River.

The evidence, as well as the other data, discloses that on the Ohio River, as well as its main tributaries, where reservoirs could act more directly on the floods than elsewhere, with the exception hereinafter stated, there are no suitable sites where reservoirs could at any moderate or reasonable expense and without working far reaching and extensive damage be constructed that would at all be adequate to pen up and retain the great downpour from innumerable mountain torrents during the great freshets of January, February and March. There are no great basins adequate for reservoir purposes either on the Monongahela, the Alle-

gheny, the Tennessee or the Cumberland, and to be effective in repressing the floods of the Ohio, big, strong reservoirs would be requisite on these streams.

The only place where a reservoir basin can be found, proximate and sufficiently large to afford a holding ground at all commensurate with any material or practicable relief, is the St. Francis Basin, but the cost of constructing and maintaining a system of reservoirs in this basin would be enormous, and far greater than the cost of leveeing the entire river front of the basin. The scheme is regarded by nearly all engineers and other experts as wholly impracticable. In short, your committee can discover no just or adequate relief in reservoirs.

Outlets.—Neither can your committee discover from the evidence or through other sources any material relief from the outlet system. It is not practicable to relieve the river by means of outlets except below the Red River. Two important natural outlets now exist and have for years existed on this reach of the river—the Atchafalaya and Bayou Lafourche. A third, Bayou Plaquemine, is now closed, pending its preparation for reopening by means of locks and dams. But these outlets, or others that might be constructed on this reach of the river, could afford no perceptible relief for the river above, where relief is much more called for and needed. The St. Francis, Yazoo, White and Tensas Basins can get no relief from any practicable outlet system. And where this system exists and is feasible there is no disposition to extend it or to substitute it for levee enlargement.

Levees.—The history of levee construction on the Mississippi River has been a history of the gradual reclamation of the several basins or bottoms from the inroads of the floods of the river. Anterior to levee construction these basins served as great natural reservoirs for the floods, the exterior hills or ridges of the basins serving as the high water banks of the river, and within these banks, so wide apart and with these basins for a high water bed, the floods never reached the high level nor the increased rapidity obtained since the great extension of the levee system. Levees are the penning up of the floods of the river from these high water basins. The narrowing of the high water stream by means of levees does not result in materially scouring a deeper channel nor in raising the bed of the river, and so the stream at its flood stages, as it becomes narrower, also becomes higher. Contraction without deepening of necessity leads to elevation, and as a consequence levee construction has brought in its wake higher flood levels, necessitating from time to time higher and stronger levees. The history of levee construction shows this.

The first levee construction began in 1717, when a levee one mile long was constructed to protect New Orleans, then a mere village. This levee was 4 feet in height and 18 feet across at the top. The country settled up slowly and levee construction only kept pace with the settlement. Fifty years after this levee was built the settlements extended only 30 miles above and 20 miles below the embryo city. It was not until after Louisiana had been ceded to the United States that levee extension was undertaken on an enlarged and systematic scale. By 1828 the levees, though of rather inferior character, had been extended nearly up to the mouth of the Red River. At the beginning a levee 4 feet in height was ample, but as levee construction progressed up the river and additional basins and bottoms were inclosed and protected the levees were of necessity increased in height. There are still levees below New Orleans that are only from 3 to 4½ feet in height, but the average height of the levees in Louisiana, above New Orleans, is now from about 12 to 13 feet, and this height proved insufficient in the great flood of 1897.

The flood stage of 1897, above New Orleans, was from 1⅛ to 3½ feet higher than that of any previous flood, notwithstanding the flood level at Cairo was less than in 1882-83 and 1884. Three great crevasses occurred in 1897 that remained unrepaired until after the flood subsided, and several minor crevasses occurred which were closed during the pendency of the flood. This increased flood level was "partly due to the improvement and increase of levees." The experience of 1897 indicates that a complete inclosure of all the river basins will require from 3 to 4 feet higher levees in Louisiana. The levees on the Yazoo Basin were only 4 feet high in 1858. From 1874 to 1882 they were raised to from 7 to 8 feet, which proved insufficient under the flood of 1882, and based on this flood as a standard, the levees were increased to an average of from 13 to 14 feet in height prior to 1897. This was more than 3 feet above the high water of 1882, but it proved utterly insufficient under the flood of 1897.

Since the floods of 1882-83 and 1884 the White River Basin, the Upper Tensas Basin and much of the St. Francis Basin have been inclosed, and this, together with the higher levees on the Yazoo front, have greatly aggravated and raised the flood levels on this reach of the river. The flood of 1897 made it plain that a complete inclosure of all the river basins would require an increase of from 4 to 6 feet in height of the Yazoo levees.

The work of inclosing the White River Basin was commenced in 1888, and most of it was done after 1890. By 1897 the basin had been inclosed by a levee of an average height of 12 feet, deemed sufficient under the flood levels of 1882-83 and 1884, but this proved utterly insufficient in the flood of 1897. That flood overtopped the levee at many points, and was from 4 to 6 feet higher than any previous flood, clearly indicating that a complete levee system along the entire river would require an increase of 6 feet in the levee height along this basin.

In the Upper Tensas Basin nearly all levee construction has taken place since 1882—mainly since 1892. In the Lower Tensas Basin there was an old levee existing before this period, but of low grade and insufficient in strength. By 1897 the Upper and Lower Tensas Basin levees had attained an average height of 13 feet. In the flood of 1897 the river was from 2½ to 3 feet higher in front of these basins than in the flood of 1882, and hence the levees were insufficient. Had the water in 1897 not been any higher than in the floods of 1882-83 and 1884 the levees would have been ample. Several serious crevasses occurred in these levees during this flood. The higher flood level of 1897 was largely due to increased levee construction and the further inclosures of river basins. The completion of the levee system would require the levees on the Tensas Basin to be raised to the height of from 17½ to 18 feet.

In the St. Francis Basin levee construction began in 1893. Since that time a continuous levee of an average height of 9 feet has been constructed from Point Pleasant, Mo., to Chute 38, Arkansas, a distance of 127 miles. About 100 miles more are required to reach the mouth of the St. Francis River and to entirely inclose the basin. The levees on the St. Francis Basin proved insufficient for the flood of 1897, and several serious and extensive crevasses occurred. These levees need to be made stronger and higher, at least 2 feet higher than the grade of 1897.

The flood of 1897 wrought great havoc, especially in the older levees, many of which had been defectively and improperly constructed. There were 23 breaks in the St. Francis front, 6 in the Yazoo front, 14 in the White River front and 4 in the Tensas front, most of which occurred from an overtopping of the levees. Below the Red River there were only a few small breaks, and these were closed during the pendency of the flood. Engineer Ockerson in his testimony (p. 432) describes the flood of 1897 and compares it with the flood of 1882, as follows:

"From a point about 100 miles below Cairo to the Gulf the stage reached in 1897 was greater than any previous record. As far as volume of water is concerned, however, the flood of 1882 was much greater than that of 1897. The flood of 1882 stood above the danger line at Cairo, or 42 feet on the gauge, for a period of 72 days. The flood of 1897 stood above the danger line for a period of 54 days. During the flood of 1897 the tributaries below Cairo were all rather low."

Table Showing Relative Heights of Floods of 1882 and 1897.

	1882.	1897.		1882.	1897.
Cairo	51.9	51.6	Greenville	41.7	46.8
Belmont	45.1	45.1	Lake Providence	38.3	44.4
New Madrid	40.9	40.3	Vicksburg	48.8	52.4
Cottonwood Pt.	37.5	39.3	St. Joseph	44.9	47.9
Fulton	36.7	37.5	Natchez	47.8	49.8
Memphis	35.2	37.7	Red River	48.5	50.2
Mhoons	39.8	41.6	Bayou Sara	39.3	43.8
Helena	47.2	51.8	Baton Rouge	36.0	40.7
Sunflower	41.7	47.3	Plaquemine	31.3	36.3
White River	48.4	52.4	College Point	23.2	28.0
Arkansas City	47.1	51.9	Carrollton	15.0	19.0

A due consideration of the testimony and other data bearing on the subject makes it clear that the flood of 1897 was in its effects and consequences greatly enlarged and aggravated by the extensive inclosure of basins and the extended and enlarged levee construction that had taken place since the floods of 1882-83 and 1884, though it is doubtless true that if no levees at all had been in existence a larger area would have been submerged. Engineer Starling concurs in this conclusion in the following clear and apt language:

"It is not only the magnitude of the flood of 1897 which has made it of surpassing importance to the engineers of the Mississippi service. The widespread damage which it has wrought, while great, is yet not without a parallel. Its principal interest to the engineer is due to the experience which has been derived from the wholesale closure of unleveed tracts and the extraordinary elevation of its high water line consequent thereon. There are two of the great basins into which the Mississippi Valley is divided which have only recently been protected to any extent by levees. These are the St. Francis and the White River basins. The former was closed during the last three years, or since the flood of 1893, to a distance, measured along the river, of about 120 miles. There still remains a gap of about 100 miles. The White River Basin has been undergoing a gradual process of closure for several years. In 1893 there was a gap of about 15 miles, extending between points 330 and 360 miles, respectively, by river, below Cairo. In 1896 this gap was closed and the line of levee was made continuous from the hills at Helena to a point 8 miles above the mouth of White River. It is to the building of these lines and to the maintenance of the lines previously existing until a late period of the flood that the unparalleled stages attained by the water have been due."

The construction and repair of levees was, in the first instance, undertaken by riparian owners, afterward by parishes or counties, then by the States or certain levee districts, under the authority of the States, and finally by the latter and the Federal Government combined, which is the system now prevailing. The first material aid given by the Federal Government was a grant of swamp and overflowed lands, made to the several States in 1850. The same year Congress also made provision for a survey and investigation of the Mississippi River.

This work was carried on for the next ten years under the direction of Captain Humphrey and Lieutenant Abbot, who made their final report in 1861. During the Civil War levee construction was at a standstill. After the war was over the several States began, without concert and without due plan or system, to extend and repair the levees. But the great flood of 1874 showed how inadequate, both in quality and

quantity, the efforts of the States were. Congress again intervened and passed an act providing for the appointment of a commission of five engineers to investigate, determine and report as to the best plan for relief against the floods. This commission made its report in 1875, and came to the same conclusion as Humphrey and Abbot did in 1861—that a system of levees could alone afford adequate protection. But no systematic improvement of the river by the Federal Government was yet undertaken. Finally, in 1879, Congress passed an act creating the Mississippi River Commission, outlining its work in the following terms: "It shall be the duty of said commission to take into consideration and mature such plan or plans and estimates as will correct, permanently locate and deepen the channel and protect the banks of the Mississippi River, improve and give safety and ease to the navigation thereof, prevent destructive floods, promote and facilitate commerce, trade and the postal service."

From 1879 to 1882 $1,475,000 was appropriated by Congress for expenditure by the commission in making surveys and in improving the navigation of the river, but none of it was allotted for levee construction. In 1882 Congress appropriated the gross sum of $4,123,000, and from this the first direct allotment for levee construction was made—about $1,300,000 in all.

From each appropriation made the commission allots a certain proportion for the construction and repair of levees in each levee district, which is expended by the United States engineer in charge of the district. The commission plans the work, subject to the approval of the War Department, and the district engineers carry on the work conformable to the plan.

The first effort of the commission was directed to the closure of the Yazoo Basin, and then followed the improvement of the Tensas Basin, then the White River Basin, and, finally, a part of the St. Francis Basin. In the respective levee districts the State and Federal engineers, while acting in concert and harmony as far as possible, work each on separate and distinct portions of the river. One reach is constructed under Federal authority and another under State authority. When a levee is constructed the constructing engineer or his successor takes charge and care of the same. In case of an emergency there is by mutual consent a sort of joint care and supervision. As a rule both Federal and State engineers are men of fine attainments, high character and great public spirit, which tend to obviate any friction that otherwise might ensue from an undefined joint tenancy. It would no doubt be advisable to provide by law in which authority the care and maintenance of a constructed levee should vest. The evidence discloses the fact that 18 suits have been brought against the United States for damages claimed to arise from the construction and maintenance of levees or failure to construct or maintain proper levees along the Mississippi River. The aggregate amount of damages claimed in these suits is $656,337.04.

From a table (following p. 518 of testimony) prepared by Captain Waterman, secretary of the Mississippi River Commission, under the direction of General Gillespie, president of the commission, it appears that the total yardage of levees constructed by Federal, State, local and private authority is 164,860,375 yards, built at a cost of $47,631,503.78, of which yardage 68,570,431 yards were constructed by Federal authority, at a cost of $13,320,708.44, and 96,289,944 yards by State, local and private authority, at a cost of $34,310,795.34.

It is estimated that it would cost to complete the entire levee system, from the head of the St. Francis Basin to the Head of the Passes, at a grade sufficiently high and strong to afford complete protection against floods at the highest probable stages, the sum of from $18,000,000 to $20,000,000, and that it would take from four to five years to complete the system.

From all the evidence taken and considered by your committee it is evident that the basins and bottoms along the Mississippi River exposed to the floods of the river can only be protected and preserved from such floods by an ample and complete system of levees from Cairo to the Head of the Passes. Crevasses and inundations, resulting in extensive loss of life and property, are liable to occur during all floods so long as the system is incomplete. The burden of completing the levee system is too great for local and State authority. Your committee are of the opinion that the Federal Government should continue, as it has since 1882, to aid in the great task of controlling and repressing the floods in the river.

Navigation, Mississippi River.—The testimony discloses that the navigation of the Upper Mississippi River has been considerably improved by the reservoirs, on the reach above Lake Pepin, and by riprapping, wing dams, spur dikes, hurdles, revetment works and a little levee work at various points on the river below that reach.

The Mississippi River Commission has carried on more or less extensive improvements of the navigation of the river on many of the reaches below Cairo. Such improvements, in addition to levee work, have consisted of bank protection in the form of riprapping and various kinds of revetment work, of channel contraction by means of jetty work, hurdles and various forms of spur dikes, and of dredging on an extensive scale. Some of the work has been rather tentative and of a temporary character, and on account of the great cost has not been followed up.

At present, aside from levee work, the chief reliance for obtaining a low water navigable channel seems to be dredging. The new style of hydraulic dredges seem to be very potent and effective and seems to give great and promising results. Four new dredge boats have been for some time completed and in use, and two more are under contract and by this time ready for use, and there is money available for another dredge. It is estimated that from nine to ten dredges will be required to keep a due low water channel open. In the light of results obtained your committee recommend that ample provision be made for the construction of dredge boats and dredging. In view of the great cost, especially great as to results, it seems that it would be more judicious to limit revetment work to levee and harbor protection. Contraction, by means of jetties, dikes and dams, supplemented by dredging, seems to have given the best results at least cost. There is no doubt that revetments are very efficacious, but the cost is so immense that its systematic application is scarcely warranted.

Jetties and Passes.—As the Mississippi River in its downward course is about to debouch into the sea it divides itself into three great passes, through which it enters the Gulf and forms the delta at its mouth. These passes are known as the Southwest Pass, South Pass and Pass à Loutre. From New Orleans down to the Head of the Passes there has been no impediment to deep water navigation. The impediment occurs in the passes, especially at their heads and mouths, chiefly the latter. Prior to the improvement of the South Pass by means of jetties navigation was chiefly confined to the Southwest Pass, though Pass à Loutre had for some years been utilized to some extent.

In 1839, when the Southwest Pass was first examined, it was 15.2 miles long and 13 feet deep on the crest of the bar, and it was then, as now, of an average width of twice the width of the South Pass. Between that time and 1877 considerable work was done in improving this pass, but such work, aside from a short and abortive jetty work on one side of the pass in 1856, consisted of dredging and stirring up the bed of the channel by means of drags, harrows, scrapers, blasting, torpedoes and other similar appliances. By these means a depth of 18 feet was at one time, for a short period, obtained on the crest of the bar. In 1874, the year before the improvement of the South Pass began, the Southwest Pass had attained a length of 18 miles, with a depth of only 15 feet on the crest of the bar, and on February 9, 1898, the pass had attained a length of 18½ miles, with only a depth of 9 feet on the crest of the bar, according to soundings then taken.

In aid of the improvement of the South Pass Captain Eads placed a mattress sill across the head of the Southwest Pass, which, aside from a little dredging prior to 1878, is the only improvement made in this pass since 1875.

Prior to 1875 like efforts at improving Pass à Loutre, except jettying, were also made, which were, in like manner, partially successful. By the fall of 1858 an 18-foot channel had been obtained in this pass, and for some years it was, on account of being the shorter pass, utilized for purposes of navigation, but in 1875 the channel was destroyed by a large mud lump, and since that time no improvement has been made, except placing a mattress sill at the head of the pass and the work of attempting to close a large crevasse on the south side of it near the upper end, both of these works being in aid of the maintenance of the South Pass jetty system.

The South Pass in 1838 was 11.3 miles long, 700 feet wide, except at the extremities, and 8 feet deep on the crest of the bar. In 1875 it was about the same length and width, but only 7 feet deep on the crest of the bar. In 1874 a board of engineers, consisting of three army engineers, three civil engineers and one from the Coast and Geodetic Survey, was appointed to devise and determine upon some plan of securing deep water navigation through one or more of the passes. This board, after visiting Europe and examining many works there involving similar problems, recommended, in January, 1875, the improvement of the South Pass by means of jetties. In pursuance of this recommendation Congress, in March, 1875, conferred the task of making the improvement upon James B. Eads and associates. The jetties were practically built on lines recommended by the board.

The original act provided for a channel 30 feet deep and 350 feet wide, but by 1878 it became evident that such a channel could not be obtained by the work then laid out, and accordingly Congress was induced to remit, by acts passed in 1878 and 1879, the requirement to a channel 200 and 250 feet wide and 26 feet deep, and on this basis the work was deemed completed in July, 1879. In making the improvement, and as a part of it, training dikes were built at the Head of the Pass, and mattress sills were laid at the head of the Southwest Pass and Pass à Loutre. In 1891 the west end of the Pass à Loutre sill was carried away, and a large break occurred on the west bank of Pass à Loutre about 1½ miles below the head of the South Pass.

This break, although several attempts have been made to close it, has not yet been closed, and in consequence thereof, as well as on account of the loss of the contiguous end of the Pass à Loutre mattress sill and portions of the training dikes, and lack of repair and maintenance in some of the training dikes, the inflow of water into the South Pass has been less than before, which has, no doubt, to some extent detracted from the scouring force in the pass, necessitating some dredging for the maintenance of the requisite channel. Before these drawbacks occurred the pass received from 10 to 11 per cent. of the water in the main stream; since then only 7 per cent. Three hundred feet of the jetties at the sea end have been washed

away on both sides, and in addition to this 150 feet of the jetty on the west side. None of the jetties thus washed away have been replaced. The east dike at the head of the pass has also been washed away. This was a training dike 1,250 feet long, and has never been replaced.

There is also an open and exposed gap 1,100 feet long between the end of the Pass à Loutre mattress sill and the end of the bank or dike on the east side of the pass. This gap was, when the work was completed, filled with a training dike. Five hundred feet of the mattress sill in Southwest Pass has also been carried away. In short, neither the jetties nor the training dikes nor mattress sills have been kept up to the condition they were in 1879, but have been allowed to diminish and deteriorate.

Up to 1889 the channel was maintained at the required depth substantially without dredging. Since that time it has deteriorated and has not been maintained without considerable dredging. During the year ending June 30, 1896, there were 169 days of dredging. Within the last four years there has been an average of 100 days dredging each year. The channel was not kept at the required depth for 47 days during the year 1897. On the whole, it appears that, although the jetties have accomplished much good and great results, they have not wholly succeeded, owing to the causes enumerated, in maintaining the fine channel that existed from 1879 to 1889. To maintain the good results then obtained, the dikes, sills and jetties carried away should be replaced or restored as far as practicable. Besides, the jetties should be extended seaward further than originally built, in order to keep pace with extension of the bar into the Gulf.

Jetties are the artificial extensions of the natural banks of the stream, and as the bed of the stream is, from the silt moving in the river, prolonged into the Gulf, the jetties must, of necessity, keep pace with such extension. For practical purposes the pass is not adequate for vessels drawing over 24, or at most 25, feet of water. This is insufficient for the wants of modern commerce. Vessels drawing from 27 to 30 feet and over are now quite common and much more economical than small vessels. It is very doubtful whether a channel sufficient for this larger class of vessels can be obtained in the South Pass. Major Quinn maintains that it can. Engineer Donovan, with a twenty-year acquaintance with the pass, maintains that it cannot.

Your committee visited the pass in February, 1898, and, with a 26-foot channel, found the pass bank full at all points. Unless the pass can absorb much more water the scouring process cannot be increased nor a deeper channel obtained by that method. To secure a greater volume of water it would be necessary to build and prolong great training dikes at the head of the pass and to fortify them with mattress sills and other works so as to bring about a larger inflow. In the next place, it would be necessary to build strong and extensive levees on both sides of the pass from the head to the jetties. There is scarcely sufficient foundation for such levees. The earth and riprapping would have to be brought from a great distance, and the embankment would be subject, more or less, to the storms, the waves and the back wash of the Gulf. In short, such leveeing would be an extensive and most expensive jettying from the head of the pass to deep water in the Gulf. These are some of the difficulties which occur even to the lay mind. To say the least, the cost would be enormous and the result very problematical.

But the commerce of the Mississippi Valley asks and is entitled to a much deeper and broader channel to the sea than that now afforded or likely to be afforded by the South Pass. The Southwest Pass is regarded in many quarters—lay and expert—as the cheapest and most feasible route through which to obtain the requisite deep water navigation. Congress has already made provision for a thorough examination and survey of this route. The engineers having the work in charge have not yet made their report, and until they do it would be premature for us to suggest or advise. We may add that to improve the Southwest Pass and at the same time to maintain and utilize the South Pass, thus securing the advantages of two passes, is no novelty. This plan was adopted in 1856, when provision was made and work carried on for the improvement of both the Southwest Pass and Pass à Loutre. In case of extensive repairs or accidents there would always be one pass open and available for navigation.

Missouri River.—In respect to the Missouri River Commission and its work, we beg leave to state that it has had charge of the river from Sioux City to its mouth, and that its work in recent years has been chiefly confined to the improvement of the navigability of some 45 or 46 miles of the lower reach of the river, and to so-called harbor improvements for the protection of the river fronts of towns from the inroads of the river on the other reaches of the river.

The Missouri River is so eccentric and uncertain that great difficulties are encountered in controlling its movements from year to year, and nothing but systematic and patient effort can avail in its improvement. The commission has recommended in all its reports the improvement of the river by reaches, commencing at the mouth, and the work done under this system has proved eminently successful, but Congress has unfortunately permitted the appropriations for the general improvement of the river to be diverted to local improvements, which, being isolated and unsupported, are usually swept away by the annual overflows.

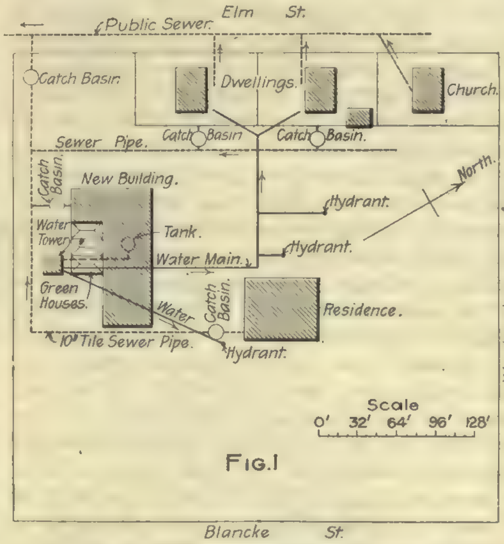
The conditions of the river, by reason of the failure to adopt systematic and continuous improvement by reaches, as recommended by the commission, has been so bad as to discourage navigation, the rates of insurance upon boats and cargoes being absolutely prohibitory.

Your committee is of opinion that in view of the great agricultural wealth of the country through which the Missouri River flows, and especially the enormous production of grain, the river should be so improved as to afford every facility for its navigation by boats and barges, so as to prevent excessive charges by railroads, and also to make lower rates for transportation. If the system recommended by the commission could be faithfully adhered to for a few years the river would be put in such condition as would induce the presence of steamboats and barges, so as to render it impossible for railroads to monopolize freights.

THE DEVELOPMENT OF A COUNTRY RESIDENCE AND STABLE.

The country place of Mr. W. Lüttgen, at Linden, N. J., occupies the whole of a 400-foot block, bounded by some of the principal streets of the village. The residence is a large frame house on the northeast corner of the block; south of it is the "new building" and water tower, and at the west is a small church and two separate houses, occupied by members of his family. The location of the buildings and the arrangement of the water supply and drainage systems are approximately indicated in Figure 1. The house itself was built several years ago, and when it became inadequate for all requirements it was decided not to remodel or materially extend or reconstruct it. In order to retain it for family and residence purposes an adjacent auxiliary structure was planned to provide room for various specific requirements, and was so arranged as to include the stable, carriage house, greenhouses, power house, work shops, storage room, etc. This building was constructed in 1897, and upon its completion provided for all the accessories to the residence building, and dispensed with the former detached out-buildings, which were then removed. The idea was a novel one, and was executed in an original manner, largely designed and supervised by Mr. Lüttgen. The auxiliary structure, which is called the "new building," thus compactly unites all the accessory buildings under one roof, and has the effect of enlarging the residence and disembarrassing it of various apartments not required for continuous use, and of grouping the rooms needed for amusement and transient purposes in a convenient manner more effectively, simply and economically than could have been done by any practical revision of the original residence. In connection with this improvement, the heating, lighting, water supply and drainage systems have been developed so as to provide entirely independent service for an isolated country establishment of moderate size, and their principal features are described in this article.

The new building is two full stories in height besides the commodious loft, and is about 112 x 66 feet in extreme dimensions, one wing being 25 feet and the other one 37 feet in inside width. The framework is of wood with paneled outer walls filled with hollow brick faced with concrete, as shown in the exterior view, Figure 2, showing the main entrance. Figure 3, showing general cross-sections, and Figures 4 and 5, showing the first and second floor plans, respectively, give the general arrangement of the building. On the first floor



PLAN OF THE LUETTGEN ESTATE.

are a commodious bowling alley, bicycle room, summer laundry, engine and motor room, storage battery room, toilet rooms, greenhouse annex and a large cellar, which is used for storage and miscellaneous purposes, and also contains stalls for two or three cows and horses, should extra stable room be necessary for a short time.

The second story is entered from the main stairway in front, which rises about eight feet above the ground and gives admission directly to the billiard room, and through that into the ball room. Beyond the latter are two rooms connected with wide doorways and serving, the first for a stage, with a large removable sectional platform, which can be used for theatrical or dramatic purposes, and the second as a dressing room. There is also a property room in the rear of the dressing room. From the entrance to the billiard room, a short flight of stairs leads to an interior side hall at a higher level, and from this hall open three sleeping rooms and a bath and toilet room for bachelor guests. Beyond the toilet room the hall extends to the rear of this wing, but is partitioned at the toilet room and divided into corresponding sleeping rooms and bath rooms for the women servants, who have access to it by outside stairs. A special entrance is also made from the servants' hall into the stage room, so as to make the latter accessible without passing through the main entrance. In the transverse wing of the building the floor corresponding to this floor is at a somewhat lower level, and is occu-

pied by the horse stable and carriage room, access to which is had by an inclined roadway platform to the outside drive at one end, and through a second story doorway at the other end, where supplies may be hoisted in and out with a tackle. Above the stable is a loft used for hay and grain storage and other purposes, and above the billiard room and sleeping room is another loft, used for storage and the owner's workshop. The roof trusses over the main wing and the stable wing are of 41 and 27 feet span respectively. Both of them are built of light wooden members, and auxiliary iron tie rods, framed together as indicated by the sketch, Figure 6, which also shows a section through the hollow brick, concrete and wooden framed walls.

The stables, although simple in construction and providing for only three horses, are conveniently arranged and equipped, and have their details carefully suited to the conditions of such an establishment. As abundance of room was available, a space 30 feet long and the full width, 25 feet, of the wing, was devoted to the stables, carriage wash and harness room, and was covered with a 4-inch concrete floor laid on double-ring red brick arches sprung between the webs of 12-inch steel floor beams, supported on the brick foundation walls, which rise on all sides to the varying levels of the first main floors. The upper surface of the concrete is level, except in the stalls, where it is pitched about a quarter of an inch to the foot towards the center of the wing, and terminates in an open gutter in the concrete. The drainage is thus led to a floor strainer, through which it is discharged into a bell trapped waste pipe, which empties into a soil pipe with ordinary S trap and vent. A similar shallow open gutter extends across the two ends of the floor opposite the stalls to drain it from water spilled there in washing carriages. The arrangement of stalls, etc., is shown in Figure 7, which also gives the location of an iron trap door in the floor over an inclined iron chute, through which the manure is thrown into a pit outside. At one corner of the carriage-washing platform is an iron sink with hot and cold water, supplied from the greenhouse system or the house pipes, as may be most convenient. The wainscot is cement to a height of about 30 inches; above this level to the ceiling and elsewhere throughout this story the walls are wainscoted with varnished, narrow-beaded yellow pine, with which the underside of the second story floor beams are also ceiled. A space 21 feet long, originally intended for four stalls, was divided into but three, which are therefore unusually commodious. Each has a removable floor grating, made of 2 x 6-inch wooden strips nailed to cross pieces, so as to provide complete drainage through and under it. The two gratings in each stall join closely, and have their top surface flush with that of a 2-inch cross plank over the open gutter, and hinged to the stall posts, so as to prevent its being displaced, while still allowing it to be revolved to give access to the gutter for cleaning. The stall partitions are made of horizontal 2-inch spruce plank, and are 4 feet high and 8 feet long, finished at the outer ends with square chamfered vertical posts, extending to the ceiling, and capped with heavy wire screens 28 inches high. Grain is stored in large wooden boxes in the loft, and is delivered to the floor below through a flat vertical tube with stop slides in the bottom and a removable box below, as shown in Figure 9.

The residences are heated by separate hot water and hot air systems, but all are lighted and supplied with water by the general plant installed in the engine room of the new building. Power was formerly derived from a coal burning steam boiler, which has been replaced by a plant recently installed by Westinghouse, Church, Kerr & Co. There is a Westinghouse two-cylinder gas engine with a capacity of 10 brake horse-power, which uses gas from a public main at the rate of about 100 feet per hour when running, effecting a notable economy over the former coal consumption. The engine is belted to a counter-shaft, from which are driven a pump, bi-polar electric generator, and a booster, which is used to increase the voltage of the current for transmission to the storage battery. The generator is a 9-kilowatt 125-volt dynamo, and the booster is a 500-volt machine. To avoid running the engine late at night a storage battery has been provided, which operates such lights as are required after the engine is shut down, and takes care of the peak of the load. It is of the Manchester type, made by the Electric Storage Battery Company, of Philadelphia; and has a capacity of 20 amperes discharge at 110 volts, and will operate 40 incandescent lights for eight

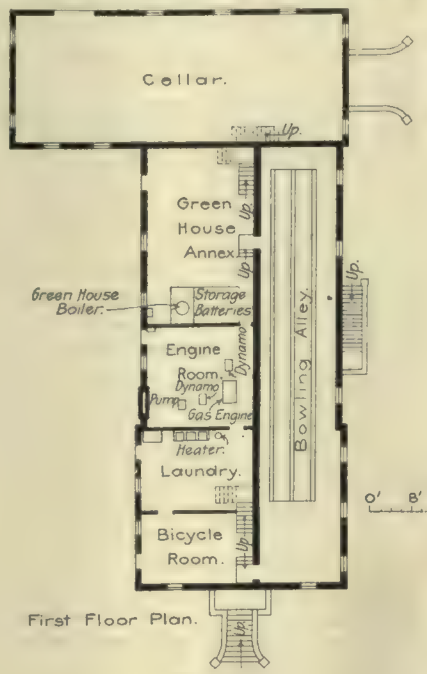


Fig.4

Fig.5

FLOOR PLANS OF THE NEW BUILDING.

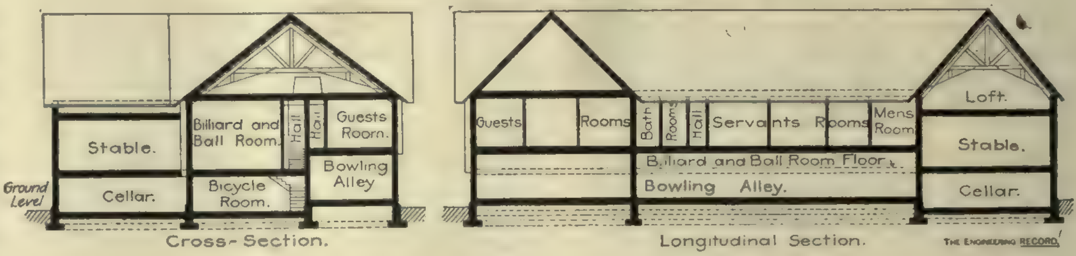


FIGURE 3.—SECTIONS OF THE NEW BUILDING.

FIGURE 2.—EXTERIOR OF NEW BUILDING.

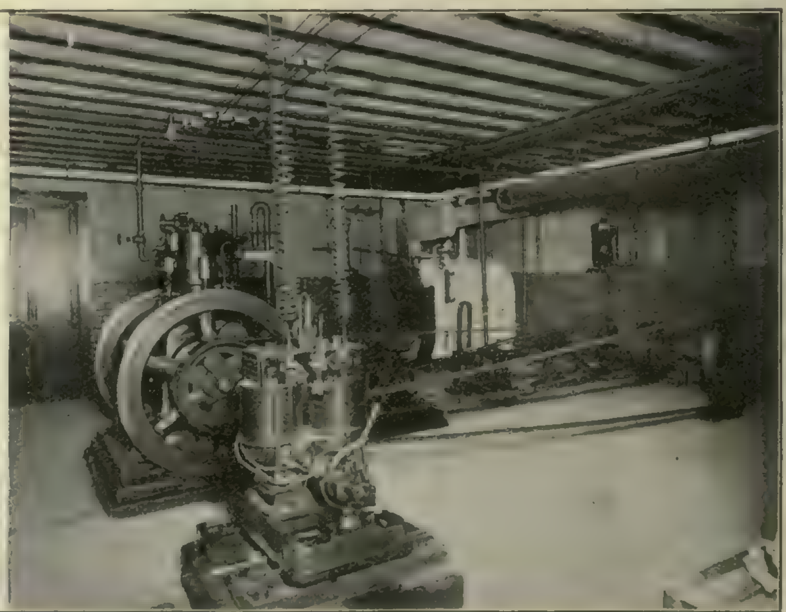


FIGURE 12.—THE POWER PLANT.

hours. The engine is usually run until 8 or 9 o'clock in the evening, making about five hours a day in the winter time. The plant is looked after by a man who has charge of the general water supply, plumbing, pipe fitting for greenhouses, etc. The arrangement is considered

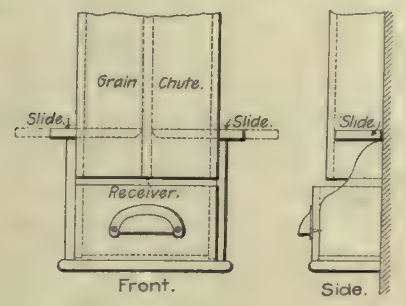


FIG. 9

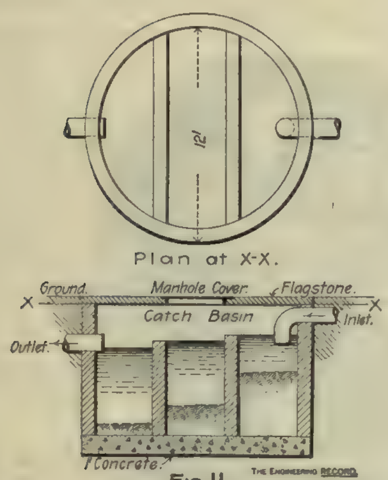


FIG. 11

the additional amount contained in the lower tanks. It is intended to utilize the windmill service whenever it can be operated, but in case it is disabled or insufficient, an independent pump shown in Figure 12 has been installed in the engine house, and is cross-connected to the tanks, which it fills at the rate of about 1,500 gallons an hour. This is a small double-cylinder pump, driven at about 200 revolutions per minute.

The rain water and sewage from the entire premises are collected in a system of drains in-

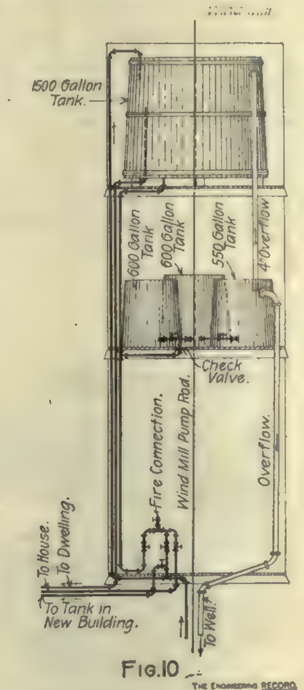


FIG. 10

STABLE AND WINDMILL DETAILS.

satisfactory and economical, and has the advantage of being wholly self-contained and independent of the surroundings or of any public service. The repairs have been practically nothing so far. The appearance of the plant is shown in Figure 12; the boiler in the background is in no way connected with the power plant.

The water supply for all purposes is derived from an artesian well, over which has been built a wooden tower with boarded sides, making a house about 15 feet square and 40 feet high, surmounted by a Corcoran windmill to operate the pump. This pump is provided with a water jacket around the cylinder, and receives the suction at the upper end, so as to keep itself always primed. The pump delivers through a 1½-inch pipe into the top of a 15,000-gallon circular wooden tank in the upper part of the windmill tower. The tank overflows into one of three connected 600-gallon circular wooden tanks on the floor below it. These furnish the supply for the residence and other dwellings, and can also deliver to a 1,500-gallon wooden tank in the attic of the new building, to supply its fixtures and the stable independently of the residence. The arrangement of the water tower, tanks, windmill and well connections is shown in Figure 10. The residence and the smaller dwellings are both supplied from different connections to the same tank, and in order to prevent the dwellings from drawing all the water out of the tank, leaving none for the residence, a vertical standpipe about two feet high is fitted to the upper end of the outlet, where it enters the bottom of the tank. If the reserve for the residence is not wanted, the standpipe can easily be detached and allow the dwellings to draw down to the bottom of the tanks. Ordinarily the connection between the main supply pipe and the upper tank is opened, as well as that to the branch from the lower tank, the latter being protected by a check valve opening downwards; the supply is normally from the upper tank under maximum pressure, unless the water there should become exhausted, when the supply will be automatically increased by

dicated by dotted lines in Figure 1, which discharge into a public stream that must not be polluted with solid matter. In order to intercept everything but the liquids, the drains discharge through several catch basins shown in Figure 11. Each is a circular brick well about 8 feet deep and 12 feet in diameter, with a concrete bottom, domed top and flagstone cover with manhole. There are two vertical brick walls or diaphragms dividing the well into three nearly equal chambers, into the first of which the sewage is discharged through a 12-inch glazed pipe sealed by a down bend dipping below the surface of the water. The contents of the first chamber flow over the top of the wall into the second chamber, from that into the third, and thence out through a second catch basin just inside the street drain, thus insuring the passage of all sewage through at least six settling chambers, in which so much sediment is deposited that it is said the effluent is practically clear. These basins are cleaned periodically.

POSSIBILITIES OF ECONOMY IN PUMPING ENGINES.

At a recent meeting of the New England Water-Works Association a paper was presented by Mr. Geo. H. Barrus on the possibilities of economy in pumping engines, as based on the latest accomplishments, and, through the courtesy of the association, "The Engineering Record" is able to print a considerably condensed abstract of the paper. The paper and discussion in full will appear in the "Journal" of the association at a later date. Mr. Barrus called attention to the fact that the recent test by Prof. W. F. M. Goss, of Purdue University, of the 20,000,000-gallon pumping engine built by the Snow Steam Pump Works for the Indianapolis Water Company, showed that engine to be the most economical of any yet tested. To compare it with others, the author presented a table showing the essential features in its performance with those of a number of other prominent pumps, together with some data and calculations made by him, and not found in the published reports of the tests. All of the engines were of the triple-expansion type, and had the barrels of the cylinders and receivers

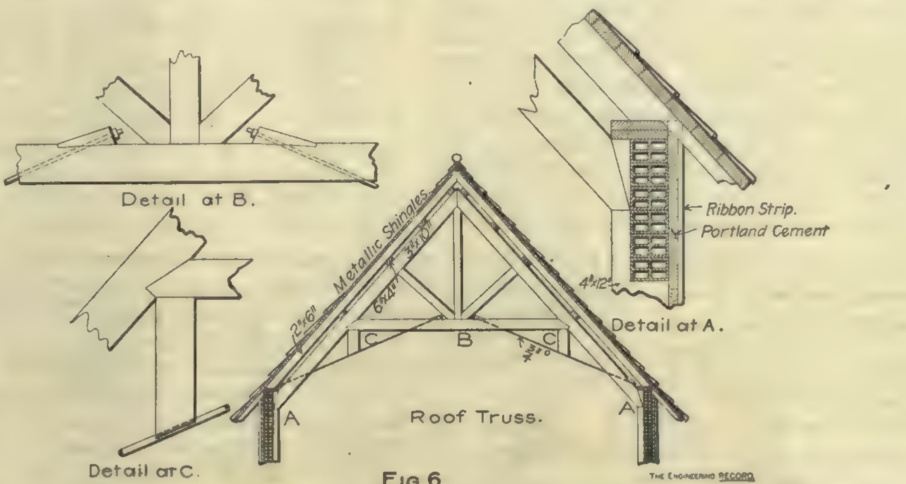


FIG. 6

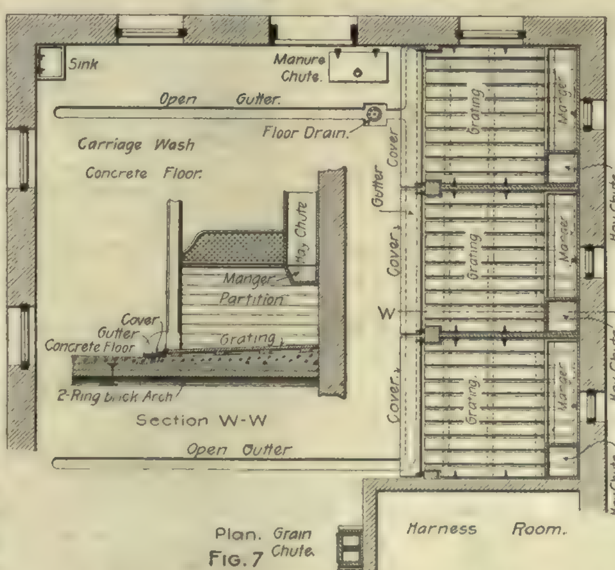


FIG. 7

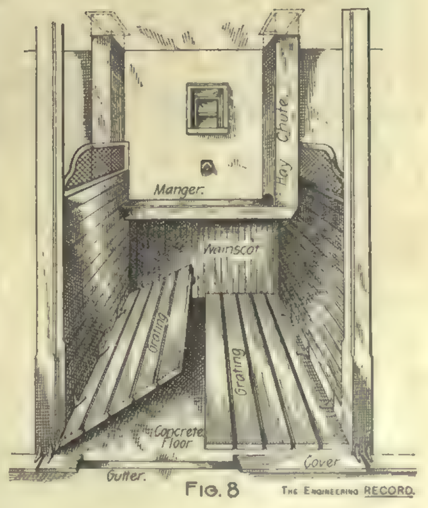


FIG. 8

ROOF AND STABLE DETAILS.

steam jacketed. The Chestnut Hill engine and that at Indianapolis had the heads of the cylinders fitted with steam jackets also. The table is given below:

Mr. Barrus believed all of the tests were reliable, and said Prof. Goss had repeated that of the Indianapolis engine and verified the results first obtained. With the exception of the two tests conducted by the author, there were no published statements concerning the conditions of the valves and pistons of the engines as regards tightness. In both the Detroit and Buffalo engine they leaked somewhat. The author stated that the economy of a steam engine depends upon the steam pressure, the efficiency with which the expansive force of the steam is utilized, and the quantity of cylinder condensation and leakage. As applied to a pumping engine, the economy is also dependent upon the friction of the engine and pump. These four controlling factors are given in the table. Line 10 gives the steam pressure; line 30, the diagram factor, that is, the ratio which the actual mean effective pressure measured from diagrams bears to the theoretical mean effective pressure; line 27, the cylinder condensation and leakage at cut-off in the high-pressure cylinder, including the condensation in jackets and reheaters; line 20, the friction.

In the light of what the data reveals, Mr. Barrus believed that a duty of 150 million foot-pounds per million heat units is a result which ought to be readily duplicated, and very likely surpassed, by any of the various types of engines referred to, provided they are given an equally favorable opportunity. The Milwaukee engine worked under a steam pressure 34.2 pounds below that of the Indianapolis engine, and the author estimated that if the pressure had been raised in the Milwaukee engine to the same point, with a corresponding increase in the ratio of expansion, the duty would have been increased 7.1 per cent. Furthermore, if the friction of the Milwaukee engine had been no greater than that of the Indianapolis engine, the duty would have been still further increased 5.1 per cent. These two changes would have brought the duty per million heat units up to 154.2 million foot-pounds. Again, if the Chestnut Hill engine had operated with the same cylinder condensation and leakage as the Indianapolis engine, the duty would have been increased 2 per cent.; and, further, if the friction had been no greater in one case than in the other, the duty would have been increased 6.6 per cent. more, bringing the final result up to 154.2 millions. In the Detroit engine an increase in the boiler pressure from 125.2 to 155.6 pounds, with a corresponding increase in the ratio of expansion, would have increased the duty 8.2 per cent. If the cylinder condensation and leakage had been no greater in one case than in the other, the duty would have been further increased 1.9 per cent. If, also, the friction had been only 4.6 per cent., there would have been a still further increase of 6.5 per cent., making the final result 152.3 millions.

The possibilities of economy in pumping engines, as based on the latest accomplishments, in a word, seem to be that with a boiler pressure of 175 pounds per square inch, a diagram factor and cylinder condensation and leakage as favorable as obtained in the Milwaukee engine, and the friction as low as 5 per cent., which appears to be capable of realization, a duty can be obtained of at least 155 million and possibly 160 million foot-pounds, for the expenditure of a million heat units.

TABLE ILLUSTRATING THE POSSIBILITIES OF ECONOMY IN PUMPING ENGINES.

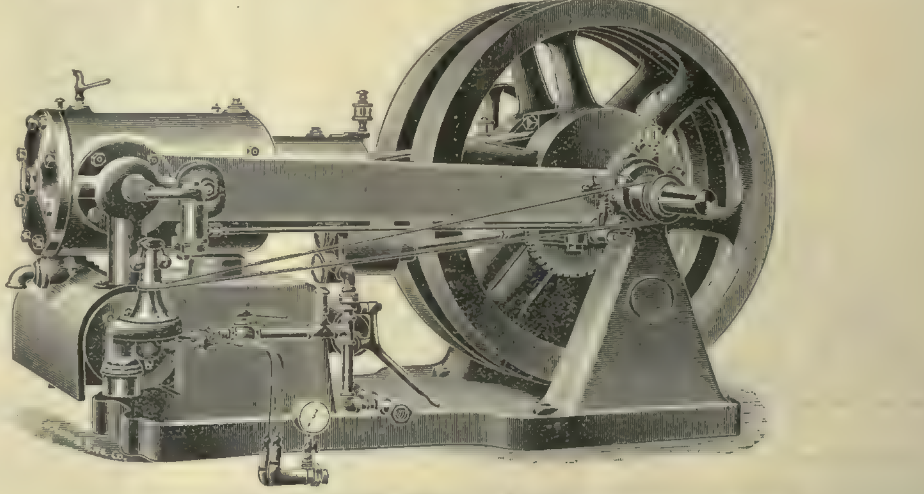
1. Designer or builder	E. P. Allis Co.	E. D. Leavitt, Jr.	E. P. Allis Co	Lake Erie Eng. Works:	Snow Steam Pump Works.
2. Locality	Milwaukee, Wis.	Chestnut Hill, Mass.	Detroit, Mich.	Buffalo, N. Y,	Indianapolis, Ind.
3. Test by	R. C. Carpenter.	E. F. Miller.	Geo. H. Barrus.	Geo. H. Barrus and Newcomb Carlton.	W. F. M. Goss.
4. Capacity, gals. in 24 hrs	18,000,000	20,000,000	24,000,000	30,000,000	20,000,000
5. Steam cyls., ins	28, 48, 74 x 60	13.7, 24 37, 39 x 72	28, 48, 74 x 60	37, 63, 94 x 60	29, 52, 80 x 60
6. Plungers, ins	32 x 60	D'ble acting. 17.5 x 48	36 x 60	42 x 60	33 x 60
7. Total head, lbs	70.4	59.4	53.4	86.1	88.7
8. Piston speed, ft. per min.	203.1	607	209.9	207.7	214.6
9. Volume ratio, H.-P. to L.-P. cyls	7.1	8.3	7.1	6.5	7.7
10. Press. near throttle, lbs†	121.4	175.7	125.2	167.1	155.6
11. Cut-off press., lbs†	118.6	151.5	119.4	152.2	153.
12. Release press. L.-P. cyl., lbs‡	5.3	6.9	5.8	7.4	6.4
13. Back press. L.-P. cyl., lbs	1.6	1.5	2.8	2.2	2.5
14. Cut-off, H.-P. cyl	.337	.384	.338	.323	.315
15. Clearance H. P. cyl	.014	.015	.014	.014	.018
16. Ratio of expansion	2[illegible].4	21.	20.3	19.6	23.8
17. Ditto, referred to press. nr. throttle.	20.8	23.9	21.2.	21.3	24.3
18. Abs. press. near throttle ÷ ratio of expan., lbs	6.6	9.1	6.9	9.3	6.8
19. Indicated H. P	573.9	575.7	573.7	1,185.5	775.5
20. Friction, per cent	9.2	10.5	10.2	5.1	4.6
21. Dry steam per I. H. P. per hour, including jacket and reheater steam, lbs	11.68	11.22	12.52	12.39	11.23
22. Percentage of steam condensed in jackets and reheaters	9.2	17.1	12.7	13.7	10.5 (est)
23. Dry steam per I. H. P. per hour, exclusive of steam used in jackets and reheaters, lbs	10.61	9.3	10.93	10.7	10.08(est)
24. Steam accounted for by indicator, H. P. cyl. cut-off, lbs	9.05*	8.5*	9.5	9.1	8.7*
25. Steam accounted for by indicator, L.-P. cyl. cut-off, lbs.	8.7*	9.6*	9.5	9.7	8.7*
26. Steam accounted for by indicator, L.-P. cyl. release, lbs	9.04*	9.1*	9.9	9.7	9.8
27. Cylinder condensation and leakage, including jacket and reheater condensation, at cut-off, H.-P. cyl	.225	.242	.211	.266	.227
28. M. E. P. referred to L.-P. cyl., lbs	21.77	26.36	21.03	27.19	23.65
29. Theoretical M. E. P. referred to press. near throttle and ratio of expansion at same point.	26.42	33.23	26.76	34.63	29.66
30. Line 28 ÷ line 29, or "diagram factor"	.824	.794	.792	.786	.797
31. Duty per mil. heat units, ft. lbs.	137,000,000	141,900,000	129,700,000	135,400,000	150,100,000
32. Duty per 1,000 lbs. dry steam, ft. lbs.	154,000,000	154,900,000	142,400,000	152,000,000	167,800,000

*Calculated by G. H. B. † Above atmosphere. ‡ Above zero.

THE AULTMAN-PRIESTMAN OIL ENGINE.

The Priestman oil engine is of the single-acting type, using kerosene or carbon oil, brought into an intimate mixture with air and made to explode behind the cylinder piston. The new engine, the general form of which may be seen from the accompanying cut, is built by the Aultman Company, of Canton, Ohio, which recently undertook its manufacture.

The most notable recent change, perhaps, in the construction of the engine is the position of the flywheels, which are mounted between instead of outside the main bearings, as is the general practice. This transforms the engine into the class known as the straight line, in which the power transmitted by the connecting rod is absorbed by the flywheel without first being transmitted through the main bearings, relieving the latter of a considerable twisting strain. This fact is evidenced, the builders say, by the minimum of wear and of lubrication required. The working parts of the engine are few, and the only parts about the engine which are mechanically operated are the exhaust valve, governor, a small power pump which is operated by an eccentric for pumping the oil, and a little device for making and breaking the electric battery circuit.



THE AULTMAN-PRIESTMAN OIL ENGINE

Until comparatively recently the oil engine has not been successfully operated with the heavier and safer constituents of petroleum, such as the grades of kerosene or carbon oil commonly burned in house lamps. Such oils do not evaporate on exposure to the atmosphere, as do gasoline, naphtha, etc., and so, not giving off explosive gases, are highly desirable in many places where the dangerous nature of the lighter oils renders their use undesirable. The present engine, however, is stated to be adapted to use high-test safe petroleum as fuel.

The method of operation of this class of oil engines is as follows: A fine kerosene spray is injected into the chamber shown directly underneath the cylinder head. Here this spray is mixed with the proper proportion of air for supporting combustion, and the mixture heated by the hot exhaust gases, which are made to pass through an annular space surrounding this mixing chamber before being expelled into the atmosphere. The heated charge of oil spray and air is then drawn through the inlet valve into the cylinder by an outward stroke of the piston. The inlet valve is not mechanically operated, but is opened automatically by suction, or, in other words, the pressure of the atmosphere. The return stroke of the piston compresses the charge, which is then ignited by an electric spark from an ordinary battery, and the resulting expansion of the heated products of combustion drives forward the piston, thus imparting the energy which is utilized for doing work. During the succeeding stroke of the piston the exhaust valve is held open mechanically, and the dead gases are swept out of the cylinder, which is thus prepared for the reception of a fresh charge of oil and air. The cycle of events just described embraces two revolutions of the flywheels.

The chief departure in the new engine, it is claimed, from the gas-engine principle of operation is in the treatment of the fuel, a considerable portion of which, if not all, is said to

be burned as a liquid spray instead of as a gas. As evidence that this is so, the engine is stated to be easy to start and no trouble is experienced in attempting to get a proper proportion of air and oil. In fact, it is considered unnecessary to mix the oil and air in an exact ratio, as is the case with the gas and gasoline engines, since the ratio is several thousand to one in any case and need not be maintained at any exact figure to give a good explosion. Another claim made for liquid fuel is good lubrication of the cylinder, for which no special cylinder oil is used. It is said that the cooling water surrounding the cylinder can be allowed to boil without increasing the friction. The oil, which is kept in a tank located wherever convenient, is pumped into the spray maker under a pressure of about 8 pounds. The consumption is given as about 1¼ pints per brake horse-power per hour. The steam-engine method of governing, that is by throttling the charge, is employed and impulses are taken regularly, each charge of oil spray being proportioned to the load carried. The speed regulation is said to be good enough to adapt the engine to electric lighting service. The Aultman Company has recently added an improvement by which the engine can be started from an air storage system without recourse to any preliminary hand pumping or turning of flywheel. It should be added that the preceding description is abridged from a paper by Mr. Norman McClintock.

PAPERS AT THE AMERICAN SOCIETY OF HEATING AND VENTILATING ENGINEERS.

At the meeting this week of the American Society of Heating and Ventilating Engineers, a number of papers were presented, of which abstracts are herewith printed. The discussion they elicited will be found in the account of the convention, presented elsewhere.

THE RELATION BETWEEN ARCHITECT AND ENGINEER.

[By T. N. Thomson.]

This paper was a plea for an earlier consideration of the heating and ventilating plant in the design of a building. While the author believed that the frequent tardy selection of a heating and ventilating system was often due to the excusable ignorance of a petulant owner, he nevertheless held that the architect was responsible for a disregard of heating and ventilating problems at the outset. Mr. Thomson said in part: "The reason why this state of affairs exists, possibly, is that the owner does not know what kind of a heating system he wants, and consequently his architect has been working in the dark; it is more probable, however, that the energies of the architectural force have been concentrated on the construction of the building, and the heating system has, therefore, been overlooked."

The result is the apparatus is not installed until the building is nearly completed, and is an expensive and unsightly example of a compromise upon the part of both architect and engineer. As the author put it: "Engineer and architect now consult and decide upon a 'give and take' plan. The architect is willing to cut out here and build up a little there in order to conceal certain flues. He changes the plans somewhat to get in a central vent stack, and puts in a few more open fireplaces for the sake of ventilation. He also agrees to build an underground duct, and brick in the indirects, etc., all for appearance and general utility's sake. The engineer, on the other hand, cuts out some indirects and replaces them with direct radiation, because it would weaken walls or beams too much if the proposed flues were all run through, and so the thing goes until a fairly good arrangement is mapped out on the 'trestle board.' But see what it will cost to make the changes in the building; compare it with the very simple, economical and unobtrusive system that could have been devised if architect and engineer had but worked together on the first lay-out of the plans, before the construction was commenced.

"This is no fable—it is an every-day occurrence, and almost every engineer can testify to it. Why is it that some of the very finest and most costly buildings in the country to-day are defaced internally by steam pipes running here, there and everywhere? It is simply because no provision was made for a better arrangement in the working drawings, and before the building was commenced." . . . .

"Every square foot of floor surface within the walls of a building is valuable; it represents so much money invested. Every square foot of surface covered by or obstructed with engineering apparatus means just so much available rental space paid for and lost. Then why is so much floor space wasted by machinery, pipes, ducts, casings, etc., being indiscriminately scattered everywhere? Only because the building has been built without consultation with the heating engineer and the other engineers."

VENTILATION AND HEATING OF TALL BUILDINGS.

[By Henry C. Meyer, Jr.]

The paper deals with the ventilation of tall buildings, and treats also of some of the details of the steam apparatus met with in heating plants. The author believed that the subject of ventilation in buildings of modern construction was not given the attention it deserved. While there was a certain demand for a special provision for supplying fresh air, it was not great enough, and but few buildings are being so equipped. He considered that the matter lay to a great extent with the architect and engineer, who must urge upon the owner the desirability of proper ventilation. He called to mind the absurdity of the man who takes great care to see that the schoolrooms occupied by his children a few hours each day are abundantly supplied with fresh air, while he betakes himself to his own office, where he spends twice the time in an atmosphere purified as best it may. The author believed, moreover, that a ventilating system is justified from a business point of view. In the first place, he says that the cost of a ventilating system in comparison with the cost of a large building is small, and that the extra layout will be considered a good investment when business men awake to the fact that more and better work may be realized from the occupants of well-aired rooms. He was of the further opinion also that notwithstanding the greater cost of operating the ventilating system, the effect of the extra expense or rental values would not be such as to keep tenants away, but would be outweighed in their eyes by the additional attractive feature resulting from the special air supply. He said that in considering the cost of a ventilating system it should not be forgotten that the number of really cold days in a year in the latitude of New York and Chicago was not very great, and also that in almost all the tall buildings there was considerable more exhaust steam than is needed to do the simple heating of the building.

He then took up in brief a description of the methods of supplying fresh air in different buildings. He said that one of the earliest really tall buildings in which provision was made for an air supply was the Manhattan Life Building* in New York city. In this the building is warmed by direct radiators placed inside of the windows. Long narrow slots were cut in the window sills, admitting fresh air over the radiators, so that it would meet and mingle with the column of heated air rising from the radiators. To make the air supply independent of the force and direction of the wind, each room is connected to one of four systems of foul-air ducts carried above a suspended ceiling in the corridors, each of the ducts connecting with a flue or shaft leading to a fan chamber on the roof, where a powerful exhaust fan tends to create a vacuum throughout the building, insuring a flow of fresh air through the window openings. Messrs. Kimball & Thompson were the architects of this building, and Messrs. Gillis & Geoghegan the leading contractors.

The next building referred to was the Buffalo Real Estate Exchange,* an 11-story building warmed entirely by indirect radiation. He described it in brief about as follows:

Two independent hot-blast coils and fans are employed. The building is E shaped in plan. Near each angle in the building is a shaft running from the cellar to the upper floors and containing a number of galvanized iron flues, one independent flue being carried up from the coils to each of the upper floors. Each flue supplies one-half of a floor, and does this by means of a duct located above a suspended ceiling, the duct supplying registers opening into the top of each room. The air passes out of the rooms through registers into the corridor, and leaves the building through openings over the elevator shaft. The architects of the building, Messrs. Green & Wicks, of Buffalo, informed the author but a few weeks ago that the plant cost but little more than the ordinary heating system, and had given excellent satisfaction, so much so that they would install the same system again if opportunity offered. The Buffalo Forge Company were the contractors for the heating system. In this building the temperature of the rooms is regulated by controlling the amount of heated air admitted, as all of the air must be raised to a temperature necessary to warm the most exposed rooms. The ideal arrangement, the author stated, would be to have a double-duct system; that is, a hot and cold-air duct, with a mixing damper for each room, but the cost of such a plant would make it almost out of the question. It might be well in such a system of air supply, he thought, to depend partly on direct radiators, say to put in enough to supply the heat transmitted by the walls and windows, and depend upon the blower system for air for ventilation only.

Still another type of ventilating apparatus was found in the American Surety Building,† in New York City, of which Mr. Bruce Price was the architect. Mr. Alfred R. Wolff, who designed the ventilating system, provided an extensive Sturtevant hot-blast plant in the basement, supplying about four changes of air per hour to the seven lower stories. From each of these foul air is drawn by flues to fan chambers on the roof. The plant of the Singer Building,‡ in New York, and that of the Carnegie Building, in Pittsburg, both designed by Mr. Wolff, are arranged with the direct-indirect system of supply with an exhaust ventilating system, and both are said to have been very satisfactory. He believed that this last-mentioned type of plant or that used in the Buffalo building mentioned, would, in all probability, be most used in the future, as the flues required in the system where the air is both supplied and removed by a blower system take up so much room as to render them objectionable, particularly if the building is a tall one.

In considering the details of the steam and exhaust piping in modern buildings, the author believed that in office buildings where the head room was restricted, a good arrangement was to provide an elbow on the nozzle of each

* The heating and ventilating plant in this building was fully described and illustrated in "The Engineering Record" of October 6 and November 3, 1894.

* The heating and ventilating plant in this building was fully described and illustrated in "The Engineering Record" of May 2. 1896.

† An illustrated description of the mechanical plant of this building may be found in "The Engineering Record" of March 7, 1896.

‡ The heating and ventilating plant of the Singer Building was described in "The Engineering Record" of September 3, 1898.

boiler and run a horizontal pipe from the elbow to an angle stop-valve bolted to a flanged nozzle on top of the steam main. The stop-valve should have its stem in a vertical position, so that, on shutting down the boiler, there would be no pressure on the packing when it is required to repack the valve. The branches to the engines should in every instance be taken from the top of the main. The connections to steam pumps which have a variable stroke would not, he said, be damaged by water, and hence it did no harm to connect the steam supply pipes for pumps to the side of the mains. The author mentioned a plant where the connections to the pump were made at the bottom of a steam main, the object being to drain the main in this way. This, however, did not seem to him to be good practice, as it tended to turn a steam cylinder into a pump; moreover, the condensation in the steam main contains no oil, and was at high temperature, and, therefore, could well be returned directly to the boilers.

Speaking of drips, the author said that the high-pressure drip—that is, the condensation which occurs in the high-pressure steam pipes —could be led to a trap or traps if the different drains were likely to be under different pressures. The traps could either discharge into the main return tank, from which the condensation may be pumped back to the boilers by a regular boiler feed pump; or they could discharge into the automatic receiver and pump, the latter returning it to the boilers. In large plants, he said, where the condensation in high-pressure pipes is considerable, the latter method is sometimes adopted. The author was of the belief that engineers had, in many instances, gone too far in endeavoring to save the heat of steam condensed in exhaust pipes, feed-water heaters, etc. The reason for his belief is that almost all of the large buildings—every one in New York City, except perhaps the Bowling Green Building—had more steam exhausted by the engines and pumps than they could possibly condense in their heating systems, and for that reason it was better to let the low-pressure drips go to waste than attempt to save the heat they contain, as the heat necessary to warm the cold feed which would have to be supplied to take the place of the drip wasted could be warmed in the feed-water heater by a part of the steam which would otherwise pass into the atmosphere. He said that if the cost of water should warrant such an action, or if the feed-water should be such as to cause scale to form in the boilers, it might be better to save the drip from the low-pressure piping and in the feed-water heater if it was of the closed type, rendering it harmless by the use of some form of mechanical filter for removing the oil. Unless a filter is used the author was strongly in favor of throwing away the drip from all exhaust piping and the condensation occurring in a closed feed-water heater.

He claimed that the importance at locating a grease extractor was often not appreciated. He said it should be placed so as to protect the feed-water heater as well as the heating system.

In concluding, he said that a suggestion was made to him several years ago by Mr. W. J. Baldwin, which seemed to him to deserve wide publicity. The ordinary exhaust-steam heating system usually consists of a main exhaust pipe dividing into two pipes, one containing a back-pressure valve and leading to the atmosphere, while the other conveys the exhaust steam to the heating system. As is usual, a reducing valve admits steam to this latter pipe to supplement the supply of exhaust steam when necessary, and it was found in a certain plant that occasionally, owing perhaps to lack of proper adjustment, the reducing valve would open when the pressure in the heating system was high enough to open the back-pressure valve, so that live steam was blowing through the back-pressure valve and out in the atmosphere. This was discovered, and the evil remedied by placing a check valve in the branch leading to the heating system, so that live steam could not flow through the reducing valve and out into the atmospheric connection. It occurred to the author that as back-pressure valves are usually set to open at a pressure of from two to three pounds on the heating system, and reducing valves to open at some lower pressure, there was not much margin, so that many plants might occasionally suffer a loss of steam from the cause mentioned. A balanced check valve designed to offer little resistance to the passage of steam flowing through it in the proper direction would overcome this.

SOME FORMULAS FOR DISK FANS.

[By Prof. J. H. Kinealy.]

The desire to obtain formulas for disk fans that would be at practical value in designing led to an investigation of the subject, and a final derivation of two simple equations. At the outset it was held that the consideration of pressure in connection with fans of this type was useless, in that they were not adapted to working against pressure; what was really wanted was the relation of speed, diameter and capacity for conditions of free entry and exit. One of the formulas is intended to give the proper number of revolutions per minute, at which a fan of a given diameter should be run, and the other to enable the designer to determine the number of cubic feet of air which a disk fan of a given diameter ought to be expected to deliver per minute.

The first of these is:

$$D\,N = 21{,}000 \qquad (1)$$

where D is the diameter in inches and N the number of revolutions a disk fan of any type may be run. This formula is based on the knowledge that a cast-iron wheel may have a peripheral velocity of from 80 to 100 feet per second, without undue stresses being set up. The maximum number of revolutions at which the fan should be run is authorized as 10 per cent. greater than that given by the formula.

The capacity formula is:

$$C = 7\,D^2 \qquad (2)$$

for a disk fan with straight vanes set at an angle between 40 and 45 degrees, revolving just outside of a delivery tube whose diameter is slightly greater than that of the fan. For a Blackman fan it is:

$$C = 11\,D^2 \qquad (3)$$

C is the number of cubic feet of air per minute, and D the fan diameter in inches. Formula (2) is based upon the results of experiments made by Mr. William George Walker,* given in a paper read before the Institute of Mechanical Engineers. Formula (3) is derived in a similar way from the results of experiments quoted by Mr. George E. Babcock in Volume VII., of the "Transactions" of the American Society of Mechanical Engineers.

Several formulas for fans of foreign make, derived in a paper read by Mr. A. Marx, before a meeting of heating and ventilating specialists in Munich, August, 1898, compared favorably with those of the present paper, when transcribed into English units.

HEATING A PRIVATE RESIDENCE WITH A WARM-AIR FURNACE.

[By B. Harold Carpenter.]

The design of a warm-air heating plant for a private residence is described in this paper.

The building has a total volume requiring warming of 38,800 cubic feet. The air is supplied from out of doors through an underground brick duct, 12 square feet in cross-section, leading to a warm-air furnace. A design of furnace was chosen to give as large radiating surface as possible in the effort to minimize the chances of overheating, which, it is considered, is one of the bad features of the ordinary warm-air apparatus. The total surface of the furnace available for heating is 107 square feet, making the ratio of building contents to heating surface 365 to 1. A circular grate has a surface of 4.9 square feet. The square feet of air passage in the furnace was calculated from its dimensions, and by assuming an average value for the velocity of air flow through the furnace, the total volume of air supplied the building was determined. An average velocity of 4.8 feet per second was chosen on the basis of a velocity of from 2.5 to 4 feet per second to first floor, 5 feet per second to second floor, and 6 feet per second to the third. The cross-section of the air rising through the furnace was taken as 12.5 square feet, and the total quantity per minute was found to be about 3,600 cubic feet. This was sufficient to change the air throughout about every 11 minutes.

The air is carried from the furnace in a system of flues concentrated about the center of distribution, and combining in each flue the supply of two or more rooms. Pipes carrying the air supply to individual rooms from these combination flues extend into the flues from 2 to 4 feet below the connection, intercepting a portion of the rising air for their respective rooms.

THE NECESSITY OF VENTILATION.

[By H. Eisert.]

The paper was introduced by a statement of the composition of air, leading to a discussion of the various ways by which it became vitiated. The effect of the products of respiration was taken up, and tables were appended with data from experiments of Messrs. H. Rietschel and H. Wolpert. By these, it appears that a man under average conditions exhales about 0.7 of a cubic foot of carbonic acid per hour. The vitiation of air by combustion was next considered, and a table from the work of Röttinger was used to show the relative oxygen-consuming qualities of different sources of lighting. It was shown, for example, that some fishtail gas burners produced anywhere from 0.215 to 0.494 of a cubic foot of carbonic acid per candle power per hour. The range credited the Welsbach was 0.03 to 0.057 of a cubic foot per candle power per hour. The paper next considered the danger arising from an atmosphere permeated with gases from experimental or industrial processes, and referred to a table setting forth the relative detrimental effects of various gases and vapors, with a reference that problems involving the dilution of dust-laden air had to be given special consideration. The subject of heat generation by living beings and illumination was then discussed. It was said that an adult gives off on the average about 400 B. T. U. per hour. The heat units for illuminating gas were given as 580 to 600 per cubic foot per hour, and for petroleum as 150,000 per gallon per hour. The heat from electric illumination was usually neglected.

The remainder of the paper was devoted to an exposition of formulas, by which the amount of air required to maintain the proper dilution of the impure gases could be determined. The first of the formulas was based on the allowable limit of carbonic acid. The second was based on the supply of air necessary to keep the temperature within habitable bounds in places where people are assembled together. Under ordinary conditions it was considered that a change of air in an ordinary room at 1.5 or 2 times an hour was quite sufficient as far as purposes of ventilation were concerned. When considerations of heating were also to be considered the paper said that more than five changes per hour could not well be permitted without causing annoying drafts. As regards the proportion of carbonic acid, the allowed limit for healthy people was given as 0.15 per cent., and for sick rooms not to exceed 0.07 per cent.

(To be Continued.)

* A reprint of Mr. Walker's paper was published in "The Engineering Record" of July 24 and August 7, 1897.

AMERICAN SOCIETY OF HEATING AND VENTILATING ENGINEERS.

The fifth annual meeting of the American Society of Heating and Ventilating Engineers was called to order January 24, 1899, in New York City, with President Wiltsie F. Wolfe in the chair. The first session was in the afternoon and was a business meeting. The president, in his address, referred to the work the society had done in its furtherance of the scientific heating and ventilating plant as against the old system installed from a purely commercial point of view. He said the society was strong in numbers, and financially better than ever before, and made suggestions by which the field of influence of the society might be increased. The report of the secretary corroborated the statement of the president, and showed a total membership of 120, a healthy net gain over that of last year. The treasurer's report showed a good balance to the credit of the society, with no unpaid bills.

Mr. N. P. Andrus made a report for the committee on compulsory legislation, in which he showed that the passage through the legislatures of various States of bills defining requirements and limits of heating and ventilating, was fraught with considerable work, and only hopes of success. Later in the meeting, the president took the floor for a discussion of the subject, and expressed the belief that the most promising results would probably accrue from the personal work of specially appointed members who could make their arguments under the most favorable conditions. He thought tnat the average legislator did not realize the advantages or even the necessity of obligatory measures affecting heating and ventilating. Some interesting statistics were presented in several individual reports, bearing on the condition of schoolhouses in different large cities. These will doubtless be distributed for examination before the next semi-annual meeting.

The second session of the convention was held in the evening of the same day. A canvass of ballots for officers for the ensuing year resulted in the election of Mr. Henry Adams, Washington, D. C., President; Mr. D. M. Quay, Chicago, First Vice-President; Mr. A. E. Kenrick, Brookline, Mass., Second Vice-President; Mr. F. A. Williams, New York, Third Vice-President; Mr. W. M. MacKay, New York, Secretary; Mr. J. A. Goodrich, New York, Treasurer. Board of Managers: Messrs. S. A. Jellett, of New York; Wiltsie F. Wolfe, of Boston; B. Harold Carpenter, of Wilkes-Barre, Pa.; Henry C. Meyer, Jr., of New York; A. A. Cary, of New York. Council: Messrs. R. C. Carpenter, of Ithaca, N. Y.; John Gormly, of Philadelphia; Wm. McMannis, of New York; W. S. Hadaway, Jr., of New York; B. F. Stangland, of New York.

The first paper read before the convention was presented by Mr. H. Eisert, entitled "Necessity of Ventilation." This appears in abstract in another part of this issue. Mr. Kenrick took exception to the statement made that practical experience had shown that under ordinary temperature conditions the air in an occupied room could not well be changed more than five times per hour without causing annoying drafts, and claimed that his experience in Massachusetts had demonstrated the possibility of so doing in seven minutes. Mr. Kenrick, on further questioning, said this was possible in a gravity system with a temperature difference between outside and inside of a building of 40 degrees.

One member believed that the paper showed the value of the heat unit method of determining heating surfaces in ventilating plants. It gave data for taking into account the heating effect of lights and human bodies in auditoriums and audience halls, where it was often necessary to provide special methods for supplying the cool air necessary to counteract the heat exhalation from these sources. Mr. Jellett cited a case of an operating amphitheater, where it was found that there was a rise of 8 degrees in 15 minutes from 470 men.

The next paper read was that of Mr. B. H. Carpenter, treating of a hot-air-furnace installation in a residence. It appears in abstract elsewhere in this issue. Mr. Connolly questioned the use of single flues, and some doubts were expressed as to the preference for wrought-iron over cast-iron in the furnace. Mr. Kent thought that the dimensions of the apparatus were liberal, and that there was rather a large amount of air supplied the building. Mr. Richardson said in his experience single flues properly installed did not cause fires, and deemed it impracticable to run double flues in the average 4-inch partitions of a dwelling house. He knew of sheet iron existing 30 years, and thought a point in its favor was the short time it took to heat it. It seemed to be the general opinion that in many furnaces there was an insufficiency of pipe area to carry off the heated air. Mr. Gormly thought it bad practice to carry air through underground brick ducts wherever it was avoidable, as the percolation of more or less pernicious gas was liable to occur, especially when in made ground, unless care had been taken to have the brickwork grouted with cement.

The first session of the second day was held on the afternoon of January 25. The Committee on Revision of Constitution and By-laws recommended certain changes at this time. The more important were as follows: Limit allowed for payment of dues in arrears reduced from 6 months to 3; Board of Governors authorized to transfer members from junior grade to full membership; President made chairman ex officio of Board of Governors; provision made for the salary of a secretary, discretionary with Board of Managers; provision for a countersigning of checks; provision for an appointment of sub-committees from the Board of Governors for finance, membership and publication.

The first paper of the session was that of Prof. R. C. Carpenter, entitled "Investigations of a Blowing Fan," and will be published in a subsequent issue. Mr. Kent pronounced the paper the best thing on the subject in the English language. Prof. Carpenter was asked to show how the efficiency of the fan was obtained, and what margins for improvement existed for inventors. Other suggestions were made for Prof. Carpenter to investigate.

The next paper was read by Mr. Henry C. Meyer, Jr., on "Some Points Regarding the Ventilation and Heating of Tall Buildings," and may be found elsewhere in this issue. Mr. Jellett described the heating and ventilating system of a Philadelphia building, differing in some features from any mentioned by the author. Mr. R. P. Bolton, in discussing the paper, thought it best to get air and heat it at the roof of a building. He thought this air could first be used to condense steam, for while it probably would not produce an appreciable vacuum, it would save water, justifiable in view of the tremendous quantity used in the tall buildings. On this argument he considered it advisable to save all drips. In his closure, the author gave some figures he had obtained from Mr. Alfred R. Wolff, relative to the actual small cost of a heating and ventilating system. The cost of a heating installation for the large buildings ranged from 5 to 7 per cent. of the cost of the building, not including the real estate; with ventilating system it amounted to 7 to 10 per cent., an average of 2½ per cent. more than that for heating alone, which, when based on the cost of the building, including real estate, was quite small. In reply to Mr. Bolton, the author thought the loss of rentable floor area by reason of installing flues for air would amount to very little per year. He said the drip which he advocated wasting was a very small proportion of the total water delivered to buildings. He placed the valve controlling the supply from a boiler over the steam main to facilitate the management of it, and considered its vertical position was best adapted to prevent the formation of water pockets.

The concluding paper of the session was that of Mr. T. N. Thomson, treating of the "Relation between Architect and Heating Engineer." That the relation between the two was as the paper had represented was generally admitted; what was really wanted, the president said, was to inform the other fellow. It was shown in the discussion how the present relation was due in a great measure to the greater exactions on the modern engineer, whose greater work with the advance of modern architectural structures did not seem wholly appreciated. On the other hand, Mr. Jellett said that the fault lay partly with the trade, who had furnished plans, often under considerable expense and little chance of getting the contract. Mr. Jellett said that when 5 per cent. was taken as the figure for the architect's remuneration there was none of the present-day structures, of which so large a part is designed by engineers. He thought the extra cost should not be squeezed from the trade, but should come from the owner. It was finally decided to redistribute the paper before the semi-annual meeting, and in the meantime as far as possible to bring the paper to the attention of architects.

The next thing considered in the meeting was the topic as to the number of changes of air which should be allowed in different types of buildings. It was generally considered that no rule could be laid down, as each case demanded a knowledge of the probable occupancy, and depended on the volume and time which the building was to be occupied. The experience of Chief Wade, of Massachusetts, was cited, from which it was learned that 20 cubic feet per pupil in schoolhouses was insufficient; 25, only under most perfect conditions; but that 30, in most cases, was all right. A member said that the percentage of carbon dioxide should be the deciding point.

At the close of the session, the society was invited by the New York members to a dinner at the St. Denis Hotel, where an enjoyable evening was spent, and the society was introduced to ex-Senator A. A. Ray, who told how he had succeeded in getting the bill on compulsory legislation through two sessions of the New York Senate, but had failed in the Assembly.

On the third day a session was held in the morning. The first paper was presented by Mr. Wm. S. Monroe, entitled, "Some Experiments with Centrifugal Fans." The paper will be found in abstract in the next issue.

The next paper was entitled, "Some Formulas for Disk Fans," by Prof. J. H. Kinealy, and will be found in abstract on another page. Mr. Kent did not think the speed should be limited by the stresses permissible in cast-iron in flywheels, and therefore the speed limit was too low. He found that it compared favorably with a portion of a table published by the Buffalo Forge Company.

The next subject discussed was the topic, "What are the relative advantages of the upward and downward systems of ventilation for audience halls?" Prof. Carpenter considered the case was governed largely by circumstances. Mr. Meyer, Jr., thought with the upward system, as the openings were usually protected with a diffusing shield, the air was limited in its flow to a relatively small core, which would tend to create a draft; but that where openings in the floor were used for air exits, the air converged from a larger sphere with a minimum chance of draft. Prof. Carpenter said Peclet's conclusions on this point were that the upward was to be preferred if air could enter and pass out at points freely distributed, both on floor and ceiling; that the downward was preferable where the number was limited.

Another topic for discussion was then consid-

ered: "Would it not be in the interest of the purchaser to rate the radiators by their heating value, based on certain standard conditions?" Prof. Carpenter said that Prof. Cooley's opinion was of the affirmative, that is, in favor of trade measurements. He thought it was not practical, that sometimes there was 25 or 30 per cent. more cast iron than necessary. He mentioned, referring to experiments he had presented in a former paper, that as much heat was realized from a radiator 24 inches high as from one 38 inches in height; that in the grouping of radiators the efficiency of so doing was overlooked. Mr. Fowler suggested a standardizing by a study of the air about the radiator. The matter was referred to the Committee on Standards.

The next and last session was held in the afternoon of January 26. The topic, "Are the capacities of steam traps, as given in makers' catalogues, of any practical value to the engineer?" was first discussed. Mr. Jellett said they were misleading, as they were based on a capacity for disposing of the condensation in a certain length of pipe, which might be subjected to various conditions. Mr. Paul said it depended to a considerable degree on how the trap was connected, citing an instance of the failure to work of a temperature trap. Mr. Mackay said he thought the rating was originally based on direct radiation. He considered that with this in view the proper size might be ascertained.

On the subject of "What rules are usually followed for proportioning direct-indirect radiation, and how many heat units are given off per square foot of heating surface per hour under ordinary conditions with this system?" Mr. Jellett said he usually added from 10 to 15 per cent. of the corresponding direct surface, and as regards the heat generation he found by an experiment that the air 6 inches above a radiator 24 inches high was 164 degrees in temperature, and at an equal distance above a 37-inch radiator was but 167 degrees.

A paper was then presented by Prof. Carpenter on "Literature Relating to Blowing Fans."

This was the last paper, and the remaining topics were then taken up. One topic asked for the "General principles to be observed in the installation of blower systems of heating and ventilation." Mr. Jellett thought there was need of considerable further clearance in many heating stacks he had seen, on account of the enormous friction which he said existed, lowering thereby the capacity of the blower. He believed all long lines of ducts should be covered. As to velocities practicable, he said the speed in a main duct should not be over 2,000 feet per minute nor less than 1,200, except for factories and similar buildings, where it might be 2,500 or 3,000 feet per minute. He allowed 600 feet in flues and 300 feet into rooms.

NOTES.

Another Use for the Gasoline Engine has been found by Mr. F. W. Clisby, Chesterville, Ill., who is using one of 20 horse-power to operate a grain elevator with a capacity of 2,500 bushels an hour.

A Large Gas-Engine Plant will be installed by the London County Council at the Lot's-Road pumping station, according to "Engineering." It will consist of eight double-cylinder horizontal Crossley gas engines, four rated at 260 and four at 210 horse-power. There will also be four 5-horse-power gas engines, air compressors and pumps. The fuel will be coal gas.

Schoolhouse Ventilation is the subject of three special articles in the recently issued report of the Chief of the Massachusetts District Police for 1898. The first is a description of the indirect work in the Locke school at Arlington, designed by Messrs. Gay & Proctor of Boston. It is a two-story brick building containing eight 28x32-foot rooms. The article is written by Mr. Joseph A. Moore, who also contributes a description of a plant for a building of about the same size, fitted with a combined gravity and mechanical system. The third paper, by Mr. Frederick W. Merriam, describes a fan system for a village school.

The Park Department of Boston has long been noted for the excellent results it has attained, not only in beautifying the "natural" parks under its charge, but also in providing playgrounds for children in different parts of the city. In these places the little ones can dig sand and make mud pies to their hearts' content, and the older ones have outdoor gymnasiums and ball grounds to attract them from a life on the pavements. The city's idea is that it is a one-sided policy of education which neglects a child's physical development while looking after its mental training. An interesting description of the Board's recent work will be found in its well-illustrated twenty-third annual report.

The Paving of Street Intersections was recently before the Supreme Court of Illinois, in the case of City of Bloomington vs. Reeves et al., 52 N. E. Rep. 278, and the decision was that under the State laws "requiring local improvements in cities of less than 25,000 inhabitants to be made on petition of a majority of the property in contiguous blocks abutting on the proposed improvement, a petition for paving portions of two intersecting streets, the pavement to include the intersecting portions, so as to be one piece of pavement, must be signed by the owners of a majority of the property in each contiguous block on both streets abutting on the proposed improvement. A petition signed by a majority of the total abutting property on both streets is insufficient."

The Value of Water Meters is referred to at some length in the annual report of Mr. R. P. Chaddock, clerk of the water department of Benton Harbor, Mich.; the nature of his statements can be best shown by a few quotations: "What is needed at present is not more water but some means to save the water we have. The water-works are for the use and protection of all the people, who are taxed to pay for the plant. It would not be fair that all the people should be taxed for some addition to the system that would only supply more water to be wasted by private consumers. * * * It is a fact that there are a number of people who do not pay for the water they use, and that those who pay for it for certain uses use it for other purposes, thereby defrauding the city. If every service line were metered this waste would stop, and it would reduce our pumping to a great extent, as there would be no water taken without being paid for."

TRADE PUBLICATIONS.

It seems hardly consistent to class celluloid-covered thumb-tacks as publications, yet as they are the latest as well as one of the most useful outputs of the bureau of publicity, or whatever the department is, of the N. Y. Expanded Metal Company, Postal Telegraph Building, New York, this seems to be the most fitting place to bring them to the attention of the readers of "The Engineering Record."

The W. J. Clark Company, Salem, O., has issued a catalogue of some of plate and sheet metal work it makes to order, such as tote boxes, shop pails, hand barrows, steel tool boxes, casks, melting ladles and tank heads.

The Ridgway Dynamo & Engine Company, Ridgway, Pa., has issued a "Mechanics' Fair Bulletin," which illustrates and describes its exhibit at the Mechanics' Fair in Boston. It also gives the size, capacity and principal dimensions of the Ridgway high-speed engine, and the capacity, efficiency, etc., of the Thompson-Ryan dynamo, which the company makes and directly connects to its engines. The engine is made both simple and compound.

SOCIETY AFFAIRS.

The Scranton Engineers' Club has elected the following officers: President, W. M. Marple; vice-president, C. C. Rose; recording secretary, H. W. Rowley; corresponding secretary, Morgan Davis; treasurer, A. C. Lamont; librarian, A. E. Lister; directors, James Archbald, W. A. May, Charles Farrer.

The Engineers' and Architects' Club, of Louisville, has elected the following officers: President, Charles Hermany; vice-president, Henry Vogt; secretary, Marshall Morris; directors, W. M. Anderson, J. M. Johnson, Calvin M. Duke, Webster Gazlay, Soren Thurstensen and Pierce Butler.

The nineteenth annual meeting of the Engineers' Society of Western Pennsylvania was held January 17, when the following officers were elected: President, H. J. Lewis; vice-president, H. W. Fisher; directors, P. T. Berg, Prof. F. C. Phillips; secretary, R. A. Fessenden; treasurer, A. E. Frost.

The twelfth annual meeting of the Montana Society of Engineers was held at Helena, January 12-14, when the following officers were elected: President, Eugene Carroll, Butte; vice-presidents, M. S. Parker, Butte, and Frank L. Sizer, Helena; secretary and librarian, A. S. Hovey, Helena; treasurer, Forrest J. Smith, Helena; manager, James S. Keerl, Helena. Mr. Parker read a paper on the partial failure of a timber dam belonging to the Montana Power Company, which covered the same ground as his article in "The Engineering Record" of August 6, 1898.

The Ohio Society of Surveyors and Civil Engineers elected the following officers at its twentieth annual meeting, held in Cincinnati January 18-20: President, E. A. Kemmler, Columbus; vice-president, H. C. White, Warren; secretary-treasurer, Prof C. N. Brown, Columbus. Board of trustees, J. M. Harper, Cincinnati; J. L. Gilpatrick, Granville; J. D. Varney, Cleveland; J. C. Crouly, Lima, and J. B. Weddell, Mansfield.

The Louisiana Engineering Society held its annual meeting on January 14, when the following officers were elected: President, T. L. Raymond, first assistant engineer, New Orleans drainage commission; vice-president, C. H. Chamberlain, assistant engineer, Texas & Pacific Railroad; secretary, J. F. Coleman, assistant city engineer of New Orleans; treasurer, Alfred F. Theard, chief draftsman, drainage commission; director, H. J. Maloche, consulting engineer; manager, Col. S. F. Lewis, State engineer, who was president of the society during the past year.

PERSONAL AND OBITUARY NOTES.

Mr. J. T. Brown has been appointed street commissioner and superintendent of waterworks of Pendleton, Ore.

Mr. Ernest W. Bailey has been appointed city engineer of Somerville, Mass., and Mr. William F. Hall a member of the water board.

The board of regents of the University of Wisconsin have created the office of dean of the faculty of engineering and tendered it to Prof. J. B. Johnson, M. Am. Soc. C. E., who has been connected with Washington University, St. Louis, for about fifteen years.

Mr. George Pegram, M. Am. Soc. C. E., recently chief engineer of the Union Pacific Railway, has accepted the position of chief engineer of the Manhattan Elevated Railway, succeeding Mr. John Waterhouse, who becomes consulting engineer. Mr. Pegram was engineer for some of the Gould roads for a number of years, and was appointed consulting engineer of the New York elevated lines about a year ago by President George J. Gould.

Among recent changes in the army were the following in the regular and volunteer corps: Col. Eugene Griffin, First Volunteer Engineers,

honorably discharged; this vacancy in the regiment has led to the promotion of Harry E. Hodges to be colonel; William J. Sewell, Jr., to be lieutenant-colonel, and William R. Ramsay to be major. The previous orders of Captain David L. Hough, of the same regiment, have been countermanded, and he has been sent to Havana on temporary duty. Major Charles L. Woodbury has been assigned to duty on the staff of the commanding general at Santiago.

General Michael Annenkoff, who died a few days ago in Russia, has been considered for many years one of the world's greatest pioneer engineers, ranking with Theodore D. Judah in this particular field. He served in the Russian army in various capacities before he came to the attention of General Skobeleff, whom he finally succeeded as builder of the famous Trans-Caspian Railway. One section of this line runs through a desert of fine shifting sand, moved by the lightest wind. The right of way was planted with shrubs and water was brought astonishing distances for irrigating this growth and to keep alive patches of grass, which were coaxed to grow at places. Clay and brush were used on the embankments, wells were sunk in the desert, and the road finally completed and put in such a condition that its maintenance is not the unmanageable undertaking it was expected to be. The fuel problem was a serious one for a time, but was solved by adopting oil from the Baku wells for both locomotives and stations. The line was built for military purposes, but is said to have enough freight traffic to pay maintenance and operating charges and something more. Of recent years General Annenkoff had been devoting his attention to the Trans-Siberian Railway, of which he was an enthusiastic advocate. He worked out the general plans for this undertaking, and was largely instrumental in securing the necessary financial backing for the construction.

CONTRACTING NEWS

OF SPECIAL INTEREST TO

CONTRACTORS, BUILDERS, ENGINEERS, AND MANUFACTURERS

OF ENGINEERING AND BUILDING SUPPLIES.

For Proposals see pages 200 and ix.

WATER.

Winchester, Ind.—S. D. Fox, City Clk., writes that Daniel W. Mead of Rockford, Ill., has been employed as consulting engineer, to prepare plans and specifications for the proposed water-works and electric light plant. The letting of contract for same has been postponed until plans have been prepared.

Sumpter, Ore.—It is stated that a company has been incorporated, with a capital of $25,000, to put in a gravity water system.

Chelan, Wash.—M. M. Kingman writes that a dam is to be built to hold the water in Lake Chelan; estimated cost, $4,000, the water to furnish power for pumping and electric light plant.

Bozeman, Mont.—George D. Pease, City Clk., writes that $165,000 water-works bonds were sold Jan. 17 to Mason, Lewis & Co. of Chicago.

Moorhead, Minn.—D. E. Aahl, City Recorder, writes that bids will be asked in February for a boiler for the water-works and electric light plant; cost, about $1,000. Committee in charge, H. Johnson, O. Martinson and J. T. Wentzell.

South Bend, Ind.—It is stated that Babcock & Wilcox Co., New York City, have secured the contract for two boilers, for $2,773.

Palmyra, N. Y.—It is stated that the Palmyra Water-Works Co. will extend its mains.

Dyersburg, Tenn.—A bill is before the Legislature authorizing the issue of $50,000 bonds for water-works and electric lights.

Pine Island, Minn.—J. C. Clark, Village Recorder, has been instructed to secure information regarding the construction of water-works.

Alexandria, S. D.—Press reports state the construction of water-works and an electric light plant is under consideration.

Hartford, Mich.—It is stated that L. C. Colburn, Pawpaw, Mich., has prepared plans for the water supply to be secured from artesian wells. Bids will be received in February.

Harrisburg, Pa.—The Eastmere Water Co. has been chartered, with a capital stock of $15,000, to furnish water for domestic and other purposes. The directors are J. G. Ewing, Edwin W. Jackson, Roy G. Cox of Harrisburg, and others.

Hempstead (L. I.), N. Y.—Local reports state that the village is considering the municipal ownership of the water-works and electric light plants.

Memphis, Tenn.—Frank O. Rettig, manager of the Big Spring Ice Co., Chattanooga, Tenn., will build an ice plant at Memphis; contracts for drilling well and air compressor for lift are not yet awarded.

Hammonton, N. J.—The Water and Light Committee of the Council has under consideration plans for the construction of water-works, to cost about $25,000. Local reports state that the matter will probably be voted upon at the March election.

Williamsburg, Ia.—We are informed that a water plant is to be installed in the spring. Address the Mayor.

Frankton, Ind.—Press reports state that a system of water-works is to be built.

Mankato, Kan.—Water-works bonds to the amount of $20,000 were voted for at a special election held Jan. 19.

Atlantic, Ia.—A special election will be held Feb. 2 to vote on the proposition to authorize the City Council to lease a system of water-works, with an option of purchase.

Petaluma, Cal.—It is stated that a special election will probably be called to vote on issue of bonds for the purchase of Sonoma County Water-Works.

Monticello, Ark.—Bids are being received by Walter G. Kirkpatrick, Jackson, Miss., for pump, hydrants, steel tank and ½ mile of 8-in. pipe.

Fort Meade, S. D.—Bids are wanted Feb. 18 for sinking an artesian well. J. T. French, Jr., Acting Ch. Q. M., Office of Ch. Q. M., Dept. of Dakota, St. Paul, Minn.

Hastings, Neb.—Bids are wanted Feb. 13 for furnishing 30,000 ft. of 4-in. and 6-in. pipe and 37 4-in. to 10-in. gate valves. E. A. Francis, City Clk.

Providence, R. I.—It is stated that the Council has appointed a committee to decide on a filter system. O. F. Clapp, City Engr.

Spring Lake, N. J.—Bids are wanted Feb. 18 for a steel tower and a steam pumping plant, as advertised in "The Engineering Record."

Rockford, Ill.—Local press reports state that the lowest bid received for furnishing water pipe for extensions during 1899 was from Dennis Long & Co., Louisville, Ky., as follows: 6-in. pipe, $16.75 per ton, and 4-in. pipe, $17.25 per ton.

Rocky Mount, N. C.—The proposition to construct water works and sewers is said to be under consideration.

Newark, N. J.—Local press reports state that the construction of a local storage reservoir is under consideration.

Elmwood, N. Y.—Elmwood Water Co. has been incorporated at Albany, with a capital of $100,000; directors, Robert C. Pruyn, of Albany; William L. Elkins, Jr., of Philadelphia; John Dunfee, of Syracuse, and others.

Exeter, Cal.—It is stated that bids are wanted Feb. 9 for the purchase of a 10-year franchise to lay pipes for water and gas. T. B. Twaddle, Chmn. Co. Supervisors, Visalia, Cal.

St. Louis, Mo.—Bids are wanted Feb. 7 for laying about 35,600 ft. of water pipe; also for furnishing 4,100 tons of 6-in. to 30-in. cast-iron water pipe, 200 tons special castings, 179 6-in. to 30-in. stop valves, etc. Robert E. McMath, Pres. Bd. Pub. Improvements.

Elkhart Lake, Wis.—It is stated that bids are wanted Feb. 20 for water works and an elevated tank; estimated cost, $5,000. G. A. Kraemer, Village Clk.

Niagara Falls, N. Y.—The Council has directed the Board of Public Works to ascertain the cost of a pump and filter machinery, and also to obtain an estimate of the cost of operating such machinery.

Memphis, Tenn.—The committee appointed with authority to act in the matter of improving the water supply at the poor house has under consideration the proposition to sink a well about 350 ft. and build a steel water tower and tank; also pump and air lift.

Missoula, Mont.—It is stated that R. M. Cobban and Samuel Dinsmore have an interest in a projected irrigation scheme by which a large dam is to be constructed to irrigate lands in the Hell Gate, Missoula and Frenchtown valleys. Cost, about $25,000.

Blockton, Ia.—It is stated that plans and specifications are being prepared for a water system.

McCune, Kan.—A special election will be held Feb. 1 to vote on the proposition to issue $2,000 bonds to sink a well preparatory to putting in water-works.

Hyattsville, Md.—Press reports state that it is proposed to organize a stock company for the purpose of constructing water-works.

Utica, N. Y.—The Common Council has under consideration the municipal ownership of the water-works.

Penngrove, N. J.—Press reports state that the construction of water works, with a system of filtering, is under consideration.

Ottumwa, Ia.—It is stated that the Council is considering a resolution to submit to vote the proposition to build or purchase water-works.

Wamego, Kan.—F. S. Haack, City Clk., writes that water-works bonds to the amount of $250,000 have been sold.

Sterling, Colo.—It is stated that a movement is on foot to sink a deep well for a pure water supply for domestic purposes.

Montgomery, Ala.—George A. Ellis, Consulting Engineer, has recommended the purchase of one 5,000,000-gal. vertical triple expansion high duty pumping engine; also that the present horizontal pumps be exchanged for a horizontal duplex compound condensing pumping engine of 5,000,000-gal. capacity; also the purchase of new boilers, pipe, casting, etc.; total estimated cost, $60,000.

Boston, Mass.—The following bids were opened Jan. 25 by City Engineer Jackson for 5,500 tons of cast-iron water pipes, the amounts and sizes being: 550 tons of 30-in., 125 tons of 24-in., 975 tons of 16-in., 2,300 tons of 12-in., 50 tons of 10-in., 875 tons of 8-in., 500 tons of 6-in., 20 tons of 4-in., 105 tons of specials; *a*, price per ton for pipe; *b*, per ton specials; *c*, total; Warren Foundry & Machine Co., 160 Bway., New York City, *a*, 16.70; *b*, $33; **c*, $93,561.50. Camden Iron Wks., Philadelphia, *a* and *b*, $17.06; *c*, $93,830. McNeal Pipe & Foundry Co., Burlington, N. J., *a*, $16.87; *b*, $42; *c*, $95,423.65.
*Contract awarded.

New Bedford, Mass.—According to local press reports the Water Board on Jan. 20 opened the following bids for a supply of cast-iron pipe and special castings: *a*, 534 gross tons class B straight pipe; *b*, 17 gross tons special castings; *c*, totals: Warren Foundry & Machine Co., N. Y. City, *a*, $9,985.80; *b*, $722.50; *c*, $10,708.30. R. D. Wood & Co., Philadelphia, Pa., *a*, $10,081.92; *b*, $714; *c*, $10,795.92. McNeal Pipe & Foundry Co., Burlington, N. J., *a*, $9,820.26; *b*, $714; **c*, $10,534.26.
*Contract awarded.

Vailsburgh, N. J.—Eugene A. McMurray, C. E., of Newark, writes that the contract for constructing water-works has been awarded to A. Costa of Orange, N. J., at 12 cts. per ft. for laying 4-in. pipe, 13 cts. for 6-in. and 17 cts. for 8-in., and $2 per cub. yd. for rock excavation. For award of contracts for materials see last week's issue.

Detroit, Mich.—Local reports state that the following bids were opened Jan. 17 for four water tube steam boilers, set up complete at the pumping station: Wicks Bros., Saginaw (contract awarded), $13,977; Cahall Sales Department of Mansfield, O., $16,355; Cassius C. Peck, Rochester, N. Y., $14,425; Babcock & Wilcox Co., New York City, $22,500. The Michigan Brass & Iron Wks. were the lowest bidders for stop-cocks and were awarded the contract at $4.32 per dozen for ⅝-in. and $6.72 per dozen for 1-in.

SEWERAGE AND SEWAGE DISPOSAL.

Quincy, Mass.—The Sewer Commissioners in their annual report recommend that during the coming year the system be extended, and they request an appropriation of $75,000 for this purpose.

New Orleans, La.—The Engineer of the Board of Drainage Commissioners has been instructed to prepare plans and specifications for a new pumping station for the fifth district.

Paris, Ill.—Louis E. Fischer, City Engr., is preparing plans and estimates for a sewerage system, to cost about $25,000.

Niles, O.—It is stated that an ordinance has been passed authorizing the issue of $12,000 bonds to construct a sewer.

Grass Valley, Cal.—All bids received Jan. 10 for the $40,000 sewerage bonds have been rejected and new bids will be asked.

Champaign, Ill.—Local reports state that City Engineer Tarrant is preparing plans for a brick drainage sewer 5 ft. in diameter; probable cost, $11,000.

San Diego, Cal.—The City Council on Jan. 19 authorized the call for bids for a sewer to cost $4,500.

Steelton, Pa.—Alexander Potter, C. E., of New York City, has been employed as consulting engineer for the sewerage system.

Worcester, Mass.—Local press reports state that Fred A. McClure, City Engr., is preparing plans for Millbrook sewer.

Brooklyn, N. Y.—Bids are wanted Feb. 8 for furnishing Maine rock lime at the several sewage disposal works in the 26th and 31st wards. Jas. Kane, Commr. Sewers, New York City.

Havana, Ill.—H. C. Breidert, City Engr., writes that bids will probably be asked about April 1 for the continuation of main sewer outlet, consisting of brick sewers, with necessary manholes, catch basins, etc.; estimated cost, $9,500.

Logansport, Ind.—It is stated that plans and specifications are being prepared for 4 miles of sewer extension. W. A. Osmer, City Engr.

Independence, Mo.—According to press reports bids will soon be asked for the construction of a sewer system.

Syracuse, N. Y.—It is stated that work will begin Feb. 15 on the construction of Midland Ave. trunk sewer. Thomas Moore, of Buffalo, has received the contract for $50,000.

Newark, N. J.—A bill has been introduced in the State Legislature providing that any two or more municipalities may unite to construct a trunk sewer to the Staten Island Sound. The towns interested are Newark, South Orange, Vailsburg, Irvington, West Orange and Millburn.

Everett, Mass.—A bill is before the Legislature providing for the issue of $100,000 bonds for the extension of the sewer system.

Watertown, N. Y.—The Common Council and Board of Public Works have under consideration plans prepared by City Engineer McComb for a trunk sewer.

St. Paul, Minn.—The Common Council has passed a preliminary order for the Hamlin sewer system; estimate, about $34,000. Bids will shortly be asked for Custer St. sewer extension; estimate, $3,800.

East Liverpool, O.—F. H. Croxall, Secy. Sewer Commrs., writes that the contract for about 7 miles of 4 to 12-in. terra cotta sewer pipe has not been awarded and new bids will be asked.

Bridgeport, Conn.—Local press reports state that the Sewer Committee has recommended the bonding of the city to the amount of $200,000 for sewer construction.

Niagara Falls, N. Y.—The Common Council has been petitioned to build about $40,000 worth of sewers.

Steelton, Pa.—Bids are wanted Feb. 8 for 13 miles of 4 to 24-in. vitrified sewer pipe, as advertised in "The Engineering Record."

Louisville, Ky.—It is stated that bids are wanted by City Buyer Weaver until Feb. 1 for sewer pipe, sewer brick and iron castings for the year.

Stockton, Camden County, N. J.—Bids are wanted Feb. 9 for constructing 20-in. x 30-in. brick lateral sewers in several streets, and for a 3-ft. x 4-ft. 6-in. brick lateral sewer in 26th St. William S. Abbott, Town Clk.

Atlanta, Ga.—Bids are wanted Feb. 6 for constructing brick and pipe sewers, furnishing vitrified pipe, castings for manholes, catch basins, cement, etc., for 1899. David G. Wylie, Commr. Pub. Wks.

Chattanooga, Tenn.—The Board of Public Works has asked the City Council to appropriate $1,500 for the purpose of assisting the Erlanger Hospital trustees in building a sewer.

Philadelphia, Pa.—The Common Council has passed a bill authorizing the construction of a sewer in Cottman St. Cost, about $5,000.

Ellwood City, Pa.—An election will be held Feb. 21 to vote on the issue of $8,000 bonds for sewer purposes.

Sioux City, Ia.—City Engineer Lewis is preparing plans for a sewer for Perry St. Probable cost, $20,000.

Guelph, Ont.—A special committee has been appointed to consider the advisability of constructing a system of sewers.

Aiken, S. C.—It is stated that the contract for a system of sewerage and filtration beds has been awarded to C. A. Robbe, of Augusta, Ga., for $20,916. Other bids received were as follows: Cronin & Oliver, Aiken, $23,831.94; Edward H. Post, Wilkesbarre, Pa., $24,007.95; George H. Tenney, Baltimore Md., $24,357.25; Howard Neeley, Pensacola, Fla., $21,290.25; C. T. Hookway, Syracuse, N. Y., $22,342.75; Van D. Hite Smith, Charleston, S. C., $28,083.72; Sweeney & Houston, Pittsburg, Pa., $25,708.25; Gude & Walker, Atlanta, Ga., $27,805.87.

Denver, Colo.—The following bids were opened Jan. 16 by the Board of Public Works for Capitol Hill storm sewer, District No. 1: James J. Fleetford, Denver, $244,159.62; The J. M. O'Rourke Construction Co., Denver, $309,735.19; The Queen City Construction Co., Denver, $322,806.93; W. C. Bradbury & Co., Denver, $329,412.95; Berm Brewer & F. C. Schrader, Denver, $334,410.83; Tully & Stenger, Detroit, $347,499.60; Ross, Fraser & Co., Denver, $349,367.05; The R. P. McDonald Building Co., Denver, $353,127.65; The Denver Paving Co., Denver, $357,302.61; Wickham Bros., Council Bluffs, $364,993.09; Katz & Crandall, Omaha, $374,171.81. Engineer's estimate, $380,664.

BRIDGES.

Cleveland, O.—The Willson Ave. bridge has been partially destroyed by recent floods; estimated damage, $15,000.

Monroe, Neb.—The construction of a bridge across the Loup River is being considered.

Greece, N. Y.—A committee has been appointed by the Board of Supervisors to secure plans, and estimates for a bridge across the Genesee River, between Greece and Irondequoit, at the Ridge roads.

St. Paul, Minn.—The Chicago Bridge & Iron Co., Chicago, Ill., is stated to have received the contract for rebuilding the Sixth St. bridge, at $14,737.

Toronto, Ont.—The Legislation and Reception Committee of the City Council has approved of the Humber River bridge project, and the City Engineer's recommendation asking for $14,000 has been sent to the Council, in order that provision may be made in the estimates.

Washington, D. C.—The following bills passed the Senate: For a bridge across the Savannah River, from the mainland to Hutchinson Island; for a bridge across the Missouri River, at Lexington; also bill authorizing the St. Louis, Siloam & Southern RR. Co., of Missouri and Arkansas, to construct a bridge across the White River, in Arkansas.

Oakland, Cal.—The Board of Supervisors adopted a resolution providing for a new bridge on Walnut Creek, near Seminary Ave., to replace present structure.

Philadelphia, Pa.—It is stated that the Wissahickon Bridge Co. will apply Feb. 10 to Governor Stone for a charter to build a steel bridge across the Schuylkill River. Incorporators: James Christie, Albert Major, Charles Major, and others.

Homestead, Pa.—See "Railroads."

Eau Claire, Wis.—Bridge bonds to the amount of $10,000 have been sold.

Marietta, O.—The construction of a bridge across the Muskegon, to cost about $100,000, is stated to be under consideration.

Ottawa, Kan.—A petition has been presented to the Board of County Commissioners for a bridge across Middle Creek, between Harrison and Cutler Townships.

Washington, D. C.—Col. Charles J. Allen estimates the cost of rebuilding the Long bridge at $2,953.

Helena, Ark.—Bids are wanted Feb. 15 for all steel necessary for the construction of three bridges. N. J. Fritzon, Chmn. Bd. of Pub. Affairs. Thomas M. Jacks, City Engr.

Adrian, N. D.—Bids are wanted Feb. 15 for repairing the bridge across James River. Charles Alister, Co. Aud.

Seneca, Kan.—Bids are wanted Feb. 15 for two iron bridges. A. G. Sanborn, Co. Clk.

David City, Neb.—Bids are wanted Feb. 6 for building iron bridges during 1899. John J. Graham, Co. Clk.

New York, N. Y.—Bids are wanted Feb. 2 for rebuilding the Blissville bridge crossing Newtown Creek, at Greenpoint Ave. John L. Shea, Commr. of Bridges.

Arcadia, Neb.—Bids are wanted Feb. 9 for a steel or iron bridge, 280 ft. long, across the Middle Loup River. Vincent Kokes, Co. Clk.

Des Moines, Ia.—The Board of Public Works estimates the cost of repairing the Walnut St. and West Ninth St. bridges at $10,000.

Sandyhill, N. Y.—An appropriation of $6,000 has been made for a steel bridge over the canal on upper Main St.

Aspen, Colo.—Local press reports state that M. J. Patterson has received the contract for constructing a steel bridge across Roaring Fork River, near Basalt, at $1,998; approaches $4 per foot.

Redwood Falls, Minn.—The Redwood County Commissioners have appropriated $1,750 toward rebuilding with iron and steel the Minnesota River bridge at North Redwood, on condition that Renville County appropriate the same amount.

Springfield, Mass.—The construction of a bridge across the Connecticut River, to replace the present toll bridge between Springfield and West Springfield, is being considered.

Rockford, Ill.—Bids are wanted Feb. 20 for a plate girder bridge over Keith Creek, as advertised in "The Engineering Record."

Denver, Colo.—Local press reports state that the Mayor has signed the appropriation of $12,500 for rebuilding the bridge formerly across Cherry Creek at Blake St., and placing it at Stout St.; also for placing a bridge across Cherry Creek at South 14th St. and 8th Ave.

Somerville, Mass.—The Middlesex County Commissioners have ordered the construction of a steel bridge at Beacon St. over the Fitchburg R.R.

Ottawa, Ont.—Plans for a steel bridge at Maria St. over the Rideau Canal, have been agreed upon. Estimated cost, $30,000.

New York, N. Y.—The Municipal Council has adopted the ordinance providing $1,500,000 bonds for the erection of steel towers on the new East River bridge.

San Francisco, Cal.—The Board of Directors of the San Francisco & San Joaquin Valley Railway is stated to have awarded the contracts for 8 bridges over San Joaquin, Middle and Old rivers to the Keystone Bridge Co., Pittsburg, Pa., at $25,000. The contract for the piers was awarded to the Thomson Bridge Co., San Francisco, Cal., at $15,000.

St. Joseph, Mo.—Bids are wanted Jan. 30 for a bridge at Dittemore on Union Road. Theo. Steinacker, Co. Surveyor.

PAVING AND ROADMAKING.

New York, N. Y.—The Board of Public Improvements has passed ordinances for asphalting several streets.

Wilmington, N. C.—A bill is before the Legislature providing that an election be held May 2 to vote on the issue of $50,000 North Hanover County bonds for road improvements.

Athens, Ga.—W. W. Turner, City Clerk, writes that an election has been called for Feb. 27 to vote on the issue of $100,000 street improvement bonds.

Kansas City, Mo.—Petitions are being circulated asking for the repaving of Seventh St. with brick or asphalt.

Cincinnati, O.—Local reports state that the contract for macadamizing Hopson St. has been awarded to D. Folz, Cincinnati, for $7,656.

Warrensville, O.—The County Commissioners have been petitioned to macadamize the Warrensville plank road.

Chicago, Ill.—The Chicago City Railway Co. has made a proposition to the Board of Local Improvements that if the property owners will agree to pave Indiana Ave. for a distance of about two miles with asphalt the company will pave the center 16 ft. and lay grooved rails.

Williamsport, Pa.—The Highway Committee has decided to recommend $30,000 for paving during the year, also $10,000 for highways.

Cincinnati, O.—Bids are wanted Feb. 1 for paving East Pearl St. with granite block pavement. A. B. Rattermann, Pres. Bd. City Affairs.

Brockton, Mass.—The Board of Aldermen has under consideration the issue of $100,000 bonds for permanent highway improvements.

Washington, D. C.—The House has passed bills authorizing the extension of Pennsylvania Ave. and New Hampshire Ave. A bill has been introduced in the Senate for paving South Carolina Ave.; appropriation, $100,000.

Elyria, O.—Local reports state that on Feb. 4 S. B. Dudley, of Oberlin; S. B. Day, of Elyria, and F. D. Warren, of Wellington, the County Road Commissioners, will consider the proposition to bond to the amount of $200,000 or $300,000 for macadamizing.

Ft. Wayne, Ind.—Plans have been ordered prepared for sheet asphalt pavements on two streets.

Bryan, Tex.—The Paving Committee has been authorized to employ a civil engineer to prosecute the work of street improvement provided for by an ordinance for the issue of $15,000 bonds.

Jersey City, N. J.—It is proposed to pave with asphalt on Newark Ave. Estimated cost, $15,000.

Eu Claire, Wis.—Bids are wanted Jan. 30 for repaving with vitrified brick, as advertised in "The Engineering Record."

Cleveland, O.—Bids are wanted Feb. 17 for paving several streets with brick. Geo. R. Warden, Dir. Pub. Wks.

West Newton, Pa.—See "Power Plants, Gas and Electricity."

Midvale, N. J.—Bids are wanted Jan. 31 for macadamizing the main road. Edward N. Kevitt, Dir. Co. Bd. Chosen Freeholders, Paterson.

Baltimore, Md.—The Council Committee on Highways will report favorably an ordinance to repave with asphalt block Bayard St.; also an ordinance to repave Pine St. with sheet asphalt; appropriation, $4,600.

Philadelphia, Pa.—The Committee on Plans and Improvements of the Fairmount Park Commission has approved the recommendation of Chief Engineer J. T. Vogdes to appropriate $25,000 for the completion of the drive on the west side of the Schuylkill; also $30,000 for widening, macadamizing and asphalting the walks on East Park drive, and $16,000 for macadamizing Lincoln Ave.

New York, N. Y.—The Uvalde Asphalt Co. has been incorporated, with a capital of $200,000. Directors: John T. Marston, Ralph T. Rokeby, Charles L. Spencer and others.

Decatur, Ala.—J. H. Edwards writes that on Jan. 17 it was voted to issue Morgan County turnpike bonds to the amount of about $200,000.

Houston, Tex.—In amplification of the item printed last week concerning 19,000 sq. yds. of repaving, it may be said that the bid of the Ayres Asphalt Co., which amounted to $42,846, was for laying sheet asphalt on 6 in. of concrete made of broken stone and Portland cement. The company offered to guarantee the pavement after the expiration of its first five years for 7½ cts. per yard per year. The Louisiana Improvement Co. bid $39,987 for sheet asphalt on 6 in. of gravel and American hydraulic cement concrete, and $42,647 for sheet asphalt on 6 in. of gravel and Portland cement concrete. The maintenance bid of this company was a sliding scale ranging from 3 cts. per sq. yd. for the sixth year to 7 cts. for the tenth. Hipp & Key bid $40,842 for rock asphalt on 6 in. of broken stone and American hydraulic cement, and guaranteed to maintain it after the expiration of the first five years for 3 cts. per sq. yd. per year. This firm also bid $39,892 for brick paving on a foundation made with gravel and American cement, which was the lowest bid received for brick paving. The firm submitted the only bid for Telford macadam, which was $1 per sq. yd. plus $5,692 for grading, curbing, etc.

Baltimore, Md.—The Pimlico Boulevard Association is considering plans for the proposed boulevard on Park Heights Ave., which provide for a speedway 40 ft. wide, a cycle path 20 ft. wide and a footway about 10 ft. wide. Before anything can be done it will be necessary for the City Council to pass an ordinance.

Syracuse, N. Y.—Mayor McGuire has given directions preparatory to rescinding all proceedings of the Common Council in regard to paving East Genesee St. The object of this action is to begin all proceedings over again and have the street paved under a new contract.

Macon, Ga.—The Grand Jury has recommended that an election be held at once to vote on the issue of $500,000 bonds for the improvement of county roads and bridges.

Geneva, N. Y.—Bids are wanted Feb. 20 for paving with vitrified brick or asphalt about 18,000 sq. yds., as advertised in "The Engineering Record."

Atlanta, Ga.—The Committee on Bridges has reported that five spans of the Mitchell St. Viaduct need asphalt paving at once, and asks for an appropriation of $8,000.

Belleville, Ill.—An election has been called for Jan. 28 to vote on the issue of $35,500 bonds for macadamizing public roads in Centerville Township.

Indianapolis, Ind.—Resolutions have been adopted for brick paving in several streets.

Bedford, Ind.—It is stated that bids are wanted by the Council Feb. 22 for paving about 17 blocks with brick. G. C. Houston, City Engr.

Plainfield, N. J.—It is stated that bids are wanted Feb. 6 for macadamizing several streets. Jas. T. McMurray, City Clk.

New Orleans, La.—It is stated that bids are wanted Jan. 30 for paving 2 streets with asphalt pavement. W. S. Douglass, Comp.

Lakewood, O.—Press reports state that it is proposed to construct a road 120 ft. wide to extend from Lake Erie to Linndale; also a boulevard, to be known as Clifton Boulevard, with a roadway 60 ft. wide, with car tracks and bicycle paths on either side.

Darby, Pa.—Bids are wanted by the Clerk of the Council Feb. 6 for paving Pine St. with Telford.

Albany, N. Y.—Bids are wanted Feb. 6 for paving Elizabeth, Hamilton and Dover Sts. with brick. Thomas J. Lanahan, Clk. Bd. Contract & Apportionment.

Louisville, Ky.—Local press reports state that asphalt paving contracts have been awarded as follows: To the Barber Asphalt Paving Co., New York City, for Chestnut St. and East Broadway, amounting to $84,637, and to the Alcatraz Asphalt Co. for Hepburn and Von Borries Aves., amounting to $19,747.

Atlantic City, N. J.—The following bids were received Jan. 16 in response to the second call for bids for paving, as advertised in "The Engineering Record:" *a*, 21,340 yds. macadam; *b*, 5,025 yds. vitrified block; *c*, 137 cu. yds. concrete; *d*, 13,840 lin. ft. straight curb; *e*, 512 lin. ft. radius curb; *f*, 100 lin. ft. curb reset: *Turner & Moore, Atlantic City, *a*, 72 cts.; *b*, $2.20; *c*, $5.00; *d*, 40 cts.; *e*, $1.25; *f*, 10 cts. T. J. McGovern, *a*, 76 cts.; *b*, $2.23; *c*, $4.50; *d*, 45 cts.; *e*, $1.10; *f*, 7 cts. J. B. Reilly & Co., *a*, 78 cts.; *b*, $2.20; *c*, $4.50; *d*, 49 cts.; *e*, $1.25; *f*, 9 cts. Delaware River Quarry & Construction Co., *a*, 75 cts.; *b*, $2.17; *c*, $5; *d*, 46 cts.; *e*, $1.12; *f*, 10 cts. Dennis Roe, *a*, 75 cts.; *b*, $2.20; *c*, $4.50; *d*, 49 cts.; *e*, $1.25; *f*, 10 cts. Alcatraz Paving Co., *a*, 79 cts.; *b*, $2.15; *c*, $4.75; *d*, 47 cts.; *e*, $1.20; *f*, 10 cts.

*Contract awarded, according to local press reports.

POWER PLANTS, GAS AND ELECTRICITY.

Oconto, Wis.—C. A. Brigden, City Clk., writes that the People's Land & Mfg. Co. is desirous of obtaining a 5 or 10 year contract with the city and rebuilding its plant, which was burned last November, but the city is considering the construction of a municipal electric light plant, to be paid in yearly installments.

Hempstead (L. I.), N. Y.—See "Water."

Oakland, Cal.—The Equitable Gas Light Co. has been incorporated to construct a gas plant on the water front of this city; capital, $1,500,000. Principal office to be at San Francisco. W. J. Dingee, Pres.

Dyersburg, Tenn.—See "Water."

St. Louis, Mo.—The St. Louis Light, Heat & Power Co. is stated to have applied for a franchise to construct an electric power plant.

Roswell, N. M.—The Council is said to be considering the matter of granting an electric light franchise.

Winchester, Ind.—See "Water."

San Francisco, Cal.—The St. Helena Electric Light & Power Co. has been incorporated to build and operate light plants; capital, $30,000. Incorporators: J. E. Primstone, Geo. W. Crum, and W. A. Leonard, San Francisco.

Evansville, Ind.—The Council has passed an ordinance providing for an electric light plant.

West Newton, Pa.—An election will be held in February to vote on issuing $16,418 bonds for enlarging the electric plant and for street improvements.

Mattoon, Ill.—It is stated that the car shops of the Big Four Road at this place will be equipped with an electric plant. General office, Cincinnati, O.

Wellesley, Mass.—A committee is stated to have been appointed to consider the question of the town having its own electric light plant.

Lincoln, Neb.—The Joenk-Waldman Co. has been incorporated to construct and operate an electric light and power plant and an ice plant and cold storage business; capital, $35,000. The present electric light plant is said to be owned by the company, and many improvements are contemplated.

Cassville, Wis.—It is stated that the Council has been petitioned for an electric light franchise.

Wallingford, Conn.—Thos. C. Perkins, of Mystic, is reported to have secured the contract for a municipal electric light plant.

Galion, O.—The James E. Story Co., of Cincinnati, is stated to have received the contract to remodel the gas plant.

Glendive, Mont.—It is stated that an electric light plant will be installed.

Moulton, Ia.—The Southern Iowa Electrical Co., of Keosauqua, is stated to have applied for an electric light franchise.

Le Roy, Minn.—H. E. Johnson is stated to have received a franchise for an electric light plant.

Utica, N. Y.—The contract for electric wiring at the new Academy is stated to have been awarded to the Utica Electrical Manufacturing & Supply Co. at $3,444.

Ellendale, N. D.—Henry Rusco is said to be interested in the construction of an electric light plant.

Malvern, Pa.—It is stated that a company has been formed here with a capital of $12,000 to construct an electric light plant to supply this place, Duffryn Mawr and Paola.

Stockton, N. J.—The Camden Lighting & Heating Co. is stated to have received the contract for lighting the town for 3 years, at 38 cts. per night for each arc light and $20 per year for each incandescent light.

Winchester, Va.—The Winchester Gas & Electric Light Co. is said to be considering the improvement of its plant, to include the erection of a gas holder.

Summit, Miss.—It is stated there is a petition being circulated here asking the Mayor and Council to call an election to vote on putting in an electric light plant in connection with the waterworks.

Portland, Me.—The New England Electrical Power Co. has been organized at Portland to generate and supply electricity; capital, $500,000, Austin Potter, Pres., Boston; R. M. Saltonstall, Treas., Newton, Mass.

Duluth, Minn.—The Economical Gas Apparatus Construction Co., of Toronto, is stated to have received the contract for constructing an improved Lowe water gas apparatus at the city's gas works at $5,333.

Astoria (L. I.), N. Y.—The Astoria Light, Heat & Power Co. has been incorporated to supply both gas and electricity, and will operate in the several counties comprised in New York City; capital, $500,000. Directors, Horace W. Fuller and F. R. Foraker, of New York City; T. Wilber Spear, of Brooklyn, and others.

Kenosha, Wis.—H. Schott of Chicago is stated to have applied for a franchise to construct and maintain a hot water heating plant; estimated cost, $100,000.

Clayton, N. J.—The Gloucester County Electric Co. is stated to have made a proposition to the Council to light the town.

Elizabeth City, N. C.—The Carolina New Light Co. has been incorporated; capital, $5,000. Incorporators: J. H. White, J. W. Sharber and others.

Hull, P. Q.—Bids are wanted Feb. 6 for an electric light plant. E. Carrier, Chmn. Lighting Com.

Exeter, Cal.—See "Water."

Grand Rapids, Mich.—It is stated that bids are wanted Feb. 3 for constructing the superstructure for the proposed plant. Address President Johnson, Bd. Pub. Wks.

Bedford City, Va.—The Council is stated to have purchased the electric light plant of the Bedford Light Co. New machinery will probably be put in.

Elmwood, N. Y.—The Elmwood Light & Power Co. has been incorporated; capital, $100,000. Directors: Robt. C. Pruyn, Albany; W. L. Elkins, Philadelphia, and John Dunfee, Syracuse, and others.

Sweetwater, Tenn.—A proposition is stated to have been submitted to the Aldermen by a Knoxville company to furnish the town with electric lights.

Port Huron, Mich.—The Michigan Development Co. is stated to have applied for a franchise for a gas plant.

Rochester, N. Y.—W. H. Vorce, Supt. Signal Service of the Central Hudson Railroad, is stated to have prepared plans for an electric light plant for the use of the railroad buildings in this city.

Peru, Ind.—A. L. Searles of Fort Wayne is stated to have submitted plans for establishing an electric light plant.

Fonda, Ia.—M. G. Coleman, Recorder, writes that it was voted on Jan. 23 to construct an electric light plant.

Schoolcraft, Mich.—It is stated that the citizens have asked for another election to vote on the question of constructing an electric light plant. If the proposition is defeated a franchise will probably be granted to a commercial agency.

Eau Claire, Wis.—C. A. Alderman, City Engr., writes that the Council has awarded a 5-year contract to the Eau Claire Light & Power Co. for 2,000 c.p. arc lights at $74 per yr. (about 85 lights); for 16 c.p. incandescent lights for streets and bridges, $9 per yr. (about 50 lights), and their bid of $6 per 16 c.p. light per yr. for lighting city buildings and hose houses, or 15 cts. per 1,000 watts, at the option of Council. is now being considered, as against the bid of the Eau Claire Gas Light Co. to light the city buildings and hose houses with Welsbach lamps at $1.50 per 1,000 ft. of gas.

Sea Isle City, N. J.—The following bids for lighting the borough with electricity were opened Jan. 23 by J. T. Chapman, Borough Clk.: *Kalbach, Son & Co., Ocean City, N. J., 30 1,200-c.p. arc lamps from June 15 to Sept. 15, and 20 1,200-c.p. arc lamps from Sept 15 to June 15. $2,205 per yr.; additional lamps, $8,600 per yr. Electric Light, Power & Water Co., Sea Isle City (present company), 75 50-c.p. incandescent lamps for $2,500 per yr. Welsbach Street Lighting Co., Philadelphia, Pa., 40 lamps, posts, etc., and keep same lighted for $30 per lamp, 5-year contract.

*This was the only bid received in accordance with specifications and was made on condition that the borough indemnify them against litigation by present company.

ELECTRIC RAILWAYS.

Toledo, O.—Seagrave Bros. are stated to have received a franchise for an electric railway from this city to the Fulton-Lucas county line.

Cleveland, O.—The Cleveland, Berea, Elyria & Oberlin Electric Ry. Co. is said to be considering the question of extending its line. A power plant will probably be constructed at Medina.

Indianapolis, Ind.—The County Commissioners are stated to have granted a franchise to the Indianapolis & Logansport Traction Co.

Chattanooga, Tenn.—An ordinance has been introduced in Council granting the Chattanooga Electric Ry. Co. a right of way on several streets.

Pelham Manor, N. Y.—The Tarrytown, White Plains & Mamaroneck Trolley Co. is stated to have applied for permission to construct a line on the Boston Post Road. A hearing will be given Feb. 4.

Indianapolis, Ind.—The Indianapolis & Eastern Indiana Rapid Transit Co. is stated to have applied to the County Commissioners for a right of way over the national road.

Richmond, Ind.—It is stated that arrangements have been completed for securing a right of way and making a survey for an electric railway from Richmond to Hamilton, O. H. L. Weber, City Engr. of this city, is Ch. Engr.

Rockmart, Ga.—The matter of building an electric railway from this place to the Aragon Cotton Mills, a distance of 4 miles, is said to be under consideration. Mayor Ferguson, L. J. Spinks and others are said to be interested.

Niobrara, Neb.—L. B. Rowe is stated to have applied for a franchise.

Galion, O.—W. E. Haycox, of Mansfield, and F. C. Boyd, of New Haven, Conn., are stated to have received a franchise to build an electric road from Bucyrus to Galion and Crestline.

Fair Haven, Wash.—It is stated that the City Council has under consideration the granting of a franchise to the Northern Ry. & Improvement Co.

Greenfield, Ind.—The Council is stated to have granted Wm. C. Dudding, F. G. Banker, and others, of Greenfield, a franchise for an electric railway from this place to Indianapolis.

Chicago, Ill.—Charles T. Yerkes has petitioned the City Council for permission to use the overhead trolley on the North and West Side street car systems, substituting it for cable and horses wherever the latter are now employed.

Wilkinsburg, Pa.—The Council is stated to have granted the Swissvale branch of the Monongahela Traction Co. the right of way over certain streets.

Milwaukee, Wis.—It is reported that the Milwaukee Electric Ry. & Light Co. will expend $300,000 this year in the extension of its lines.

Charleston, Ill.—The Charleston-Mattoon Electric St. Ry. Co. is stated to have received a franchise.

Stillwater, Minn.—Thos. Lowry and C. G. Goodrich, of Minneapolis, are reported to have applied for a franchise to extend the Wildwood line to this city.

Ellicott City, Md.—It is stated that the Consolidated Ry. Co. proposes to extend its line from Ellicott City to St. Charles College, a distance of about 6 miles. Wm. A. House, Gen. Mgr.

Alton, Ill.—The Alton & East Alton Ry. & Power Co. has been incorporated to operate a street railway and supply power; capital, $100,000. Incorporators: O. S. Stewell, H. S. Baker and Geo. Ryrie.

Perth Amboy, N. J.—The Perth Amboy R. R. Co. is stated to have received a franchise to construct a trolley line through the city. Leonard Lewisohn, Pres.

Cleburne, Tex.—The John A. Wilson Co., of Chicago, is stated to have applied for a franchise.

Biddeford, Me.—It is stated that a survey will soon be made by the Saco Valley Electric Ry. Co. for an electric railway from this city to Bar Mills, a distance of 22 miles. Edw. E. Walker, Pres., Philadelphia; Chas. Butler, Secy., Bar Mills.

Cleveland, O.—Jacob B. Perkins, M. F. Bramley and others have applied to the City Council for a franchise.

Frankfort, Ind.—The Clinton Traction Co. has been incorporated, with a capital of $25,000.

Pottsville, Pa.—It is stated that the Schuylkill Electric Ry. Co. will build a line from Pottsville through Mine Hill Gap to Glen Carbon, a distance of about 15 miles.

RAILROADS.

Knoxville, Tenn.—A charter has been granted to the Knoxville & Sevierville Railroad to build a railroad from Knoxville to Sevierville.

Angola, Ind.—The Northeastern Indiana St. Ry. Co. has been incorporated; capital, $50,000. Incorporators: M. E. Griswold, J. F. Shuman, and others.

Rutland, Vt.—Bids are wanted Feb. 8 (change of date) for grading, masonry and tracklaying on about 50 miles of railroad, as advertised in "The Engineering Record."

Charlottesville, Va.—The business men are stated to be interested in the construction of a railroad from this place to Alberene, a distance of about 12 miles.

Mankato, Minn.—The Mankato & New Ulm Ry. Co. has been incorporated to construct a railroad from Mankato to New Ulm, a distance of about 30 miles; capital, $50,000. Incorporators: J. W. Whitman, Chicago; W. A. Scott, St. Paul, and others.

Anniston, Ala.—A charter has been granted to the Anniston & Coosa Coalfield R. R. Co., to construct a line from Anniston to the Coosa coal fields in St. Clair county to intersect the Alabama Great Southern railroad at some point between Attalla and Birmingham; capital, $250,000. Incorporators: W. F. Johnston, C. B. Randolph, F. M. Hight, and others.

Salt Lake City, Utah.—The Dochesne Ry. Co. has been incorporated with a capital of $765,000, to build a branch of the Rio Grande & Western Railroad 50 miles long. W. F. Colton, Treas. of the Rio Grande & Western Ry. Co., Salt Lake City, is one of the incorporators.

Homestead, Pa.—The Carnegie Steel Co. is stated to have received permission to build a railroad along the river front. A steel bridge will be erected on McClure St.

NEW DEPOTS.

Des Moines, Ia.—Chas. H. Frost, Pullman Bldg., Chicago, is said to be completing plans for the $200,000 depot for the Rock Island R. R. Co. Work will probably begin early in the spring.

PUBLIC BUILDINGS.

New York, N. Y.—Bids are wanted Feb. 6 for alterations and repairs necessary to the insane pavilion at Bellevue Hospital, including heating, plumbing, gasfitting, etc. John W. Keller, Pres. Dept. Pub. Charities.

Beloit, Wis.—It is stated that bids are wanted by the City Clerk Feb. 6 for a fire house.

Atlanta, Ga.—Bids are wanted Jan. 30 for 2 temporary barrack buildings at Fort Morgan, Ala. John Simpson, Dept. Q. M. Gen., U. S. A., Ch. Q. M.

Wilkesbarre, Pa.—Competitive plans and specifications are wanted March 15 for a court house. A. D. Hay, Chmn. Co. Commrs.

Aberdeen, S. D.—It is stated that bids are wanted by the County Auditor March 8 for building an addition to the court house.

Streator, Ill.—The Building Committee of the Methodist Episcopal Church is stated to have decided to receive bids for a new edifice. W. R. Brown, of Cincinnati, O., is the architect.

Eureka Springs, Ark.—It is stated that the Emanuel Baptist Society proposes to erect a memorial chapel at a cost of $20,000.

Philadelphia, Pa.—It is stated that plans have been prepared for a $300,000 building for the University of Pennsylvania, to be used as a medical laboratory.

White Plains, N. Y.—Architects will soon be asked to submit plans for a $100,000 wing to the court house. Mr. Secor, Chmn. Bldg. Com.

Somerville, Mass.—The Library Trustees are stated to have petitioned the Council for an appropriation of $15,000 for an addition to the building.

Saginaw, Mich.—It is stated that the Board of Supervisors will be petitioned for a county asylum; probable cost, $50,000.

San Francisco, Cal.—The plans of Shea & Shea, of San Francisco, are stated to have been accepted for the Mission Police Station; estimated cost, $46,000.

Phoenix, Ariz.—The following bids for a fireproof building for the State Capitol were opened Jan. 10 by the Capitol Grounds and Building Committee: Fifield & Gallagher, Phoenix, $114,386; C. Campbell, Phoenix, $100,000; Anderson Construction Company, St. Louis, Mo., $126,189; Tom Lovell, Denton, Tex., $96,279.

Iowa City, Ia.—An election will be held Feb. 21 to vote on erecting a court house and jail to cost about $100,000.

Pekin, Ill.—The County Board is stated to have appropriated $20,000 to erect buildings at the county farm.

Indianapolis, Ind.—Vounegut & Bohn, Indiana Trust Bldg., Indianapolis, are stated to have prepared plans for a $30,000 synagogue for the Hebrew Association.

Buffalo, N. Y.—It is stated that plans are being prepared for a $35,000 edifice for the First Baptist Church.

San Antonio, Tex.—Bids are wanted for the iron, terra cotta and fireproofing for the San Antonio Loan & Trust Co. building. A full set of drawings and specifications are on file with the Roebling Construction Co., 121 Liberty street, New York City, also with the Metropolitan Fire Proofing Co., 874 B'way, New York City. Alfred Giles, of San Antonio, is the architect.

Huntington, Ind.—It is stated that the congregation of the German Reformed Church will build a $20,000 edifice.

Lincoln, Kan.—The Senate is stated to have passed a bill granting the Lincoln County Commissioners permission to erect a court house.

San Antonio, Tex.—Bids are wanted Feb. 9 for a building for the San Antonio Loan & Trust Co. Alfred Giles, Archt., 114 W. Houston St.

Canton, O.—Bids are wanted Feb. 4 for a fire engine house on Bucker St. Louis N. Ley, City Clk.

Trenton, Tenn.—R. J. Dew, Co. Clk., writes that plans have been adopted by the Committee for a $30,000 court house, and will be submitted to the court for final approval.

Milwaukee, Wis.—E. R. Liebert, 107 Wisconsin St., is stated to have completed plans for remodeling the House of Correction; estimated cost, $150,000. Mr. Haasch, Chmn. Special Com. of County Bd.

Washington, D. C.—The Senate on Jan. 25 passed a bill providing for the erection of a $1,000,000 building for the Department of Justice.

Buffalo, Minn.—The following bids for heating the court house were opened Jan. 17 by H. S. Swanberg, Co. Aud.: Roberts-Goss Co., St. Paul, $920; Moore Heating Co., St. Paul, $1,088; Saxton Phillips, Minneapolis, $1,250; Pond & Hasey, Minneapolis, $1,385; Archambo Heating Co., Minneapolis, $1,179; Allan Black, St. Paul, $1,344; Dwyer Heating Co., Minneapolis, $1,240; F. E. Kreatz, St. Cloud, $1,185; A. V. Nepil, Minneapolis, $1,450; Osterman & Moody, Buffalo, $1,173; McGaffey & Ellis, Buffalo, $1,675, private bid after balance were rejected.

NEW INDUSTRIAL PLANTS.

T. M. Porter, Waverly, Tenn., will put up in April a 40-barrel flour mill and a saw mill.

C. H. Schutte, Spartanburg, S. C., will put up a 50x110-ft. building for use as a canning factory.

The American Steel Foundry Co., St. Louis, Mo., is erecting a 200x400-ft. building and will install a power plant of 700 horse-power.

The Neal Loan & Banking Co., Atlanta, Ga., is putting up a 3-story factory 100 ft. square for the National Straw Hat Co.

Wittemann Bros., 188 William Street, New York, will add two 60x150-ft. wings to one of their plants and put in a steam plant of about 150 horse-power.

The Weber Gas & Gasoline Engine Co., Kansas City, Mo., will erect a new factory, comprising foundry, machine and pattern shop and office building. The dimensions of the building have not yet been announced.

A 40x160-ft. mill at Lockport, N. Y., has been bought by Luke Huston of that city, who will remodel it for a cold storage plant. The machinery has not yet been selected.

The Reinecke Coal Co., Madisonville, Ky., will put in four 150-H.-P. boilers and an electric plant for haulage and mining machines.

The Longview, Tex., Electric Light Co. will build a 10-ton ice plant.

BUSINESS NOTES.

The Illinois Steel Co., Chicago, announces the election of Mr. Eugene J. Buffington as its president, Mr. T. J. Hymar as secretary and the placing of the sales department under the charge of Mr. George Baker.

The Bear Creek Mill Co., Manistee, Ala., may erect a lumber plant in the fall, but no definite decision has yet been made.

The Dickson-Mason Lumber Co., Asheville, N. C., is investigating the desirability of erecting a factory at Bristol.

The Niles, Ohio, Boiler Co. has purchased the machinery of the Rippel Foundry & Machine Co., Mt. Gilead, Ohio, and will remove it to Niles, where a 50x128-ft. building and one measuring 50x112 ft. will be erected in addition to the present boiler and tank shops.

The Berlin Iron Bridge Co. has shipped a 200-ft. highway bridge 40 ft. wide to the Hawaiian Islands, where it will be put up by erectors from the United States.

A shale brick plant is being erected at Conneaut, Ohio, for L. Harper and others, which will have a daily capacity of 25,000 to 35,000 building and paving brick. The plant, which has been largely ordered from the American Clay Working Machinery Co., Bucyrus, Ohio, includes two 60-H.-P. boilers and a 100-H.-P. boiler.

BUILDING INTELLIGENCE.

NEW YORK.

387-389 E 10th st, 2 br stores and flats; cost, $50,000 all; o, Wm Evans; a, M Bernstein.

128 2d av, br store and flat; cost, $28,000; o, Julius Dreyfus; a, Geo F Pelham.

110 Madison st, br store and flat; cost, $28,500; o, Julius Dreyfus; a, Geo F Pelham.

270 to 274 Monroe st, 29 to 35 Jackson st, 3 br stores and flats; cost, $65,000 all; o, Geo Dellon, Abe Brumer, Morris Goldstein; a, Horenburger & Straub.

330 to 336 Madison st, s e cor Scammel st, br stores and flat; cost, $40,000; o, Morris Monsky; a, Horenburger & Straub.

221-225 E 3d st, 2 br stores and flats; cost, $57,000 all; o and b, Harry Fischel; a, Samuel Sass.

229-231 2d st, 2 br stores and flats; cost, $50,000 all; o, Abram Bachrach; a, G F Pelham.

7 to 11 Prince st, 2 br stores and tenem'ts; cost, $35,000 all; o, Isaac Marx; a, Horenburger & Straub.

137 Suffolk st, br stores and tenem'ts; cost, $28,000; o, Bernard Klingenstein; a, G F Pelham.

406 W 37th st, br store and flat; cost, $24,000; o, William Sauter; a, Thom & Wilson.

8th av, s e cor 42d st, br bank bldg; cost, $150,000; o, Franklin Savings Bank; a, York & Sawyer.

41 E 21st st, br stores and lofts; cost, $50,000; o, Walter M. Fernbach; a, Pollard & Steinam.

429-431 East 117th st, br and stone store and flat; cost, $30,000; o, Davis Karp; a, Max Muller.

W s 1st av, 25 n 117th st, 2 br stores and flats; cost, $45,000 all; o, Mary E Dempsey; a, Neville & Bagge.

819-821 Boulevard, br store and flat; cost, $150,000; o, Le Grand R Pettit; a, Hill & Turner.

832 Amsterdam av, br store and flat; cost, $25,000; o, Wm Cummings, Jr, and Robert Ferguson; a, Geo F Pelham.

8th av, s w cor 113th st, 2 br stores and flats; cost, $45,000 all; o, Richey & Hamilton; a, G A Schellinger.

N s 98th st, 100 w Central Park West, br flat; cost, $25,000; o, Jno Knox McAfee; a, G F Pelham.

West End av, s e cor 83d st, br and stone flats; cost, $175,000; o, The Colonial Building Co; a, Henry Andersen.

N s 118th st, 175 e Amsterdam av, 2 flats; cost, $150,000; o, Robertson & Gammie; a, Henry Andersen.

W s 7th av, 25 n 112th st, br flat; cost, $75,000; o, Leith & Glenn; a, Neville & Bagge.

229 Lenox av, br dwell'g; cost, $20,000; o, Riverside Building Co; a, Clarence True.

Amsterdam av, n e cor 145th st, 2 br stores and offices; cost, $50,000 all; o, Fredk H Walker; a, Richard R Davis.

502 W 149th st, br flat; cost, $23,000; o, John J Mahoney; a, Arthur De Saldern.

Park av, n e cor 125th st, br offices, stores and warehouse; cost, $311,000; o, Chas Ward Hall; a, C P H Gilbert.

E s 8th av, from 140th to 141st st, 8 br stores and flats; cost, $18,000 all; o, Rothschild & Strauss; a, G F Pelham.

S s 141st st, 100 e 8th av, n s 140th st, 100 e 8th av, 8 br flats; cost, $176,000 all; o, Rothschild & Strauss; a, G F Pelham.

E s Mott av, 73 n 144th st, br flat; cost, $22,000; o, Elizabeth M Kervan; a, Henry Andersen.

Washington av, s e cor 179th st, 2 br flats; cost, $37,000 all; o, John J M Dunlop; a, Chas S Clark.

Wales av, n w cor 152d st, 2 br flats; cost, $31,000 all; o, L S Horne; a, W C Dickerson.

Park av, s e cor 171st st, 3 br flats; cost, $49,000 all; o, Otto Eichler; a, W C Dickerson.

Tremont av, n w cor Hughes av, br flat; cost, $15,000; o, Conrad Simon; a, James W Cole.

MISCELLANEOUS.

Columbia, Pa.—Br and stone store and office building; cost, $10,000; o, H C Bruner; a, C Emlen Urban.

Holyoke, Mass.—Chestnut and Appleton sts, br block of tenements; cost, $25,000; o, Luther P Trowbridge.

Toledo, O.—Huron st, 4 sty bldg; cost, $20,000; o, Dennis Coghlin; a, D L Stine.

PROPOSALS OPEN.

WATER-WORKS.

Bids Close.		See Eng. Record.
Jan. 28.	New Albany, Ind	Jan. 14
	Adv., Eng. RECORD, Jan. 14.	
Jan. 30.	Baltimore, Md	Jan. 21
Jan. 31.	Bonds, Alliance, O	Jan. 14
Feb. 1.	Tuskegee, Ala	Dec. 31
Feb. 6.	Bonds, Berea, O	Dec. 31
Feb. 7.	Pipe, etc., St. Louis, Mo	Jan. 28
Feb. 7.	Bonds, Huntsville, Ala	Jan. 14
Feb. 7.	Bonds, Columbus, Miss	Jan. 14
Feb. 9.	Exeter, Cal	Jan. 28
Feb. 13.	Bonds, Reno, Nev	Dec. 24
Feb. 13.	Pipe, etc., Hastings, Neb.	Jan. 28
Feb. 18.	Fort Meade, S. Dak	Jan. 28
Feb. 18.	Spring Lake, N. J	Jan. 28
	Adv., Eng. RECORD, Jan. 28.	
Feb 20.	Elhart Lake, Wis	Jan. 28
Feb. 21.	Honolulu, Hawaiian Is	Jan. 14
	Adv., Eng. RECORD, Jan. 14 to 28.	
Mar. 1.	Oto, Ia	Jan. 21
Mar. 15.	Belem, Para, Brazil	Nov. 26

SEWERAGE AND SEWAGE DISPOSAL.

Jan. 30.	Toledo, O	Jan. 21
Feb. 1.	Pipe, etc., Louisville, Ky	Jan. 28
Feb. 1.	Hartford, Conn	Jan. 21
	Adv., Eng. RECORD, Jan. 21, 28.	
Feb. 3.	Spartanburg, S. C	Jan. 14
	Adv., Eng. RECORD, Jan. 14, 18.	
Feb. 3.	Norristown, Pa	Jan. 14
Feb. 6.	Atlanta, Ga	Jan. 28
Feb. 6.	Bonds, Glenville, O	Jan. 14
Feb. 6.	Ottawa, Ont	Jan. 21
Feb. 7.	Bonds, Columbus, Miss	Jan. 14
Feb. 7.	East Grand Forks, Minn	Jan. 21
Feb. 8.	Lime, Brooklyn, N. Y	Jan. 28
Feb. 8.	Steelton, Pa	Jan. 28
	Adv., Eng. RECORD, Jan. 28.	
Feb. 9.	Stockton, N. J	Jan. 28
Feb. 20.	Bonds, Cleveland, O	Jan. 14

BRIDGES.

Jan. 30.	St. Joseph, Mo	Jan. 28
Jan. 31.	Bonds, Jackson, Miss	Dec. 24
Jan. --	Hastings, Neb	Dec. 10
Feb. 1.	Helena, Mont	Jan. 14
Feb. 2.	Ogden, Utah	Jan. 21
Feb. 2.	New York, N Y	Jan. 28
Feb. 4.	Superstructure, Cleveland, O	Jan. 21
Feb. 6.	Frumet, Mo	Jan. 21
Feb. 6.	David City, Neb	Jan. 28
Feb. 9.	Nebraska City, Neb	Jan. 21
Feb. 9.	Arcadia, Neb	Jan. 28
Feb. 15.	Seneca, Kan	Jan. 28
Feb. 15.	Adrian, N. Dak	Jan. 28
Feb. 15.	Helena, Ark	Jan. 28
Feb. 20.	Rockford, Ill	Jan. 28
	Adv., Eng. RECORD, Jan. 28.	
Feb. 20.	Chicago, Ill	Dec. 31
	Adv., Eng. RECORD, Dec. 31.	
Mar. 1.	Quebec, Que	Jan. 7
Mar. 2.	Shreveport, La	Jan. 21
Mar. 15.	Chicago, Ill	Jan. 21
	Adv., Eng. RECORD, Jan. 21.	
Apr. 1.	Substructure, St. Joseph, Mo	Jan. 7
——	Spring Lake, N. J	Jan. 7

PAVING AND ROADMAKING.

Jan. 30.	New Orleans, La	Jan. 28
Jan. 30.	Kokomo, Ind	Jan. 7
Jan. 30.	Eau Claire, Wis	Jan. 21
	Adv., Eng. RECORD, Jan. 28.	
Jan. 31.	Midvale, N. J.	Jan. 28
Feb. 1.	Cincinnati, O	Jan. 28
Feb. 1.	Appleton, Wis	Jan. 21
Feb. 1.	Fayetteville, Ark	Jan. 21
Feb. 1.	Bonds, Shreveport, La	Jan. 14
Feb. 1.	Jamestown, N. Y	Jan. 14
	Adv., Eng. RECORD, Jan. 14.	
Feb. 6.	Plainfield, N. J	Jan. 28
Feb. 6.	Albany, N. Y	Jan. 28
Feb. 6.	Darby, Pa	Jan. 28
Feb. 6.	Toledo, O	Jan. 14
Feb. 6.	Vevay, Ind	Jan. 21
Feb. 14.	St. Louis Mo	Jan. 21
Feb. 15.	Cleveland, O	Jan. 21
Feb. 16.	Decatur, Ind	Jan. 14
Feb. 17.	Cleveland, O	Jan. 28
Feb. 20.	Geneva, N. Y	Jan. 28
	Adv., Eng. RECORD, Jan. 28.	
Feb. 22.	Bedford, Ind	Jan. 28
Feb. 27.	Yonkers, N. Y	Dec. 3

POWER, GAS AND ELECTRICITY

Jan. 30.	Laconia, N. H	Jan. 21
Jan. 30.	Pleasantridge, O	Jan. 21
Feb. 1.	Richmond, Va	Jan. 7
Feb. 1.	Tuskegee, Ala	Dec. 31
Feb. 1.	Menahgo, Minn	Dec. 31
Feb. 1.	Woodford, O	Jan. 21
Feb. 1.	Marshfield, Wis	Jan. 21
Feb. 3.	Grand Rapids, Mich	Jan. 28
Feb. 6.	Hull, P. Q	Jan. 28
Feb. 6.	Johnstown, N Y	Jan. 21
Feb. 7.	Woodsfield, O	Jan. 14
Feb. 7.	Trenton, N. J	Jan. 21
Feb. 9.	Exeter, Cal	Jan. 28
Feb. 9.	Thibodeaux, La	Jan. 21
Feb. 10.	York, Pa	Jan. 21
Feb. 13.	Gas plant, Pawhuska, O. T	Jan. 21
Mar. 1.	Sault Ste. Marie, Mich	Dec. 24
Mar. 1.	Spartanburg, S. C	Jan. 14
	Adv., Eng. RECORD, Jan. 14 to 28	
Mar. 31.	Telephone, Shanghai, China	Nov. 19
——	Pleasantville, O	Dec. 24

GOVERNMENT WORK.

Jan. 30.	Beacons, Mobile, Ala	Jan. 7
Jan. 31.	Dry dock, Boston, Mass	Dec. 31
Jan. 31.	Wharf, Atlanta, Ga	Jan. 14
Feb. 1.	Duluth, Minn	Jan. 7
	Adv., Eng. RECORD, Jan. 7 to 28.	
Feb. 2.	St. Louis, Mo	Jan. 21
	Adv., ENG. RECORD, Jan. 21, 28.	
Feb. 3.	Dredging, Duluth, Minn	Jan. 7
	Adv., Eng. RECORD, Jan. 28.	
Feb. 13.	New Orleans, La	Jan. 14
	Adv., Eng. RECORD, Jan. 14 to 28.	

Feb. 16. Buildings, Annapolis, Md........ Jan. 28
Feb. 16. Duluth, Minn ....Jan. 21
Adv., Eng. RECORD, Jan. 21, 28.
Feb. 21. Wreck, Boston, Mass ....Jan. 21
Feb. 21. Savannah, Ga.... ....Jan. 28
Adv., Eng. RECORD, Jan. 28.
Feb. 23. Kansas City, Mo .... Jan. 28
Adv., Eng. RECORD, Jan. 28.

BUILDINGS.

Jan. 30. Oshkosh, Wis.........................Jan. 7
Jan. 30. School, Chattanooga, O..............Jan. 14
Jan. 30. Fort Morgan, Ala ....Jan. 28
Jan. 31. Vent, etc., school, Rochester, N. Y. Jan. 28
Jan. 31. School bonds, Jackson, Miss. ......Dec. 24
Jan. — Superstructure, Newport, R. I.... Nov. 19
Feb. 1. School, Peoria, Ill.....................Dec. 3
Feb. 1. Owatonna, Minn ....Jan. 7
Feb. 1. Alexandria, La............................Jan. 14
Feb. 1. Elevator, Baltimore, Md...............Jan. 21
Feb. 1. Augusta, Mont...........................Jan. 21
Feb. 4. Ventilating, etc., Cleveland, O......Jan. 14
Feb. 4. Canton, O..................................Jan. 28
Feb. 6. Ventilating, etc., School, New York, N. Y.............Jan. 28
Feb. 6. Hospital, New York, N. Y............Jan. 28
Feb. 6. Ventilating, etc., school, Burlington, Vt..............Jan. 21
Feb. 6. Beloit, Wis...............................Jan. 28
Feb. 6. Ventilating, etc., school, Kansas City, Kan.............Jan. 28
Feb. 9. San Antonio, Tex ....Jan. 28
Feb. 10. Keyser, W. Va..........................Nov. 5
Feb. 11. School, Algona, Ia.....................Jan. 28
Feb. 11. School, Cleveland, O..................Jan. 21
Feb. 13. Rock Springs, Tex......................Jan. 14
Feb. 16. School, Ellendale, N. D.............Jan. 7
Feb. 16. Buckhannon, W. Va....................Jan. 21
Feb. 25. Douglass, Ga...........................Dec. 31
Mar. 1. Arkadelphia, Ark.......................Jan. 14
Mar. 6. School, Eau Claire, Wis..............Jan. 28
Mar. 8. Aberdeen, S. Dak........................Jan. 28
Mar. 15. Plans, Wilkesbarre, Pa...............Jan. 28
Apr. 3. Many, La..................................Jan. 21
Apr. 14. Plans, Bradford, England........... Jan. 21

MISCELLANEOUS

Feb. 1. Wharves, etc., Honolulu, Hawaiian Is ....Jan. 14
Feb. 1. Crane, Townsville, Australia. .....Dec. 17
Feb. 1. Ice Plants, Manila...................... Jan. 28
Feb. 1. Cement, etc., Baltimore, Md........ Jan. 28
Feb. 6. Levee work, Pointé a la Hache, La. Jan. 14
Feb. 8. R. R. Work, Rutland, Vt............Jan. 28
Adv., Eng. RECORD, Jan. 28.
Feb. 8. Baltimore, Md ....Jan. 28
Feb. 15. Canal, Albuquerque, N. Mex .... Jan. 21
Feb. 20. Newark, N. J..............................Jan. 21
Adv., Eng. RECORD, Jan. 21, 28.
Mar. 15. El. Ry., Shanghai, China...........Nov. 19

NEW SCHOOLS.

Watertown, N. Y.—The matter of erecting a new high school is said to be under consideration.

Baraboo, Wis.—It is stated that plans have been prepared for a $25,000 high school. John M. True, Pres. Bd. Educ.

Detroit, Mich.—The School Board is stated to have asked for an appropriation of $267,000 for 6 new schools.

Lexington, Ky.—Clark & Howard of Lexington are stated to have received the contract for the Reform School, at $27,954.75.

Orongo, Mo.—It is stated that the proposition to issue $10,000 school bonds will be voted on at the April election.

Fargo, N. D.—A. J. Craig of Fargo is stated to have received the contract for heating the State Normal School, at $2,200.

Marietta, Pa.—It is stated that an election will be held Feb. 21 to vote on issuing $15,000 bonds for a school.

Frostburg, Md.—The plans of Alfred Mason of Baltimore are stated to have been accepted for the proposed State Normal School.

Philadelphia, Pa.—It is stated that bids will soon be asked for 2 schools and 4 additions. Mr. Anshutz, Archt. Bd. Educ.

Du Bois, Pa.—An election will be held Feb. 21 to vote on issuing $50,000 bonds for a high school.

New York, N. Y.—Bids are wanted Feb. 6 for ventilating and heating the extension to Erasmus Hall High School, Brooklyn Borough; also for alterations and repairs, etc., to Public School No. 7, Queens Borough, and Public School No. 20, Richmond, Borough. John E. Eustis, Chmn. Com. on Bldgs.

Mt. Vernon, N. Y.—School bonds amounting to $50,000 have been sold.

Rochester, N. Y.—Bids are wanted Jan. 31 for a ventilating and heating apparatus in School No. 12. B. G. Saunders, Chmn.

Eau Claire, Wis.—It is stated that bids are wanted March 6 for a school in the 6th Ward.

New Castle, Pa.—We are informed that a 10-room school is to be built at a cost of $20,000. Thayer & Son, Archts.

Lyons, Ill.—It is stated that a $35,000 addition will be erected to the high school.

Toledo, O.—The Board of Education contemplates erecting an 8-room school on Waite Ave. Architect not yet selected.

Algona, Ia.—Bids are wanted Feb. 11 for a school. C. M. Doxsée, Secy. Bd. of Directors of the Independent School Dist.

Kansas City, Kan.—Bids are wanted Feb. 6 for ventilating and heating the high school. W. E. Barnhart, Pres. Bd. Educ.

STREET CLEANING AND GARBAGE DISPOSAL.

Philadelphia, Pa.—The contract for street cleaning in the Sixth District for the present year has been awarded to Richard P. Bennis, Germantown, for $21,474.

Oakland, Cal.—The Board of Health has passed a resolution requesting the City Council to pass such measures as are necessary to secure a crematory. G. L. Eaton, Henry Ryfkogel, John T. Kitchens, Committee on Streets, Main Sewer, Garbage, etc.

San Francisco, Cal.—The following bids for a garbage crematory at Presidio were opened Jan. 18 by Lieut.-Col. J. M. Marshall, Deputy Qr. Mr. General, U. S. A.: Matthew McGowan, 813 Oak St., $2,626; Wm. A. Butler, 40 New Montgomery St., $2,490; Sinnott & McCann, 318 Bush St., $2,932; M. McCarty, Stockton, Cal., $2,890; Victor Hoffmann, 2037 Eucinal Ave., Alameda, Cal., $2,999; John Tuttle, 516 Haight St., $2,735; J. H. McKay, 2408 Washington St., $2,430; R. W. Beattie, 1007 Larkin St., $1,970. Address of bidders San Francisco, unless otherwise stated.

New York, N. Y.—The Board of Esitmate and Apportionment is stated to have appropriated money for the construction of garbage crematories in Queens Borough. Estimated cost, $120,000.

Atlantic City, N. J.—Local press reports state that the contract for garbage removal has been awarded to Mark Townsend, Somers Point, N. J., for a term of three years. For list of bids received see our issue of Jan. 14.

Lakewood, O.—We are informed that the election to have been held Jan. 26 to vote on the issue of $150,000 sewerage bonds has been postponed.

Chicago, Ill.—It is stated that the following bids were opened Jan. 24 for the collection and incineration of garbage: Patrick Mulcaire, of Chicago, $510,000; R. B. Mitchell, of San Francisco, $538,025, and Henry McDonald, of Chicago, $626,000.

GOVERNMENT WORK.

Annapolis, Md.—Bids are wanted Feb. 16 for an armory and a boat house at the Naval Academy. A. S. Crowninshield, Ch. Bureau of Navigation, Navy Dept., Washington, D. C.

Savannah, Ga.—Bids are wanted Feb. 21 at the U. S. Engineer Office for cement and broken stone, delivered at Tybee Island, Ga., as advertised in "The Engineering Record."

Washington, D. C.—It is stated that the Westinghouse Electric & Manufacturing Co., Pittsburg, Pa., has secured a contract for a light, heat and power plant for the government proving grounds at Indian Head, on the Potomac River. Amount of contract, $100,000.

Duluth, Minn.—Bids are wanted Feb. 3 at the U. S. Engineer Office for dredging in Portage Lake Ship Canals, Keweenaw Point, Mich., as advertised in "The Engineering Record."

Kansas City, Mo.—Bids are wanted Feb. 23 by the Superv. Archt., Treas. Dept., Washington, D. C., for the boiler plant, steam heating, mechanical ventilating apparatus, etc., for the U. S. Post Office and Court House, as advertised in "The Engineering Record."

MISCELLANEOUS.

Baltimore, Md.—Bids are wanted Feb. 8 for excavating and removing about 250,000 cu. yds. of material from docks, back basin and harbor. N. H. Hutton, Engr. Harbor Bd.

Columbus, O.—An ordinance has been passed authorizing the Director of Public Improvements to contract with the T. & O. C. R.R. Co. for the raising of its tracks at the crossing of the Big Four, and appropriating $4,355 to pay for the same.

Newport, Ark.—It has been voted to construct 1½ miles of levee at an estimated cost of $3,752.

New York, N. Y.—The Municipal Council has adopted an ordinance for a bond issue of $160,000 for a park site between 114th St., 1st Ave. and the East River.

West Superior, Wis.—It is stated that the American Steel Barge Co. has awarded the contract for a dry dock 606 ft. long to Barnett & Record, of Minneapolis. The contract includes only the work of pile driving and excavation.

Philadelphia, Pa.—See "Paving and Roadmaking."

Baltimore, Md.—Bids are wanted Feb. 1 for furnishing cement, broken stone, arch bricks and sand for the use of the Electrical Commission during 1899. Charles E. Phelps, Jr., Ch. Engr.

Cleveland, O.—It is stated that the lowest bid received for widening Cuyahoga River for a distance of more than 600 ft. was from L. P. & J. A. Smith Co., Cleveland, at $16.50 per lin. ft. for the removal of old and building of new docks, and 14 cts. per yd. for dredging. Estimated cost, $20,000.

WEST INDIES AND PHILLIPPINE ISLANDS.

Refrigerating and Ice Plants.—Bids will be received Feb. 1 by Col. J. G. C. Lee, Chief Quartermaster, Chicago, Ill., for a complete refrigerating ice-making plant at Manila, Philippine Islands.

Gas and Electric Light.—Articles of incorporation have been filed at Trenton, N. J., of the Puerto Rico Company, with an authorized capital of $1,000,000. The company is empowered to manufacture and sell gas and electric light in the West Indies. The incorporators are: Matthew Randall, Nathan J. Mitchell, Edmund C. Aslop and Frank B. McMcAvoy.

PROPOSALS.

Paving.

EAU CLAIRE, Wis., Jan. 19, 1899.

Sealed proposals, addressed to C. S. Lee, chairman, will be received at the office of the City Clerk up to 3 o'clock p. m. on Monday, Jan. 30, 1899, for the repaving with vitrified brick of S. Barstow and Kelsey streets, as per plans and specifications on file in the City Engineer's office. There will be approximately 9,394 square yards of paving.

C. S. LEE,
E. S. HAMMOND,
FREDERICK STUEWER,
Committee on Pavements.
C. A. ALDERMAN, City Engineer.

Notice to the Sewer Pipe Manufacturers.

Sealed proposals, addressed to J. D. Young, Borough Secretary, will be received by the Borough Council of Steelton, Pa., on Wednesday, February 8th, 1899, for furnishing thirteen (13) miles of vitrified sewer pipe, ranging in size from 4 in. to 24 in. diameter, as follows: Fifteen thousand ft. of 4-in. house connections, 42,390 ft. of 8 in., 6,050 ft. of 10 in., 1,080 ft. of 12 in., 100 ft. of 15 in., 100 ft. of 18 in., 850 ft. of 20 in. and 5,500 ft. of 24 in.

Specifications can be secured at the office of the engineer, 137 Broadway, New York City, and can be seen at the Borough Council Chamber, Steelton, Pa.

A certified check of $500.00 must accompany each proposal. The right is reserved to reject any or all bids, or to accept that one which in the opinion of the council is for the best interest of the Borough.

H. H. CAMPBELL,
President.
J. D. YOUNG,
Borough Sec'y.
ALEXANDER POTTER,
Consulting Engineer.

PROPOSALS.

Notice to Contractors.

Sealed proposals will be received by th[e] Board of Public Works of the city of Ge[n]eva, N. Y., on or before 11 A. M. on th[e] 20th day of February, 1899, for paving wi[th] vitrified brick or asphalt about 18,000 squa[re] yards in the said city of Geneva.

Specifications will be furnished on app[li]cation.

By order of the Board of Public Work[s]
EDWARD SEYBOLT,
Sup[t]

Dated Geneva, N. Y., Jan. 23rd, 1899.

Notice to Bridge Contractors.

ROCKFORD, Ill., Jan. 24, 1899

Sealed proposals will be received at t[he] office of the City Engineer by the City [of] Rockford, until 2 p. m. on the 20th day [of] February, 1899, for the construction a[nd] erection of a plate girder bridge over Kei[th] Creek, at Seventh street, all to be made a[c]cording to plans and specifications on fi[le] in the office of the City Engineer. Pr[o]posals must be accompanied by a certifi[ed] check on some responsible bank for $[...] and payable to the order of the City [of] Rockford. The City reserves the right [to] reject any or all bids. EDWIN MAIN[...]
City Engine[er]

Steel Tower and Pumping Plant.

SPRING LAKE, N. J., Jan. 23, 1899

Separate sealed proposals will be receiv[ed] by the Mayor and Council of the Borou[gh] of Spring Lake, N. J., until 2 o'clock p. [m.] Saturday, Feb. 18, 1899, for the followi[ng] items:

First—For furnishing and erecting a ste[el] tower, surmounted by a wooden tank [of] 80,000 gallons capacity. Total height [of] tower and tank, 100 feet.

Second—For furnishing and erecting [a] steam pumping plant complete, of about [...] gallons capacity per minute, includi[ng] boiler.

All bids must be accompanied by a ce[r]tified check of 10 per cent. of the bid.

The right is reserved to reject any or [all] bids.

Specifications and further informati[on] may be obtained by applying to H. C. V[an] Arsdale at the Railroad Station, Spri[ng] Lake, N. J., or to Lehlbach Brothers, Ci[vil] Engineers, 770 Broad street, Newark, N. [J.]
H. C. VAN ARSDALE
Borough Clerk

U. S. ENGINEER OFFICE, DULUT[H], Minn., Jan. 3, 1899.—Sealed proposals [for] dredging in Portage Lake Ship Canals, K[e]weenaw Point, Mich., will be received he[re] until noon, Feb. 3, 1899, and then public[ly] opened. Information furnished on applic[a]tion. CLINTON B. SEARS,
Major Engineers

U. S. ENGINEER OFFICE, DULUT[H], Minn., Jan. 1, 1899.—Sealed proposals [for] building substructure for north pier, D[u]luth ship canal, will be received here un[til] noon, Feb. 1, 1899, and then publicly open[ed]. Information furnished on applicati[on]. CLINTON B. SEARS, Major, Engrs.

U. S. ENGINEER OFFICE, SAVANNA[H], Ga., Jan. 21, 1899.—Sealed proposals for Po[rt]land cement and broken stone, delivered [at] Tybee Island, Ga., will be received h[ere] until 12 o'clock noon (city time), Feb. [21,] 1899, and then publicly opened. Informat[ion] furnished on application. CASSIUS E. GI[L]LETTE, Capt. Eng'rs.

TREASURY DEPARTMENT, OFFI[CE] Supervising Architect, Washington, D. [C.,] January 23, 1899.—Sealed proposals will [be] received at this office until 2 o'clock p. [m.] on the 23d day of February, 1899, and th[en] opened, for fixing in place complete [the] boiler plant, low pressure and exha[ust] steam heating and mechanical ventilat[ing] apparatus, supply pumps and tanks [,] water supply, etc., and pipe and duct cov[er]ing for the U. S. Post Office and Co[urt] House building at Kansas City, Mo., in [ac]cordance with the drawings and specifi[ca]tion, copies of which may be had at [this] office or the office of the Superintendent [at] Kansas City, Mo. JAMES KNOX TAYL[OR,] Supervising Architect.

Proposals Continued on Page ix.

THE ENGINEERING RECORD.
Volume XXXIX. Number 10.

TABLE OF LEADING ARTICLES.

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THE WATER-WORKS QUESTION IN CHATTANOOGA.

Some of the citizens of Chattanooga, Tenn., are endeavoring to secure from the Legislature rights to build a system of municipal water-works. The city is now supplied by a plant which originated in the works built by the national government in 1864. These have been developed from time to time, and the present system, which is controlled by the American Water-Works & Guarantee Company, of Pittsburg, is the result of expensive and elaborate improvements carried out during the last few years. The complaint against the service of the company seems to be wholly one of water rates, which are considered to be too high. There is evidence in the interviews published in the local papers of the unfortunate but frequent disposition to compare the charges of the water company with those made elsewhere, no attention being paid to the fact that the corporation furnishing the supply has gone to great expense to construct pumps, reservoirs and filters, which are unnecessary for many plants supplied by gravity. The fixed charges and operating expenses of such a system of works are necessarily far greater than the cost of running a plant where no pumping or filtering is required. The company also supplies some of the suburbs of Chattanooga, and every person familiar with the operation of water-works knows that the suburban business is rarely anything more than a losing enterprise, conducted solely in the hope that in the near future these districts may be so built up that there will be a sufficient number of consumers along the non-paying lines to balance the losses of the first few years.

The situation to-day in Chattanooga cannot be very satisfactory to those who believe that the works should be owned by the city, but consider that in acquiring them the present corporation should be treated fairly. The superintendent of the company has offered to sell the plant or to bear half the expenses of an investigation of the rates by a board of impartial experienced engineers. In spite of this, the advocates of the plan of building a municipal plant are trying to get their bill through the Legislature. Mr. Robert Hooke, city engineer of Chattanooga, has made an estimate of the cost of a plant for supplying the city proper without regard to the suburbs. The plans provide for reservoirs, filters, standpipes and pumping engines which will cost about $638,000. If the city were to build this plant it would not only have to meet these expenses, but the present consumers will have to pay for the cost of connecting their buildings with the new mains. When the works were built they would merely duplicate part of a plant representing, all told, a much larger capital outlay, the value of which would be largely and uselessly destroyed. No fair-minded man can contemplate such a result without a desire to protest. However, the water company, whose franchise does not provide for the purchase of the works by the city, cannot be expected to allow its business to be taken from it without litigation. "The Engineering Record" is not familiar with the terms of its franchise, but from what it knows of the general trend of decisions, the city will have a long litigation with the company in all probability, and stands a good chance of being defeated on the equities of the case. "The Engineering Record" has consistently advocated the municipal ownership of water-works wherever practicable, but it has never favored the confiscation of private property.

THE MEASUREMENT OF EARTHWORK.

The Supreme Court of California has recently rendered an interesting decision on the measurement of earthwork, a question brought before it in a suit by A. V. Scanlan against the San Francisco & San Joaquin Railway Company to recover the large sum of $20, which he claimed was due because of the company's refusal to make a proper allowance for shrinkage. The contract between the two parties contained the following provisions: "On embankments a percentage for shrinkage must be added to the fill and said percentage will be as specified and marked out by the engineer, but will in no case exceed 10 per cent. of height of bank. * * * Material will be measured in embankment, but no measurement will be made of the material added for shrinkage, nor payment made for same." In the Superior Court of Joaquin County Mr. Scanlan called as a witness an engineer who testified he had measured the embankment after its completion and found it to contain a certain number of cubic yards, but he did not give the data upon which his computations were based. He testified that his computations were made by measuring a certain number of cross-sections, finding the average area of these sections, and multiplying this average area by the length of the embankment. One of these computations was based entirely on his own measurements, and the other, which was much less, on the measurements made by the company's engineer, except as to the height, which the witness filled in from his own measurements. The court adopted neither of these computations, but fixed the amount at an intermediate figure, "for which," the Supreme Court states, "we are unable to find any basis in the evidence. We think there was no evidence before the court by which the contents of the embankment could be ascertained. The finding depends entirely upon the accuracy of the computations made by plaintiff's engineer, since the measurements themselves were not before the court, and it is evident that these computations were inaccurate."

Inasmuch as the Supreme Court's decision legally establishes the method which must be followed in California in measuring earthwork, unless the contract expressly provides for some other method, it is reprinted herewith in full from the "Pacific Reporter."

"The court takes judicial notice of the laws of nature, among which are the principles of mathematics. The science of mensuration, which must control in this case, is a branch of pure mathematics, with which the court is presumed to be acquainted. By the rules of mensuration, the contents of an irregular prismoidal body, such as a railway embankment, is ascertained by dividing it by vertical planes at every change of contour of the underlying ground into a series of prismoids, and computing the contents of each of these prismoids by adding together its two end areas and four times its middle area, dividing this sum by six, and multiplying the quotient by the length of the prismoid. The product will be the actual contents of the prismoid. See Enc. Brit. (9th Ed.) art. 'Mensuration.' This method was not employed by the witness. His method was an approximation, which assumes that the middle area of a prismoid is equal to half the sum of its end areas. This is true only in the case of a prism, or in a prismoid consisting of the frustum of a regular pyramid. This aproximation, it is true, will give results correct enough for practical purposes in very uniform embankments, where there is but little difference in height. But in other cases its results are always too large, and it would be easy to suppose cases in which the excess would be greater than the difference between the estimates of the respective parties in this case.

"The plaintiff's computations made no allowance for the additional earth put on for shrinkage. It is true that there was some testimony tending to show that at the time of the measurement the embankment, to use the words of respondent's brief, 'had settled or shrunk nearly, if not quite, all it would.' This testimony was entirely too indefinite to take the place of actual measurement, to which defendant was entitled under the contract. Moreover, it did not reach the point; for the amount to be added for shrinkage, under the contract, was to be determined, within certain limits, by the defendant's engineer, and within those limits his judgment was conclusive, even if the shrinkage should turn out to be less than he had allowed for.

"The plaintiff's engineer, working as he did after the embankment had been constructed, did not know the original condition of the ground, and, in order to supply that essential factor, he made certain assumptions which may or may not have been justified by the facts, but which the evidence does not show to have been so justified. We do not think, however, that any such assumptions are allowable under this contract. Since the work is to be paid for by actual measurement and the original surface of the ground is one of the necessary data for such measurement, the builder, if not satisfied with the survey made by the company's engineer, should, before commencing work, have that survey corrected or make an accurate one for himself. A neglect to do this is equivalent to an admission of the correctness of the company's survey. The plaintiff should therefore have proved that survey, but he did not do this, and objected to the proof of it offered by the defendant, and it was not in evidence in the case. We would suggest that upon another trial of the case each side should put in evidence the measurements upon which any computation offered by it is founded, unless such proof is waived by the other side. If the measurements are before the court, errors in computation can be corrected. Our conclusion upon this point renders it unnecessary to notice the other points named. The judgment and order appealed from are reversed, and the case remanded for a new trial."

THE WATER HYACINTH.

The rivers and lakes of Florida and Louisiana have become infected of late years with a floating plant known as the water hyacinth, which is causing serious obstruction to navigation and injury to commercial interests in the districts where it grows. Like the English sparrow, yellow fever, anarchists and various other unpleasant things now in the country, it is not

a native. It has made itself very much at home, however, in parts of the two States mentioned, and become in places a greater menace to navigation than shoals and snags, for it covers the surface of the water with a thick, strong, tangled mass of vegetation, through which steamboats cannot force their way. Some time ago Lieut.-Colonel W. H. H. Benyaurd and Major J. B. Quinn, of the Corps of Engineers, U. S. A., were appointed a board to investigate the best methods of destroying the pest. In their report they say that the plant will continue to be a serious menace to the commerce of the rivers in which it has obtained a foothold, and that efforts should be made to afford some relief "to the many industries that are suffering from the accumulation of the plant in the streams. That these accumulations at many points are due to the structure and floating nature of the weed, which, under the action of currents, winds and other influences, finds lodgment in the bends and other points of the stream, is beyond doubt. These are the natural causes. In many other instances, wharves, piers, booms and indifferent bridge construction are accountable for the blockade of commerce. It was noticed last spring in the southern sections of the St. Johns that the plant had apparently disappeared, or at least had appeared to lose life, and the hope was expressed that the pest was disappearing, but with the advent of the rainy season it appeared in as great profusion in many localities as before."

Many different schemes for destroying the plant have been proposed. Among the mechanical methods, the board considered two worthy of consideration. One of these is to gather large masses together and tow them to some locality where they can be destroyed by sea water. Brackish water seems to have little influence on them, and it has been noticed that plants which have been in salt water less than 24 hours revive when they are carried back into the fresh water. There seems to be no question but that the growths have great vitality. One serious trouble was encountered in attempts to tow the plants. Large nets of very heavy chord were constructed and placed around masses of the floating vegetation, tugs were attached to the nets and efforts made to tow them away, but when any heavy strain was placed on the tow lines the weeds crowded over the net so as to make the experiment unsuccessful.

A mechanical method of preventing the spread of the hyacinth which has been tried successfully in Louisiana is the use of automatic log booms. These are arranged to open when the water current or the wind is downstream and close when the current or wind is upstream. Thin boards are nailed to the booms so as to project high enough above the water for the wind to have some effect on them. These booms simply check the spread of the weeds into waters which have previously been free from them. The best mechanical method of extirpating the plants was found to be crushing them between heavy rollers. Experiments were made by running masses of the weed through the rollers of a planing machine, which extracted about six-tenths of the moisture they contained. The crushed plants were then put in water, where they floated on the surface, and at the end of 30 days were simply a rotten mass, no signs of life having been observed since the crushing was done. Some of the crushed plants were piled on land and were dry enough to burn in 30 days.

No practicable method of destroying the plants by chemicals was found. Mr. P. H. Thomson, Plaquemine, La., has used a saturated solution of salt with enough quicklime added to make a good spraying mixture fatal to the plant. But while this liquid destroys the roots and tops in 48 hours, its cost, 2 cents a square yard, is altogether too high to permit its use over the thousands of acres of weeds now obstructing commerce on the southern waters.

GENERAL GEORGE SEARS GREENE.

Visitors to the battle-field of Gettysburg, particularly those who were there the first few days of July, 1863, will not soon forget Culp's Hill. The knoll is now a beautiful spot, with slopes cared for like the parks of British manors, but rather more than thirty-five years ago it was the scene of some of the hardest fighting on the field which marked the high tide of the civil war. The Union leader at Culp's Hill was a man 62 years old, who had won a prominent position among the makers of this country, but had answered the call to arms in obedience to the traditions of the United States Military Academy, from which he was graduated long before. In spite of his age, which most men, when they attain it, consider a title to relaxation from arduous work, he served with distinction throughout the war; and afterward, such was his wonderful physical and mental strength, entered upon a second professional career, of itself long enough and full of sufficient honorable achievements to satisfy the ambition of any reasonable man. But finally the time came when active affairs proved too bothersome; during the last two or three years the friends of General Greene have seen him less frequently, and on January 28 he died of old age.

The Greene family has held an honored place

GENERAL GEORGE SEARS GREENE.

in American history from the time when John Greene, of Salisbury, England, made his home in what is now Warwick, R. I. One of his descendants was the famous artillery commander of the Revolution, and it was through another branch that General George Sears Greene traced his ancestry. It might be added that his interest in the family history led him some ten years ago to study genealogy with such profitable results that he was elected president of the New York Genealogical and Biographical Society. He was born in Warwick in May, 1801, so that his age at his death was nearly 98 years, which, however, was several years less than the age to which a near relative had lived. He soon showed the family tendency toward military affairs, and eventually entered the West Point Military Academy, where he was graduated as second in the class of 1823. The first man in the class was Major Alfred Mordecai, who also occupied later in life a distinguished position among those in charge of civilian work. The academy at that time was under the superintendence of General Thayer, and taught engineering subjects with greater thoroughness than any other school in the country, so it is not strange that its graduates were in demand by civil bodies contemplating the construction of public works.

From the time of his graduation until early in 1827 General Greene taught mathematics or engineering at the academy or the ordnance school at Ft. Monroe, and then entered the ordnance branch, in which he served until his resignation in 1836. At that time railway construction was proceeding rapidly in many parts of the country largely under the direction of former cadets at West Point. General Greene's engagements took him to Massachusetts, North Carolina, Tennessee, Kentucky and Maryland during the next eleven years. From 1847 to 1852 he was chief engineer of the Portland & Kennebec Railroad, then he located the Albany & Susquehanna Railroad, and from 1852 to 1856 he was chief engineer of the Providence & Bristol Railroad. Finally he was placed in charge of the extension of the Croton waterworks and designed many of the structures for which the works have been noted.

He resigned the last position in 1862 to join the volunteer army. In January of that year he was commissioned colonel of the Sixtieth New York volunteers, and was advanced a few months later to brigadier-general, taking part in the Shenandoah and Maryland campaigns, including the battle of Antietam. The next year he was at Chancellorsville and Gettysburg, and was wounded at Wauhatchie. After recovering he was on court-martial duty for a time, but went back to the front in 1865 in time to take part in some of the closing engagements of the war. In March of this year he was made brevet major-general for gallant and meritorious service, and was mustered out a year later. This, however, was not his final connection with the army, for long afterward, in 1894, Congress passed a special act restoring him to the rank of lieutenant, retired, in the regular army.

The second period of General Greene's private career began as engineer in charge of the Croton works, with which he was connected until 1871. After that work, he became consulting engineer for sewerage and water systems in many places, and was connected in one capacity or another with a wide variety of public improvements. But for every work with which his name is associated probably several could be given for which he furnished important advice, were the facts known, for he was one of the most willing advisers of young men, and was never too busy or tired to assist them from his wealth of experience accumulated during a phenomenally long and active career.

He was a prominent engineer when the formation of the American Society of Civil Engineers was talked over, and became one of its founders. Mr. Hunt has told the story of its early days so well in his history of the society, from which the accompanying portrait has been taken, that it is unnecessary to repeat it here. General Greene was president of the society from 1875 to 1877, and for many years one of its most active members. Even after he had passed his ninetieth year he attended the regular meetings from time to time, and hardly an annual meeting or convention passed at which he was not present. During his long career he saw the civil division of the engineering profession advance from the place of a calling on a par with millwright work or blacksmithing to the same class as the law or medicine, and the best commentary on his attainments is that he kept abreast of its rapid growth, and, in some branches, helped it forward at a time when his age entitled him to the position of spectator rather than worker.

A New Resilient Frost Bottom has been designed by Mr. John Thomson for the Trident water meter. The two sections of the disk-casing are pressed together and are also held to their bearing by the enclosing head; which, in turn, is forced inwardly by the four-arm resilient spring-pieces secured by bolts and nuts to the main casing. The head is of cast-iron,

but the resilient pieces are punched from a fine quality of rolled steel and are then carefully hardened and tempered by a special process, ensuring great uniformity of tension.

The relation of the parts is such that the head, when bolted home snugly, will resist a pressure, without leaking, of from 300 to 325 pounds, or higher if desired, to the square inch; but when a pressure greater than that pre-determined is exerted, the spring yields and the head is driven outwardly. The extent of this movement, when a meter is frozen solid, is only about 3/16 inch; hence the increased stress upon the arms when so deflected is comparatively nominal. It should be borne in mind that when the head is forced outward by the ice the disk-casing moves with the head and that its sections separate. It is because of this fact—the disk and the disk-casing moving with the body of expanding ice—that the working parts are relieved from disruptive strain. Then when the ice is melted, as by immersing the meter in tepid water, the resilient spring simply resets all the parts to their normal position and the meter is ready to renew its function. The object of furnishing two spring-pieces in one set is because this produces a leaf-spring, obtaining a somewhat greater degree of resiliency than if formed of a single part. And this is also a precaution in event of breakage; as even if several of the arms should fail there would still be an ample reserve to ensure the operation of the meter under practically all the conditions of regular practice.

THE ERECTION OF THE SOHAN BRIDGE.

During the Afghan war a number of years ago, the key to railway communication was the bridge shown in the accompanying illustration. Military necessities called urgently for the completion of the structure, so it had to be erected during the rains, when sudden and violent floods might be expected to wash away the staging of the river span at any time. "So great, however, was the necessity for completing communication," said Sir Guilford Molesworth, in a lecture on bridge construction, "that it was determined to risk the girder. My son, who was in charge of the work, designed and constructed the staging, and then erected the girder with such dispatch that it was perfectly safe from danger in 28 working hours after the first portion of the girder had been risked on the staging."

The inclined falsework bents were adopted to offer as little resistance to the current as possible. Each bent was made of four round posts or spars spread at the bottom like battered pile trestles. They were set, butts down, on offsets at the bases of the piers and were braced by small round cross struts and X-bracing lashed on so as to form somewhat irregular panels in the transverse planes of the bents and in the approximately vertical planes of the faces of the falsework. Diagonal lateral bracing was also attached to the inclined panels formed by the longitudinal and transverse struts. The tops of the center bents took bearing on heavy horizontal stringers which served as the keys to the archlike construction. One span was erected on a pair of symmetrical fan-shaped falseworks, as shown in the foreground of the picture. Another span was erected as shown on the left on fan-shaped falsework at one end and on a temporary iron tower at the other end. The same system of corbels on a much larger scale was used in the erection of the Attok bridge described last week.

This tower was made with light interchangeable angle-iron columns in short lengths, specially designed for the rapid construction of military bridges in war time. The system was devised by Sir Guilford Molesworth for use in the construction of the railway between Pindi and Jhelum, and was afterward very effectively used in other parts of India. The towers were made heavier than was requisite for temporary use so as to support the spans under traffic in case the masonry was not completed in time. The upper part of iron tower carries a short inclined falsework bent, which bears against a bridge piece at the top and opposes its thrust to that of the long inclined bent. On top of the tower is a cribwork of wooden ties built up to support the light lattice girder stringers which carried the erection platform.

A third span of this bridge was erected on a platform carried by two of these iron falsework towers, each five stories high.

WATER SOFTENING AT SOUTHAMPTON, ENGLAND.

[By James H. Fuertes, M. Am. Soc. C. E.]

(Continued from Volume 38, Page 472.)

In 1310 the Friars Minor granted to the City of Southampton the use of the water from a spring at Colwell which was developed by them in 1290. This was the first water supply of Southampton. Six hundred and nine years have elapsed since then, and the city now obtains its supply from wells and tunnels driven in the chalk formation near Otterbourne, eight miles from Southampton, which yield about 4,000,000 gallons per day. The water from the wells is very hard and therefore unfit for use in boilers and for many manufacturing purposes. To remedy this condition the city installed a plant for softening the water in 1888. This plant is the largest of its kind in the world, and has earned wide distinction from this fact, and from its satisfactory and economical operation for a number of years. The plans for the works were made by the present water-works engineer, Mr. William Matthews, M. Inst. C. E., and approved by Mr. James Mansergh, M. Inst. C. E. The recent changes and improvements, by which the efficiency and reliability of the process have been further insured, are also due to Mr. Matthews.

Before deciding upon the location of the wells and tunnels a systematic study was made of the height of the ground water in the chalk by observations extending over different seasons of the year on wells in the neighborhood of the proposed works. After a comparison of these observations it was found that in the locality chosen there was the least fluctuation of level, which indicated that this was the most reliable source. The supply is said to be inexhaustible, and for the amounts which have so far

THE ERECTION OF THE SOHAN BRIDGE DURING THE AFGHAN WAR.

been drawn from it there have been no signs of depletion. Local rainfalls have no effect on the level of the water, yet the collective rainfall of a season will make itself manifest by a slight rising or falling of the water in the wells. The natural level of the water is about 55 to 60 feet below the surface of the ground. The water is collected in wells and in tunnels about 13x4 feet, driven into the chalk.

The water is strongly impregnated with the carbonate of lime which gives it a hardness of 18 degrees, each degree corresponding with one grain of carbonate of lime in one imperial gallon of water. The degree of hardness of the water in the wells and headings has not become less since the works were first inaugurated, as has happened frequently at other localities. As a result of the softening treatment the hardness of the water is reduced very regularly to about 5 degrees. It could be still further reduced to 4, or even to 3 degrees, but it is said that if this were done the resulting water would taste flat and insipid.

Recent improvements in the machinery of the plant have made possible the production of uniform standard solutions by which the softening may be regulated with great precision. The softening is done by the so-called Dr. Clark's process, with the employment of Atkins filters. It consists, briefly, in the addition of lime water to the hard water, by which the carbonate of lime in the hard water is changed into the insoluble mono-carbonate, which separates in the form of fine crystals held in suspension in the water, leaving the latter more or less soft according to the proportions of milk of lime added.

The lime used in the process is obtained by burning chalk quarried on the premises. The chalk is raised from the quarry on a counterbalanced car hauled up an inclined track by a rope passing around the drum of a small hydraulic hoisting engine, driven by water from the high service main. Side tracks run from this hoist to the limekilns, of which there are two, and to the store house and railroad side-track leading into the grounds. The burned lime is stored in a damp-proof room, the floor of which is high enough to allow the lime to drop through a chute to the lime mixers and slakers below. As the works are operated at present it requires the use of a trifle under two pounds of lime per 1,000 gallons of softened water, including all waste and losses. Figure 117 is a sketch showing the general arrangement, in section, of the lime store room, measuring box, slaker and water measuring tank.

The lime measuring box, Figure 118, is made of iron with an inclined bottom having a hinged door, which is held closed or allowed to open by a chain passing over pulleys to the piston rod of a hydraulic jack, shown in Figure 119. The jack is fastened to the wall in the lime store room, and is operated by water from the high-pressure main. The door of the measuring box hangs open until it is desired to charge the box with lime; it is then closed by pulling the handle of the jack in the direction indicated by the arrow. This moves the valve, admitting the water in front of the piston, and closing the door of the measuring box. When the piston has traveled the full stroke the collar on its other end strikes the lower sliding rod, which is connected with the bottom of the operating lever, and pushes the piston back enough to cut off the high-pressure supply of water, thus stopping the travel of the piston. When the box is fully charged the lever is pushed a little further in and the pressure is admitted to the other side of the piston, and the bottom of the measuring box opens.

The lime slaker, Figure 120, is a cylindrical iron tank, 4 feet in diameter and 3 feet high, containing a cage made of rods about ½ inch apart in the clear, revolving on a central vertical shaft. The slaked lime leaves the slaker through a spigot 1½ inches in diameter and falls through a screen with ⅛-inch meshes into a trough, and is then led through a pipe to the mixing wells. The water for slaking the lime is measured from an overhead tank of known capacity. The water goes to the overhead tank from the mains and passes from the box to the slaker. An ingenious cock, which is shown in principle in Figure 121, controls these deliveries by the movement of a lever. A ball float in the tank overhead prevents the water from overflowing.

The mixer is 7½ feet in diameter and 5½ feet in depth, and contains rotating stirring arms driven by a hydraulic engine. The stirring apparatus has proved much more effective than the jets of compressed air which were originally used for the agitation. From the mixer the milk of lime is forced by a belt-driven pump through a delivery pipe to the tanks where the lime water is made.

In the actual operation of the plant it was found that one of the greatest sources of trouble was in the uncertainty regarding the strength of the lime water. A variation of a small amount in the strength would render the water hard or soft, according to circumstances, and where the production of the solution depended principally upon the judgment of the operatives, with no accurate means of measuring the proportions of lime and water, the results were sometimes very unsatisfactory. In 1895 arrangements were completed for remedying this trouble. The method of producing a continuous supply of lime water of a uniform consistency from the cream of lime paste, and of adding it continuously in known proportions to the hard water, will now be described.

In Figure 122 is given a sketch plan showing the general arrangement of the softening works. The slaked lime goes first to the mixing well, where it is kept agitated with arms on a vertical revolving shaft operated by an engine driven by water power from the high-pressure main. There are four tanks in which the lime water is made; each is 9 feet in diameter and 11 feet high, with a conical bottom, making the total height from the top of the cylinder to the bottom of the cone about 14 feet. The cream of lime is pumped into each cylinder until the cone is about filled, and the softened water from the elevated water tank is admitted at the bottom of the cone and allowed to flow slowly up through the cream of lime, taking up a portion of lime in its course and forming lime water. The rate of ascent is so slow that the water becomes clear by the time it reaches the top. The cream of lime is renewed about every six hours, requiring fifteen minutes for charging. The lime water is drawn off at the top of the tanks by horizontal perforated pipes, Figure 125, about 18 inches below the top of the tanks. Figure 124 gives a sketch cross-section through the lime-water tanks, showing the connections. The cream of lime is kept agitated in the bottoms of the tanks by light stirring arms driven from above by shafting. From the bottoms of the tanks, Figure 123, waste pipes lead to a pump

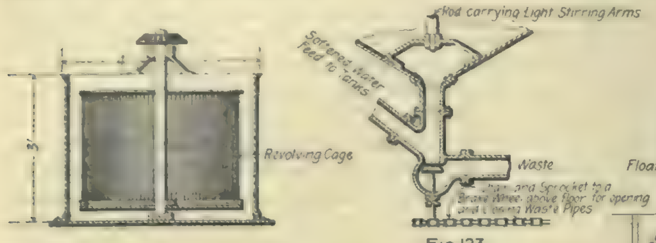


Fig.123

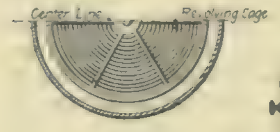


Fig.120

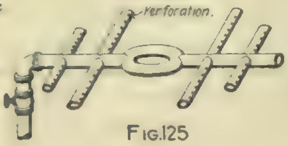


Fig.125

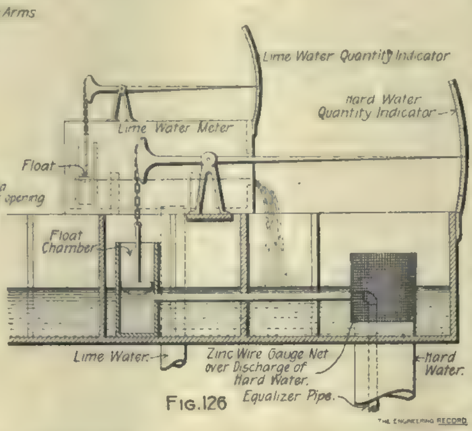


Fig.126

DETAILS OF THE SOUTHAMPTON WATER SOFTENING PLANT.

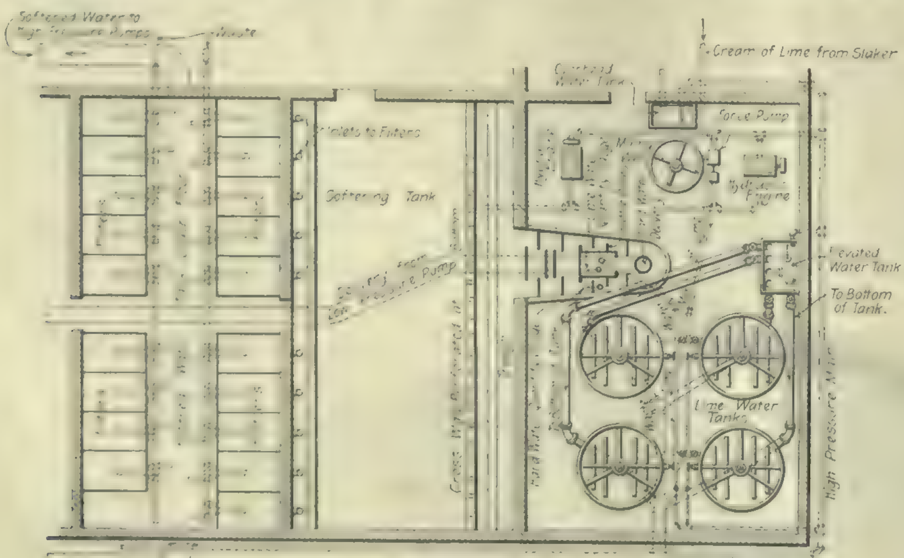


Fig.122

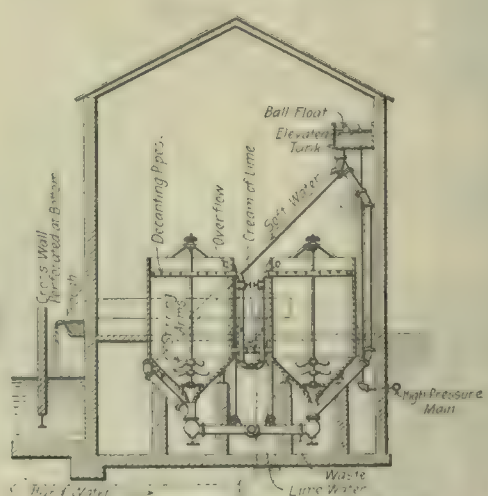


Fig.124

GENERAL ARRANGEMENT OF SOUTHAMPTON SOFTENING WORKS.

MR. WILLIAM MATTHEWS, M. INST. C. E., CORPORATION WATER-WORKS ENGINEER.

which throws the residue to tanks on the hill above, where it is allowed to settle. The clarified water is drawn off to the softening tanks, and the waste lime is discharged into a pit.

The lime water, after entering the perforated pipes, passes through a main to the lime-water measuring box in the baffle plate channel, where the hard water is delivered from the pumps. The lime water falls out of this box over a weir into the stream of hard water, and the two become thoroughly mixed by the baffle plates before entering the softening tank. After passing the baffles the mixture runs into an elevated trough across the end of the softening tank, and falls over the outer lip of the trough into the tank, behind a wall having perforations along the bottom.

The flow of water to the measuring box and the proportion of water and lime can be regulated by suitable valves. The quantities of flow of hard water from the pumps and of lime water from the tanks are indicated by gauges operated by floats, and the quantity of lime water can be varied to suit the flow from the pumps. Figure 126 gives a sketch section of the gauges for judging the flow of lime water and hard water. The float chamber for the hard-water indicator does not communicate directly with the water between the baffle plates, but with the service pipe from the low-pressure pumps, in order to lessen the vibration. The scale of the hard-water indicator is divided to show the flow in gallons per hour, and the scale of the lime-water indicator shows the proper quantity of lime water to add. This is regulated by the valves drawing the lime water from the tanks.

The softening tank is 76 feet long, 44 feet wide and 6 feet deep along one side and 7 along the other. It holds approximately one hour's supply for the city; one hour being sufficient time to allow of the complete chemical reactions. There is scarcely any deposit in the softening tank, the crystals of lime remaining in suspension. The tank does not ordinarily require cleaning more often than once a month.

After passing through the softening tank the water is taken through 19 Atkins filters, which remove the crystals of lime and deliver the clear softened water into a tank beneath the floor of the filter room, from which it flows to the pumps. As a rough approximation, six filters are required for each million gallons of water. Each filter consists of a hollow shaft having longitudinal slots, on which is mounted a series of hollow perforated disks, separated from each other by collars. The faces of the disks have a diameter of 3 feet, and they are made of perforated zinc. Over the faces cotton cloths are tightly stretched. There are 20 of these hollow disks to each filter, making 40 filtering surfaces. The cloths are held over the disks by iron rings pressed over the edges, the rings on opposite sides of a disk being bound together by copper wire. The hollow shaft containing the disks is mounted in an iron tank, one end of the shaft passing through the end of the tank through a stuffing box, and connecting with the discharge to the filtered water tank and with a bypass to the waste drain. The shafts are arranged so that they may be rotated in the tank by gearing, and may be lifted out of the tank by an overhead crane for the purpose of renewing the cloths. The latter are cleaned of the deposit of crystals by a spray of water driven against them as they are slowly rotated.

The cloth is of cotton, specially made for the purpose, and has a linty surface, neither very loosely nor very tightly woven. Its average life is about three months, wearing out sometimes in two months and lasting often as long as four months. As there are nearly 5,000 square feet of filtering surface in the 19 filters there is an average of perhaps 50 square feet of cloth worn out daily in the filtering of about 3,000,000 gallons, or of approximately 16 square feet per million gallons filtered. The wear is said to be mostly from washing. The crystals in the water get into the meshes of the cloth and cut it when washed out by the high-pressure spray. When newly put in the cloths are not so effective as they become after a little use, when the mesh of the cloth gets partially clogged. The life of the cloth is apparently also affected by the quality of the lime used in making the lime water, as it has been observed that when using chalk of high purity the cloths lasted much longer than when using the chalk obtained nearer the surface and containing adulterating matter. The crystals of carbonate of lime washed from the filter cloths are taken out, in the wash water, by a drain to the four tanks, where the crystals settle down. After sedimentation has taken place the clear water is run back into the headings. The lime thus precipitated is a waste product so far as is at present known.

The cost of softening the water has been about half a cent per thousand gallons for operation and about half a cent additional for capital charges, making in all 1 cent per thousand gallons as the cost of the water softened and delivered to the pumps. The operation of the plant requires skillful workmen and close attention to duty. The tank for the softened water after filtration is very small, and if the filters were not kept clean and closely watched the supply of water would run so short that the pumps would have to be stopped. The pumping plant, machine shop and other accessories to the works are of much interest and contain special features that have called out much ingenuity and originality in their execution. The writer is indebted to Mr. William Matthews for the pleasure of a visit to these interesting works.

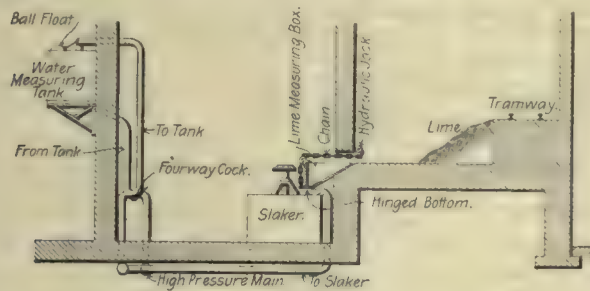


FIG. 117

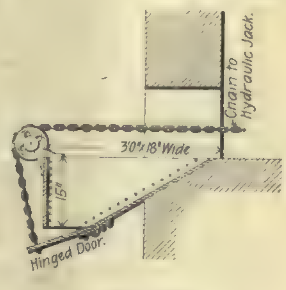


FIG. 118

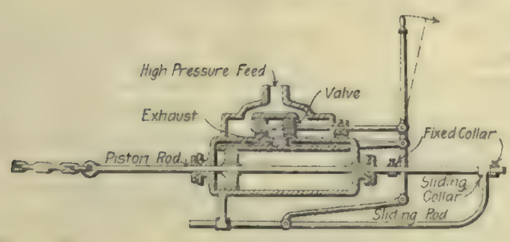


FIG. 119

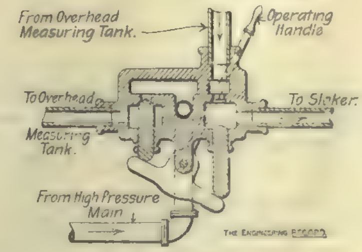


FIG. 121

LIME MIXING APPARATUS, SOUTHAMPTON, ENGLAND.

THE NEW MASONRY DRY DOCK AT BOSTON.

The Bureau of Yards and Docks of the Navy Department opened bids this week for a large dry dock in the Navy Yard at Boston. This is to be 788 feet long on the coping from the head to the outer end of the table, 750 feet long on the coping from the head to the outer gate sill, 729 feet long on the floor from the head to the outer gate sill, 689 feet long on the floor from the head to the inner abutment, 114 feet wide on the coping in the body, and 72 feet wide on the floor, 102 feet wide on the coping at the abutment, 100 feet wide at the entrance on the mean high-water level and 39 feet deep from the coping to the floor in the body. The draft over the sill at mean high water is 30 feet. The accompanying outlines of the head and entrance of the dry dock show its general features.

The structure is to be built either of stone masonry or concrete and stone masonry. The body is to be granite in all wearing parts, but the invert may be of either limestone or granite where covered by concrete. The coping stones are to be not less than 2 feet thick, 3 feet wide and 4 feet long, and rounded on the upper edge to a radius of 4 inches. At least one-eighth of the entire area of the face of the wall must be headers. All the stone masonry of the wall and the entrance of the dock is to be ashlar, in continuous courses and patent hammered on the face, six-cut work. This ashlar must be of granite of a quality approved by the engineer, and of a specific gravity not less than 2.7. All masonry not included under ashlar may be of rubble consisting of stones of such thickness that two courses shall equal in height the course of face work, the stones being large and well shaped. The beds may be natural or rough dressed, to form joints not exceeding one inch in thickness. The concrete is mixed in the proportion of one part of Portland cement, two of sand and five of broken stone or gravel. The cement is to be measured as it is delivered, packed in barrels. The quality of the broken stone is not specified, but if gravel is used it must be of silica of acceptable size and quality. The concrete must be mixed in the following manner:

"The sand and cement shall be thoroughly and evenly mixed, dry, on close platforms, after which water will be added in the form of a spray, until the paste assumes a proper and uniform consistency. This mortar will then be spread uniformly over the gravel or broken stone, which shall have been previously thoroughly moistened and spread in an even layer on the mixing platform. The ingredients shall then be thoroughly mixed and incorporated by being turned over at least three times previous to being conveyed to the place of deposit. It shall be deposited in layers not more than 9 inches in thickness, and thoroughly rammed until water appears on the surface. The surface of each layer is to be thoroughly moistened before the succeeding layer is deposited upon it, and if it has been exposed a long time it must be dusted with neat cement after it has been watered. In laying the concrete, where not too deep, the contractor shall take up for construction a length that can be completed in one day, and finish off in steps to where the work is to begin on the following day, and then have the work start in a bed of 2 inches of neat cement after the surface has been cleaned, the object being to avoid horizontal joints. All concrete newly started on a dry surface should be bedded in 2 inches of neat cement."

The cement specifications were unusually elaborate, and are reproduced in full:

"1. The cement is to be of the best grade or quality.

"2. The contractor shall give a certificate to the effect that the cement furnished has been seasoned or subjected to aeration for at least 30 days before leaving the works.

"3. The cement is to be packed in strong and well-coopered barrels lined with moisture-proof paper. The gross weight of the barrel is not to be less than 400 pounds; the weight of the cement not to be less than 375 pounds.

"4. Immediately upon receipt, the cement is to be stored in a dry, well covered and ventilated place, and thoroughly protected from the weather.

"5. Of every lot of 800 barrels or more, the contractor shall supply an abstract of the chemical analysis of a mixed sample of the cement taken from any 10 barrels of the lot. Specific gravity shall not be less than 3.

"6. Samples of the cement are to be taken with a suitable instrument from the interior of the barrels. Samples are to be taken from every fifth barrel in lots of 20 or more up to 100 barrels. If more than 100 barrels are to be tested, then a sample is to be taken from every tenth barrel. If less than 10 barrels are to be tested, the samples are to be taken from at least 3 barrels. The separate quantities so taken shall be mixed thoroughly together while dry, and the compound regarded as the sample for test.

"7. Ninety-five per cent., by weight, must pass through a No. 100 sieve having 10,000 meshes per square inch, the wires to be No. 40, Stub's wire gauge, and 75 per cent., by weight, must pass through a No. 200 sieve having 40,000 meshes per square inch, the wire to be No. 28, Stub's wire gauge.

"8. All neat cement for test is to be mixed on glass with clean fresh water of a temperature between 60 and 70 degrees F.; the quantity of the water to vary between 20 and 25 per cent., by weight, of the quantity of cement used.

"9. Cakes of the paste, mixed as specified in paragraph 8, are to be molded on glass; these cakes to be circular in shape, about 3 inches in diameter, ½ inch thick in center, and drawn down to ⅛ inch at circumference.

"One cake is to set in air and one to set immersed in water. Two wires are to be used to determine the setting quality: The first, called wire A, is to be one-twelfth inch in diameter at the lower extremity and loaded with one-quarter pound at the upper end; and the second, called wire B, is to be one twenty-fourth inch in diameter at the lower extremity and loaded with one pound at the upper end. Cement will be considered as quick setting if it bears needle A without making an indentation at the end of 30 minutes after having been mixed; and as slow setting if needle B makes an indentation during any time between one hour and six hours after having been mixed. The slow-setting cement must have its final set at the end of eight hours, that is, it must bear needle B without being indented by it.

"10. A small quantity of the sample cement specified in paragraph 6 is to be mixed with only sufficient water to give it the consistency of wet sand, and is to be immediately pressed into glass tube of about ½ inch in diameter. Within two or three days any swelling will be shown by the glass bursting; or shrinkage by the cement becoming loose in tube. Either defect is a cause for rejection of the cement.

"11. Three cakes of neat cement are to be prepared as specified in paragraphs 8 and 9. One cake, after having set hard on the glass on which it was molded, is to be immersed in cold water, and examined from day to day during a period covering 7 or 27 days. If it warps, checks on surface, cracks at edge, or leaves the glass, such defects are cause for rejection of the cement.

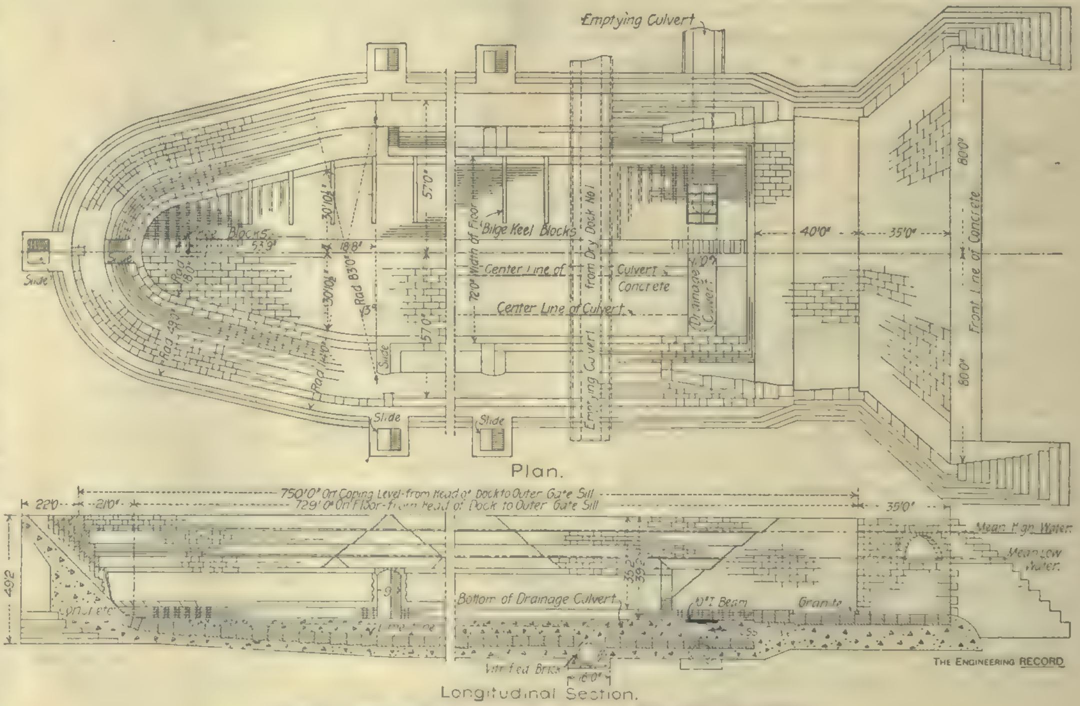
"The second cake is to be kept in air of the prevailing outdoor temperature and humidity, and at the end of either 1 week or 4 weeks it should exhibit none of the defects enumerated above, but should be uniform in color, constant in volume, and adhere to the glass.

"The third cake is first to set hard on glass in moist or humid air, and then to be immersed in water at a temperature of 212 degrees Fahr. for a period of 24 to 48 hours. At the expiration of this time, the defects previously described in this paragraph should not appear; if they do, it is the cause for the rejection of the cement.

"12. The sand that is to be mixed with the neat cement for compounding the mortar briquettes for test shall be No. 4 standard crushed quartz passing through a No. 20 sieve (400 meshes to the square inch), wire to be No. 28, Stub's wire gauge, and it shall be caught on a No. 30 sieve (900 meshes to the square inch), wire to be of No. 31, Stub's wire gauge.

"13. Neat briquettes: Moisten the cement with 20 to 22 per cent. of water, mixing and kneading it quickly by hand, using rubber gloves as a protection. When thoroughly worked, fill the molds at once, having first wiped them on the inside with an oily cloth to prevent sticking. Mortar briquettes: One part, by weight, of cement to three parts, by weight, of the kind of sand specified in paragraph 12, shall be thoroughly incorporated while dry and then moistened with 10 to 12 per cent. of water in the manner specified above for neat briquettes.

"Both the neat and mortar briquettes shall be prepared by the Bohme hammer apparatus, which is a tilt hammer with automatic action.



HEAD AND ENTRANCE TO THE NEW BOSTON DRY DOCK.

The hammer is driven by a cam wheel of 10 cams actuated by simple gearing. The steel hammer weighs 4½ pounds, and when the intended number of blows has been delivered, the mechanism is automatically checked; the proper setting having been made for this purpose before beginning the work. The number of blows for each briquette shall be 150. The briquettes while drying in air should be covered with a damp cloth to prevent rapid surface drying, and to conduce to uniform set.

"14. The neat briquettes, prepared as specified in paragraph 13, shall stand a minimum tensile strain per square inch, without breaking, as follows:

After 12 hours in air and 12 hours in water ....200 lbs.
After 1 day in air and 6 days in water..550 "
After 1 day in air and 27 days in water.650 "

"The mortar briquettes, prepared as specified in paragraph 13, shall stand a minimum tensile strain per square inch, without breaking, as follows:

After 12 hours in air and 12 hours in water ....150 lbs.
After 1 day in air and 6 days in water..200 "
After 1 day in air and 27 days in water.250 "

"Notes.—The boiling-water test is designed to ascertain the durability of the cement, and it is intended to show in a few hours what would require a long period otherwise. This test is supposed to show whether an excess of free lime is in the cement. Some cements stand well for short periods, but disintegrate after 3 or 4 months, due to an excess of free lime.

"In making the mortar briquettes, the sand and cement should be thoroughly mixed while dry, and then the specified percentage of water added quickly.

"The neat tests are of less value than those of the briquettes made with sand and cement. The fineness of the cement is important; for the finer it is, the more sand can be used with it.

"Good cement should be a uniform bluish-gray color throughout; yellow checks or spots indicate an excess of clay or that the cement has not been sufficiently burned; and it is then probably a quick-setting cement of low specific gravity and deficient strength.

"A cement that will stand a high test of seven days may have an excess of lime, which will cause it to deteriorate. The 28-day test is, therefore, very useful.

"The trip hammer machine for making the briquettes removes all variability in their preparation.

"The most dangerous feature in Portland cement is the presence of too much magnesia and an excess of free lime, the latter indicated by the cracks and distortions in the test cakes, and the former in the deficiency of tensile strength of the briquettes. Over 3 per cent. of magnesia is excessive and dangerous.

"The cement that is to be made in briquettes and cakes should not be sifted, but it is to be used exactly as it comes from the barrels or bags.

"Five briquettes should be broken to test the tensile strength, and the extreme variation between the mean of the five should not be over 15 per cent.

"The test for change of volume is very important, for expansion in any work into which the cement enters would be fatal to soundness and reliability.

"The test cakes should be made by rolling the cement into balls and then flattening.

"The expanding, cracking, and disintegrating of the cement is technically called 'blowing.'

"If the cake, at the end of three days in water, shows no signs of cracking or disintegrating at the edges, it can be considered safe.

"In examining the cakes for cracks, the fine hair-like cracks found on the surface, that cross and recross each other, are not due to 'blowing,' but are merely the result of changes

of temperature. They do not denote a poor cement.

"The cracks due to 'blowing' are wedge-shaped, radiating from the center and usually accompanied by a certain amount of disintegration, especially at the edges.

"Either a Fairbank's or Riehle's machine should be used for breaking the briquettes in the test for tensile strength."

Four sub-floor culverts with concrete floors and sides run from near the head of the dock to near the abutment, where they join a semi-circular cross-culvert of 6-foot radius. This cross-culvert has a concrete floor and arch, stiffened under the keel blocks with steel I-beams and opening into the sump of the main drainage culvert. This last is 8 feet in diameter, and extends from the body of the dock to the water chamber of the pump well, and is formed of concrete lined with glazed brick. The floor of the dock has an opening over the end of the drainage culvert, covered by a 10 x 16-foot iron grating. A culvert similar in all respects is to be built from the pump-well chamber through the foundation of the dock to a point 68 feet beyond the center of the dock. Both culverts are to be closed by mechanically-operated balanced gate valves at the points where they enter the pump well chamber. A discharge culvert of semi-circular cross-section with a radius of 9½ feet, resting on a timber foundation, is to be built from the pump house through the entrance wall of the dock.

Three electric power capstans are to be installed on each side of the dock, which will also be furnished with three electric winches rated at about 25 kilowatts each.

The pumping plant will comprise two vertical, cross-compound condensing automatically governed engines, each direct-connected to two dynamos, and four boilers with the necessary pipes and fittings to be installed in the Bureau's electric station at the yard. The contract drawings call for three centrifugal pumps for emptying the dock with separate independent motors, and a centrifugal pump and motor for drainage. The pumps must be of the type admitting water on both sides of the disk, and the runner-shaft direct connected to the armature shaft. These plans show one motor attached to each pump so designed as to give an average discharge of 43,000 gallons per minute by each pump during the time required to empty the dock. Bidders were allowed, however, to submit plans, using two motors to each pump, but any changes from the Bureau's plans had to be accompanied with a guaranty for the entire plant of a mean discharge of 135,000 gallons per minute, measured while pumping from the mean high-water level to the floor level, with an efficiency of machinery in the pump well of not less than 55 per cent. During the time of pumping out the dock the level of the water outside the caisson is supposed to fall from 34 to 31 feet over the floor level. The main pumps contemplated by the Bureau have a six-vane runner about 79 inches in diameter, a single 45-inch discharge pipe and two 32-inch suction pipes joining the pump casing through quarter-turn bends on each side of the runner, so as to balance the latter. The drainage pump has a 34-inch runner and 14-inch suction and discharge pipes. The Bureau's plans for the electric outfit comprise four 200-kilowatt dynamos of the compound wound, direct current, constant potential, 125-volt type. The specification reads: "The commercial efficiency of the dynamos must be not less than the following amounts: full load, 92 per cent.; half load, 90 per cent.; quarter load, 85 per cent." The motors provided for in the general plans are three of 300 kilowatts and one of 50 kilowatts. The engines when running condensing with 100 pounds initial steam pressure and 26 inches vacuum are required to be able to work continuously with a load of 600 indicated horse-power using not more than 15½ pounds of dry steam per indicated horse-power per hour. The working boiler pressure is to be 125 pounds, and the speed 150 revolutions per minute. Water tube boilers are specified.

SOUTH MARKET STREET BRIDGE, YOUNGSTOWN, O.

South Market Street, Youngstown, O., crosses the Mahoning River and Valley on a 4 per cent. grade, and is carried by a steel viaduct 1,610 feet long. This supports a 40-foot roadway and two 7-foot sidewalks, 96 feet above the water. About 978 feet of the structure is made up of plate girder approach spans, 30, 60, 75 and 90 feet in length, which are supported on towers 28 feet wide and 30 feet long. The towers have vertical columns braced on every side with horizontal struts, and latticed angle diagonals with riveted gusset plate connections. The bracing terminates at the bottom about 20 feet above the ground with horizontal plate girder struts and curved solid web portal knee braces to take up the lateral strains and afford unobstructed head room for street traffic. The river crossing is an arch span having two segmental plate girder two-hinged ribs, 210.58 feet long between centers, 60 feet rise and 122.38 feet radius. These ribs are 28 feet apart, are divided into 16 nearly equal panels by horizontal cross struts, and are braced by pairs of angle diagonals each running across two panels. Vertical columns at the skewback and at six intermediate points carry two triangular riveted longitudinal roadway trusses in the planes of the arches, and these roadway trusses are, by means of some false members, combined with essential members, apparently extended through the tops of the triangular trusses of the 165.45-foot side spans. The river ends of the 165-foot spans are supported on rocker bents 25 feet high that engage the main skewback pins, and besides these expansion adjustments five intermediate roller bearings are provided at differ-

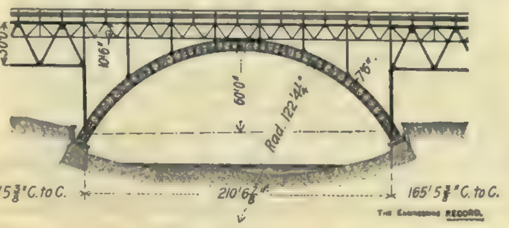


FIGURE 1.—ELEVATION OF ARCH SPAN.

ent places in the approach viaduct, and one at each abutment. The tower piers are of concrete with sandstone caps, and the abutments and skewback masonry are of sandstone, all carried down to the solid rock.

The material of the superstructure throughout is medium basic open hearth steel, except for the wrought iron diagonal rods, and is proportioned in accordance with Thacher's highway bridge specifications of 1894, providing on the viaduct for a live load of 80 pounds per square foot on the sidewalks and 90 pounds per square foot on the roadway, or a 15-ton roller with 10-foot base or a 20-ton traction engine with a 12-foot base. On the arch the dead load was assumed at 6,200, and the live load taken at 4,720 pounds per lineal foot, giving the following results: moments: dead load, 972,000 foot-pounds; live load, 2,054,000 foot-pounds; temperature, 368,000 foot-pounds; total, 3,394,000 foot-pounds. Thrusts, dead load, 335,200

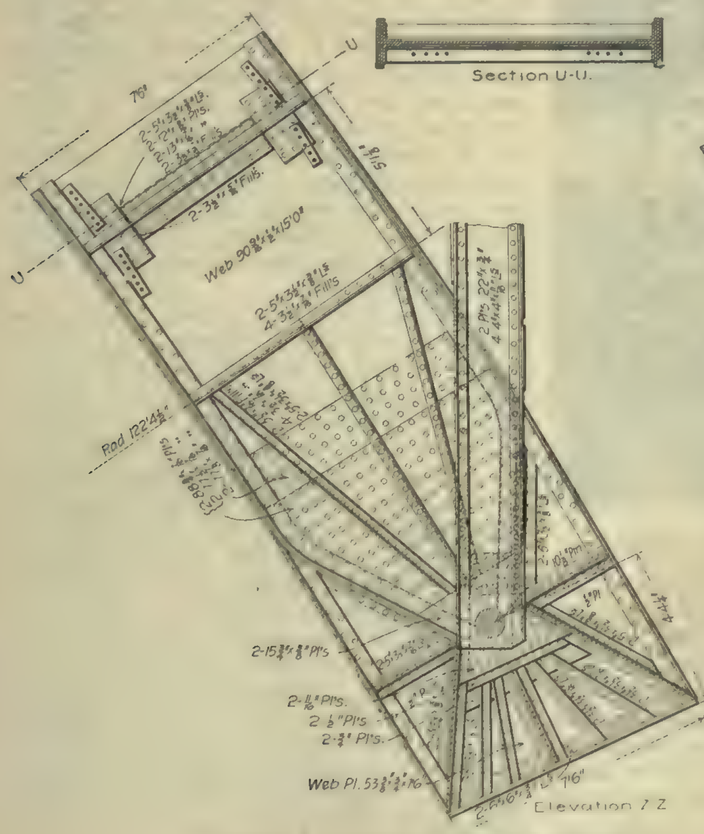


FIGURE 2.—PEDESTAL AND ARCH DETAILS.

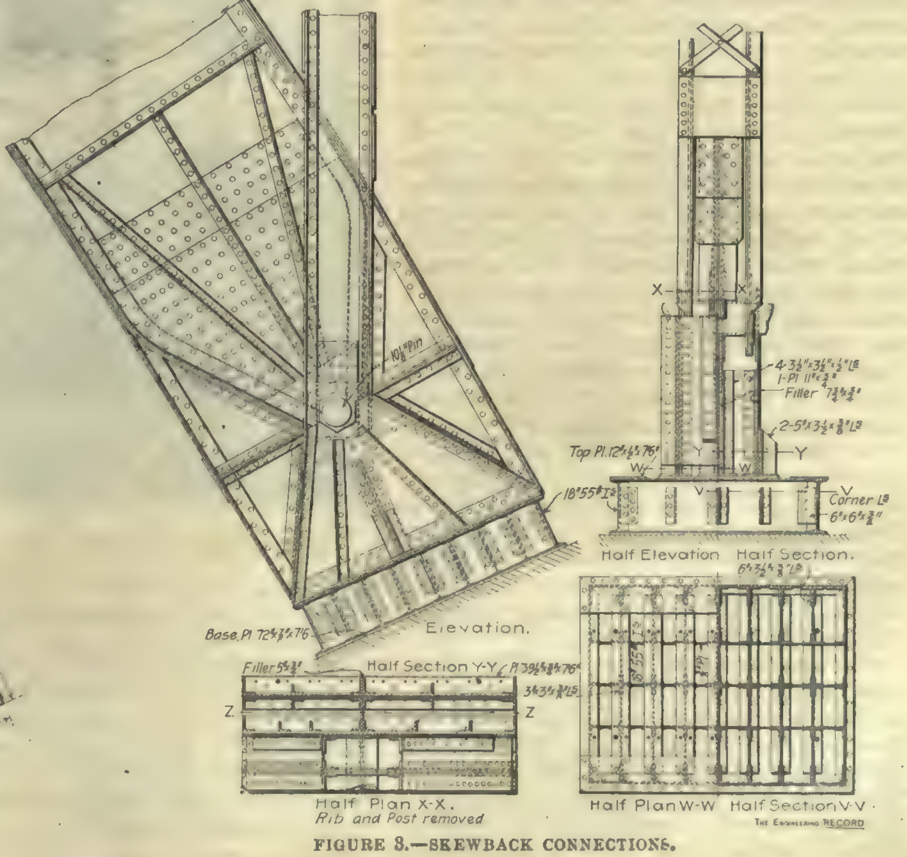


FIGURE 3.—SKEWBACK CONNECTIONS.

FIGURE 4.—FALSEWORK FOR ERECTION OF ARCH SPAN.

pounds; live load, 178,000 pounds; temperature, 7,700; total, 520,900. Total maximum shear, 115,400 pounds. The unit stresses permitted were, in tension, 10,500 [1 + (m ÷ M)] for built members, 18,000 for lateral angles, 20,000 for lateral rods. In compression 13,750—577 (l ÷ r) for two flat ends; 13,750—642 (l ÷ r) for one flat and one pin end; 13,750—707 (l ÷ r) for two pin ends, $\frac{11,700}{1+0.288(L^2 \div b^2)}$ for top flange riveted beams; $\frac{12,500}{1+0.288(L^2 \div b^2)}$ for top flange rolled beams. In the above formulas m = minimum stress, M = maximum stress, l = length in feet from center to center of connections, r = least radius of gyration of member in inches, L = unsupported length of flange in feet, and b = width of flange in inches. Eleven thousand and 19,000 pounds per square inch were allowed throughout for shearing and bearing strains respectively. The arch ribs were each made with one 90 x ½-inch web plate, two 6 x 6 x ⅞-inch angles, and three 16 x 11/16-inch cover plates in each flange. The floor beams were 54 feet in total length, having a 13-foot cantilever projection beyond each truss. Their calculated flange strain was 89,500 pounds, and they were constructed with 32 x 5/16 inch webs and 5 x 3½ x ½-inch chord angles. Horizontal lateral braces cross two panels of the floor beams throughout, and are composed of single and double pin connected rods from 1 inch round to 1¼ inches square.

The bridge was erected from one end by an overhead traveler, which ran on top of the completed viaduct, and assembled it panel by panel in advance. This traveler consisted essentially of a transverse framed bent of 12 x 12-inch timbers, 28 feet wide and 30 feet high, with a 30-foot boom on each side. The vertical bent was set on the forward end of a timber frame 40 feet long, to which it was stayed by diagonal side planks spiked on and by steel rods guying it from the top of the mast to the rear of the frame. These rods had sleeve nut adjustments and were pin connected to iron gusset plates, which were bolted to the timber. Each boom was fitted with a five-part manila tackle for topping and another for hoisting, and had a capacity of 20,000 pounds. The traveler was skidded along on the floor stringers of the completed viaduct, and had a sufficient overhang to assemble the work 30 feet in advance, material farther out being handled with a gallows frame. Falsework was built under the side spans next the arch, and the traveler was moved progressively over them to the river span, which was supported on framed falsework about 75 feet high, as shown in Figure 4.

The spandrel work and roadway system were carried on as the arch rib sections were set from one end to the other, the traveler continuing on top of the roadway from which it handled the material at the main span. The arch ribs were set on cribwork blocking on top of the falsework caps, with pairs of oak adjustment wedges, which were slacked off about 2 inches in the center to swing the span. The segments of the arch ribs were received from the shops in straight sections about 30 feet long, weighing 20,000 pounds each, maximum. They were hand riveted in the field, with web and flange plate splices, all joints being reamed in place with an air reamer. The last connection was made at the joint nearest the second skewback. All material was delivered on top of the bank at one end of the bridge, and taken to the traveler by trucks running on a low trestle alongside the viaduct, and was received by the main booms, swinging to the side through an arc of 90 degrees. Material was handled by one four-drum hoisting engine.

A general elevation of the arch span and adjacent ends of the side spans is shown in Figure 1. The skewback connections are shown in Figure 3, which is made partly in center cross-sections to give interior construction. A side elevation of the center web of the pedestal

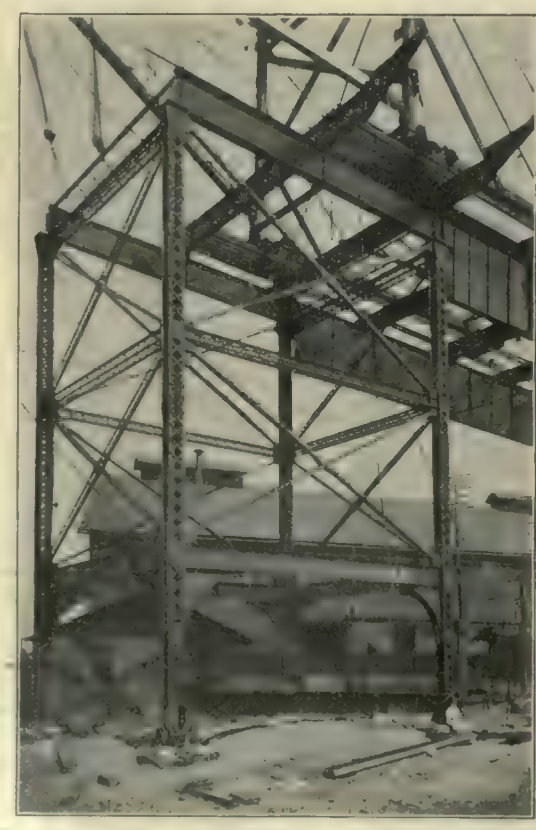


FIGURE 5.—COLUMN BRACING AND CONNECTIONS.

and details of the connected arch girder are shown in Figure 2. Figures 2 and 3 are symmetrical about their center lines. The end section of the arch rib is built up of four 6 x 6-inch curved angles and a ½-inch web plate, reinforced with two web plates, one pin plate and three radial 5 x 3½-inch stiffener angles on each side. Each chord has three 16-inch flange reinforcement plates, and has the lines of the parallel flanges continued to the pedestal by web plate gusset brackets between the beveled end and the pedestal. The pedestal has a ¾-inch planed base plate 7½ feet long by 8 feet 3½ inches wide, to which three vertical ribs are connected by two 6 x 6-inch angles each. The middle web is double, and it and the side webs are reinforced by pairs of 5 x 3½-inch and 3½ x 3½-inch radial angles, and by pin plates, and are connected by vertical transverse diaphragms in the plane of the axis of the skewback pin. The planed base plate of the grillage shoe is 72 x ⅞ x 90 inches, and its 18-inch I-beams weigh 55 pounds per foot, and are connected by three transverse lines of vertical diaphragms and by transverse end beams mitered into the flanges of the side beams and web riveted to the ends of the intermediate beams, as shown in plan, Figure 3. The falsework and traveler for the erection of the arch span are shown in Figure 4, and one of the viaduct approach towers and part of an adjacent girder span with the lower portion of the erection traveler on the floor beams on top is shown in Figure 5, where the details of portal bracing and column connections may be seen.

The bridge was designed and built by the Youngstown Bridge Company, under direction of Mr. C. E. Fowler, M. Am. Soc. C. E., as chief engineer, to whom acknowledgment is made for the data from which this description has been prepared. Mr. A. H. Heller and Mr. E. M. Scofield were Mr. Fowler's assistants in the calculation and design of the work, and the general specifications were prepared by Mr. D. M. Wise, county engineer. Mr. A. L. Wymer was superintendent of erection.

REFUSE DISPOSAL AT BARREN ISLAND, NEW YORK.

As a result of the large number of complaints received from portions of Greater New York in the neighborhood of Barren Island the Board of Health last fall named a special committee, consisting of Mr. Bernard J. York, President of the Police Board and member of the Board of Health, and Dr. William L. Jenkins to secure reports on the manufactories located on the island. This committee ordered Chief Inspector Edward L. Martin of the Third Division of the Health Department, Mr. Joseph B. Taylor, inspector of offensive trades, and Mr. John Bogart, M. Am. Soc. C. E., consulting engineer, to make individual inspections and reports, from which the following information has been obtained:

There are four companies upon the island which have plants for disposing of organic refuse as follows: P. White's Sons, horses and dead animals, fish from markets, hotel refuse and offal from slaughter houses, etc. E. J. McKeever, horses and dead animals and offal. The E. Frank Coe Fertilizer Company, fertilizer made from phosphate rock, dried blood, dried fish, potash and sodium nitrate, and the New York Sanitary Utilization Company, which treats the garbage from the boroughs of Manhattan and Brooklyn.

The plant of P. White's Sons, with 80 men, and working at its full capacity, can treat 200 horses, 60 tons of offal and 60 to 70 tons of hotel refuse per day. The material is brought on steam lighters and hoisted to the second floor of the building. The skins are removed from the carcasses, dropped to the floor below, washed in the water of the bay and then spread in layers on the floor with rock salt until sold. The garbage and carcasses are put into digesters separately and treated with steam under pressure. The digesters are inclosed cylindrical vessels of steel 5½ feet in diameter and 10 feet long, set on end, and projecting about one foot above the second floor, to which they fit tightly. Steam is admitted under 35 pounds pressure through two pipes at the bottom of the digester, and the whole mass is cooked from four to eight hours. On the top of the tank is a pipe with a valve to blow off the gases after the completion of the cooking.

The material is introduced through a door in the top, hung on hinges and fitted with a locking device and gaskets to prevent the escape of gases and odors. There is a similar door on the side, near the bottom, from which the solid material is drawn after treatment. About on a level with this door is a perforated plate, which acts as a strainer and allows the liquids to be drawn off without disturbing the solids. The lower end of the digester is conical in shape and terminates in a gate valve through which the liquids are withdrawn. The solids settle on the bottom, with water and grease on top, and the latter is skimmed off by hand scoops and removed through the door on the top of the digester. It is sent to washers and cleaned with water and then conveyed to the bleachery, which has a glass roof, where it is exposed to the sunlight, and then barreled and sold. The water is drawn off from the bottom of the digester and runs to a gurry tank, which is flush with the floor and constructed as a grease trap. Heat is applied and the grease which escaped the skimming is recovered here. The water is then run into Jamaica Bay.

The wet tankage is removed from the digesters and placed in layers, separated by gunny sacking, in a strong iron cylinder open at one end with perforations in its sides, where it is subjected to hydraulic pressure. The water which is squeezed out is taken to the gurry tank. The tankage is then sent to the dryers, which are steam-jacketed horizontal cylinders, 5 feet in diameter, 15 feet long and provided with a central shaft, carrying stirring arms. The shaft is revolved by gearing and cascades the material to facilitate the liberation of the moisture. After being in here three or four hours the dry tankage is removed, screened and stored in bags until sold.

The bulk of the vapors come from the digesters, and are conveyed through pipes to a water condenser or scrubber, where most of the gases are condensed. Those which are not are passed over the fires under the boilers and burned. The general condition of the plant is very good, the buildings are of wood liberally whitewashed, spacious, well lighted and ventilated, and there is very little odor. The condenser is not up to the rest of the plant, as it is of wood and leaks, and the supply of water is too small. The liquid from the gurry tank, which is discharged into the bay, is really a soup and rapidly spoils. Its discharge into the bay is deprecated in the reports, as it is now possible to otherwise dispose of it. It is not believed that the odors from this plant reach the mainland.

E. J. McKeever's plant treats the dead animals and offal from the Borough of Brooklyn with a small amount of butchers' bones, and the process is similar to that of P. White's Sons. There are ten digesters like those described above, and three larger ones on a new system which are about to go into use. The buildings are frame, and in very good condition, being practically new, and there is a liberal use of whitewash and water. To overcome the offensive gases resulting from puncturing the distended stomachs of dead animals it is proposed to use new methods of work and burn the gases. The vapors from the cooking are taken by pipes to a large iron receiver, which is connected with a jet condenser of the spirojecter type. By this means there is no escape of odors in the gurry tank, as the liquids are not drawn off until they have cooled below the vaporizing point. The dryer is also connected with the condenser. The effluent water and gurry liquor are taken fresh each day and evaporated in a Yaryan double-effect vacuum evaporator consisting of two horizontal cylinders with a series of coils inside. The liquor is circulated, under a vacuum, through the coils, which are surrounded with steam. The moisture is rapidly removed, the liquor entering one end of the machine and emerging from the other as a thick viscid substance known as "stick," which is mixed with certain proportions of undried tankage and dried. It it not believed that the odors from this plant travel beyond 500 feet.

The E. Frank Coe Fertilizer Company purchases fish scrap, muriate of potash, Charleston rock, tankage, dried blood, etc., and manufactures finished fertilizers. The materials are mixed in varying proportions, ground in a mill and placed in bags for shipment. The mixing is done in large shallow pans, and sulphuric acid is added. The mixture is then drawn out through the bottom of the pan and conveyed in chutes to the desired location, where it is ground in mills. The most objectionable odors are given off while the acid is being added in the mixing pans. The pans are covered and the odors drawn off by a blower and conducted to a water condenser, which is considered in the reports to be open to improvement. There is a local odor from the stored fertilizer, but no odor was noticed further away than 500 feet. The capacity of this plant is 300 tons of fertilizer in ten hours. It is run only between the first of October and the end of May.

The New York Sanitary Utilization Company treats the garbage of the boroughs of New York and Brooklyn by the Arnold system in two plants which are practically the same. The works of this company are the principal cause of complaint. The garbage is brought to the plant in scows and shoveled into flight conveyors, which carry it to the top of the building. While in the conveyor tin cans, berry boxes, etc., are all removed by hand. The garbage is discharged into digesters, which are each 5½ feet in diameter and 14 feet long. Each digester has a conical bottom with gate valves, and discharges into receiving tanks below. The garbage is cooked with steam from 6 to 8 hours, and is not strained when discharged into the receiving tanks. These tanks are about 12 feet above the lower floor, and the material flows by gravity into presses made up of frames and mats. The liquid from the presses is run into traps, where the grease is separated. The tankage is dried by steam, and then screened and bagged.

A triple-effect evaporator with a capacity of little more than one-half the quantity of the effluent reduces it to stick, which is mixed with dry tankage and dried in an Anderson hot-air drier. The scows take 4 to 6 hours in transit, and in 10 hours after unloading the garbage is manufactured into oil and fertilizer. The gases from the digesters are condensed in an 8-inch pipe, through which water from the bay is pumped, and then returned below tide water. Smith's disinfecting powder is used about the plant, and "sanitas" on the scows. The latter are also washed after unloading with hot water and then sprinkled with "sanitas" and lime.

From this plant there are two sources of odor, one the decomposing garbage as it arrives on the scows and is carried into the building, and the other is the cooked material. The plant is stated to be only fairly clean in the reports, but this is due more to the nature of the process than to any carelessness of the employees. During the summer months the garbage arrives in various stages of decomposition, and gives off very offensive odors, which are carried by the wind to considerable distances. The use of rubber tarpaulins to cover the garbage on the scows is not approved, as it causes sweating, and so does more harm than good. The odors from the cooking are disposed of in jet condensers and are no nuisance.

Most of the odors come from the pressing. The steaming garbage rushes from the receiving tanks to the mats on the presses, splashing over the floors and the workmen in a very offensive manner. The odor given off has a sweetish smell at first, but afterward becomes very offensive. It is said to be due primarily to the production of sugar by hydrolysis of the carbo-hydrates in the garbage, the sugar decomposing with the formation of caramel. This caramel odor will carry for miles in a distinct strata or stream, the line of demarkation between the tainted and untainted air being very distinct. The prevention of its escape is a difficult matter. If the garbage were cooled before being removed from the receiving tanks there would be a very large loss of grease, which would materially reduce the profits. The collecting of the vapors by fans and cremating or condensing them has been suggested, but the handling of the large volume of air necessary does not make this a very practicable method. The vapors from the driers are cared for by condensers, and on humid days the heap of undried garbage steams considerably.

Among the miscellaneous sources of nuisance the discharging of part of the effluent into the bay is mentioned. The filling of land with banana stalks, berry boxes, etc., and the tailings from the tankage screens is also condemned. The recommendations were as follows:

The Sanitary Utilization Company should build a shed under which the scows should be floated and unloaded by machinery. All openings and windows should be closed, and the requisite air furnished by fans or blowers, and drawn off and discharged into scrubbers with water greatly in excess of the theoretical amount. This water should be charged with a deodorizer, preferably hypochlorite of soda, and pumped under tidewater, and everything should be erected in duplicate. It is considered absolutely necessary to have air-tight buildings with provision for forcing in and drawing out the air. All gases which cannot be condensed should be passed through a bed of red-hot coals. New boats should also be provided of a size not to hold more than the amount of garbage collected in 12 hours, or in 18 hours at the most. They should be closed in a reasonably tight manner, and the air outlets sealed with 1 or 2 inches of water.

SEWAGE SLUDGES.

At a meeting of the Institution of Civil Engineers of Ireland, held some time ago, Dr. W. E. Adeney, curator in the Royal University at Dublin, presented a paper containing an interesting discussion of a method of treating sewage sludges so as to prevent their "after-putrefaction," not by the use of antiseptics, but by supplying the conditions necessary for their slow combustion by bacterial agencies, or, in other words, by furnishing the necessary conditions for their aerobic fermentation. The paper is presented herewith in a slightly condensed form.

It may be stated at once that it is practically easy to insure these conditions in sewage sludges if suitable substances are used in the clarification process in purification works, such compounds as those of the element manganese, for example. The marked efficiency of the compounds of this element in sewage clarification has been admitted by a number of observers, but the true explanation of the cause has only recently been discovered. During some of Doctor Adeney's earlier experiments on sewage, some years ago, he made one to ascertain whether sewage after treatment with an excess of a neutral solution of permanganate of potash would suffer, without further treatment, "after-putrefaction."

This experiment was conducted in a large glass vessel in the laboratory with about two gallons of sewage; a neutral water solution of permanganate of ptash potash was added slowly to the sewage until it remained pink in color for some time. The permanganate was decomposed, hydrated peroxide of manganese, an insoluble brown substance, being precipitated in large flakes. After this vessel had stood undisturbed for two or three days, the sewage was found to have undergone putrefaction, but an unlooked for additional change was noticed.

This was a change in the composition of the precipitated peroxide of manganese, which was indicated by a gradual change in the color from dark brown to yellowish white. Such a change was entirely unlooked for, because the peroxide happens to be one of the most stable oxides known, and one of the most difficult to reduce under ordinary conditions.

On examination of the yellowish white substance, it proved to be manganous carbonate with not a trace of the peroxide left in it. It was evident from this that the change was one of reduction, and then conversion. The reduction of the higher oxide of manganese to the form of manganous oxide under the conditions described was the more surprising since the latter is so unstable that, even when kept under water, it is rapidly oxidized to the form of peroxide. It was impossible to avoid the conclusion that this change was due to some of the organisms abundant in the sewage, and that the decomposition was probably analogus to that which Gayon and Dupetit have shown niter to undergo when it is present in water containing organic matter and the other constituents requisite for the growth of bacteria. These observers regard the decomposition of niter under such conditions as a fermentation, consisting of a direct oxidation of the organic carbon at the expense of the available oxygen of the niter, and that the decomposition may be expressed by the three following equations:

$$4\,KNO_3 = 2\,N_2 + 2\,K_2O + 5\,O_2$$
$$5\,C + 5\,O_2 = 5\,CO_2$$
$$2\,K_2O + 2\,CO_2 = 2\,K_2CO_3$$

If the decomposition of the peroxide above described be regarded as analogus in character, then it should be reduced to manganous oxide and oxygen. The latter should combine with the organic carbon to form carbon dioxide while the former should combine with the carbon dioxide formed during the fermentation, and give manganous carbonite, a stable substance:

$$2\,MnO_2 = 2\,MnO + O_2$$
$$C + O_2 = CO$$
$$MnO + CO_2 = MnCO_3$$

These reactions will be found on calculation to give rise to a considerable quantity of heat, and therefore constitute a source of considerable energy to the organisms. The question whether the reduction of the peroxide was or was not due to organisms was capable of being settled by direct experiments, and such an investigation was undertaken by Dr. E. J. M'Weeney. He immersed some carefully precipitated peroxide of manganese in carefully sterilized nutrient liquid media. No growth of organisms occurred, and no reduction of the peroxide was obtained. When, however, he seeded the nutrient media with some particles of manganous carbonate, previously obtained by the reduction of the peroxide in sewage, a rapid and abundant growth and development of living organisms took place in the media; and at the same time it was noticed that the brown color of the peroxide immersed therein was gradually and completely changed into a yellowish-white substance, which was found on examination to be manganous carbonate. It may, therefore, be taken for granted that the organisms ordinarily to be found in sewage are capable of reducing peroxide of manganese, and in doing so effect an oxidation of the organic matter at the expense of part of the oxygen combined with the manganese, forming first carbon dioxide, and then manganous carbonate. Here, then, is the key to the explanation of the observed efficiency of manganous compounds for the treatment of sewage.

Having thus arrived at the explanation of the nature and cause of the chemical changes which peroxide of manganese undergoes, when immersed in ordinary water-carried sewage, it was necessary to determine whether a similar series of changes are obtained when the peroxide is mixed with the solid organic matters of sewage.

Fortunately, Dr. Adeney had an opportunity of testing this point soon after his original experiment, on a somewhat large scale, at some purification works where manganate of soda was being employed for treating the sewage. At the works referred to, the heavier portions of the solid matters in suspension in the sewage were first separated by mechanical subsidence; the sewage was then mixed with a water solution of manganate of soda; the peroxide, which afterwards separated out, was allowed to subside, together with matters which remained in suspension in the sewage, to the bottom of the tank in which the operation was conducted. It was finally drawn off from the tank in the ordinary form of sludge. Dr. Adeney obtained several hundredweights of this sludge, and first drained it on a gravel bed, and, when of sufficient consistence, he made it up into a large heap, and left it exposed to the air in a covered shed. After about three months' time he found the interior portions of the heap still wet and of a clay-like consistence; they had assumed a grey color, and only those portions of the heap immediately exposed to the air had retained the original brown color of the peroxide. There was a complete absence of offensive odor in every part of the heap; any odor that was noticed resembled that of ordinary cultivated garden soil.

From the change of color and the absence of offensive odor, in the interior portions of the heap, it was fair to conclude that the peroxide had suffered a change in composition, and had exerted an influence, both similar in character to those which obtained when the peroxide was simply immersed in the liquid sewage. To gain, however, positive proof of this, a careful examination of portions of the interior part of the heap was made. Some of these portions were air-dried and submitted to chemical analysis with the following results:

Insoluble mineral matter	16.66	per cent.
Moisture	15.68	"
Organic matter	8.35	"
MnO	24 60	"
CaO	2.7	"
Fe_2O_3 and Al_2O_3	10.06	"
CO_2	18.98	"
Other bases	2.705	"
Other acids	0.96	"
	100 695	"

Note.—The wet sludge contained 0.014 per cent. ammonia; no nitrites nor nitrates were present in it.

These results show that the manganese was present in the interior parts of the heap as manganous carbonate; a careful examination was made for peroxide of manganese, but with negative results. Sulphides, and other products of putrefactive fermentation, were also tested for, but no indication of their presence was obtained. The organic matters which remained in the heap of sludge, after the peroxide had been thus completely changed into manganous carbonate, were next examined: and they were found to be of very great interest. A special analysis of some air-dried portions of the sludge showed that they (the air-dried portions) contained 4.7 per cent. of organic carbon and 0.67 per cent. of organic nitrogen. These organic matters were further found to be practically completely soluble in a solution of sodium carbonate, and they then formed dark brown solutions precisely similar in color and in chemical characters to those brown organic matters which are always present in cultivated soils and are known under the name of humus.

The fermentative properties of these organic matters were next examined. An experiment was first made to ascertain whether the organic matters in the interior portions of the heap had been completely fermented, or whether there still remained any in an unfermented condition. For this experiment some pieces, about 40 grams in weight, were detached from interior parts of the heap, and while still in the wet condition were mixed with 2 liters of good tap water, and then preserved in bottles out of contact with air for 21 days. On analyzing the dissolved gases and the inorganic nitrogen compounds in the water, before and after keeping for the 21 days, indications of a considerable fermentation were found, as was, of course, anticipated. The whole of the dissolved oxygen of the water had been consumed, and a large volume of carbon dioxide had been formed; but, inasmuch as no appreciable increase in the amount of ammonia, originally present, was detected, and the water remained perfectly free from offensive odor, it appeared evident that practically all the organic matters in the pieces of sludge employed for the experiment had previously suffered a first-stage fermentation, or carbon oxidation. It was fair to conclude, therefore, that the organic matters originally present in the sludge had suffered as complete a change as the peroxide, and that the changes in these two constituents of the sludge heap had been coincident; the organic matters undergoing a slow combustion or carbon oxidation, the peroxide supplying the oxygen required for such fermentation, and suffering a consequent reduction, and a final conversion into manganous carbonate.

The organic matters in the fermented sludge were subjected, however, to further experiment, to ascertain whether they possessed the characteristic properties of fermented organic matters. For this purpose an extract of them was made by means of a solution of carbonate of soda, and the fermented properties of the extract were carefully studied. The organic matters in question were found to possess all the properties characteristic of fermented organic matters. For example, when solutions of them were kept out of contact with air they were found to undergo fermentative change, but very slowly. When, however, the same solutions were mixed with ammonium compounds, the latter were readily oxidized to nitric acid in their presence.

Dr. Adeney believes these experiments show that peroxide of manganese when mixed in sufficient quantity with the solid organic matters to be found in sewage, may perform the part of an oxygen carrier to the organisms also present in the sewage, and enable them to effect a complete carbon oxidation of those organic matters, changing them into the inoffensive forms of matter—carbon dioxide, water, ammonia and humus. This view of the matter being accepted, the question arises as to the possibility of procuring a manganese compound sufficiently cheap for use in sewage treatment. This question he considers settled by the low-cost crude manganese precipitant made by Mr. T. A. Shegog, director of technical instruction under the Monmouthshire County Council.

THE BOSTON SUBWAY.

The fourth annual report of the Boston Transit Commission and its engineer, Mr. Howard A. Carson, M. Am. Soc. C. E., which has just been submitted to the Legislature, contains a resume of the work done in constructing this interesting municipal improvement. Like the preceding reports, it is illustrated with many maps and heliotype plates of details of construction, most of which are already familiar to the readers of this paper through the articles which appeared on January 23, May 15 and July 10, 1897, and February 26, 1898. The work was practically completed at the date of the report, August 15, 1898, and it is interesting to know that its cost will be considerably less than the five million dollars estimated in 1894 during the Legislative proceedings prior to the authorization of the undertaking. The report states that while the exact cost could not then be definitely fixed, it was believed it would be less than $4,250,000, exclusive of the alteration required by an act passed in 1897, which called for an expenditure of about $64,000 up to August 15. The total estimated quantities in the subway comprise 369,450 cubic yards of excavation, 75,660 yards of concrete, 11,105 yards of brick, 8,105 tons of steel, 2,285 yards of granite 117,925 linear feet

of piles, 12,440 square yards ribbed tile, 88,190 square yards of plaster, 117,980 square yards asphalt waterproofing, 6,790 square yards of artificial stone, 2,210 square yards of enameled brick and 2,855 square yards of enameled tile. Five of the workmen employed on the subway lost their lives through their own negligence or that of other employees.

The manner in which the engineering work of this undertaking was carried on reflects great credit on all concerned. The engineering staff was organized in September, 1894, and immediately began to collect and arrange all the available information bearing on the subway. Most of the route lies along narrow streets, which vilifiers of Boston have always claimed must have been laid out by straying cattle, so winding are they. The ground near the surface is nearly filled with street tracks, gas and water pipes, electric conduits, sewers and such obstructions. The subway extends deeper than the foundations of most of the buildings along its line, and injury to these structures would necessarily have entailed great loss. In order to make intelligent and economical designs it was necessary to get exact information as to all these obstructing features. Original 'surface surveys were made of all the ground through which the subway was built and of the various neighboring streets and grounds through which alternative routes were considered. The plans prepared from these surveys show all building fronts, manholes, sidewalks, lamp and electric posts, trees, fences, street car tracks and other surface objects. The subsurface surveys included frequent borings extending 20 to 80 feet below the surface, test pits in many localities, excavations in cellars and basements to determine the bottom of the foundations of adjacent buildings, trenches and in some cases tunnels along and across the streets to locate the pipes, sewers and other conduits. In all about 4,000 plans have been made and indexed.

Mr. Carson says it was constantly kept in mind that the novel conditions imposed on the subway made it necessary to work out the plans thoroughly before construction began. The commissioners personally devoted much time to the study of the details and many of the characteristic features of the subway originated with them. Some idea of the pains taken in these preliminary studies may be formed from the fact that about 70 plans were made of the proposed Causeway Street station and its connections. As it appeared probable from the first that the subway would be leased by the West End Street Railway Company the plans were discussed with its executive officers as the work progressed.

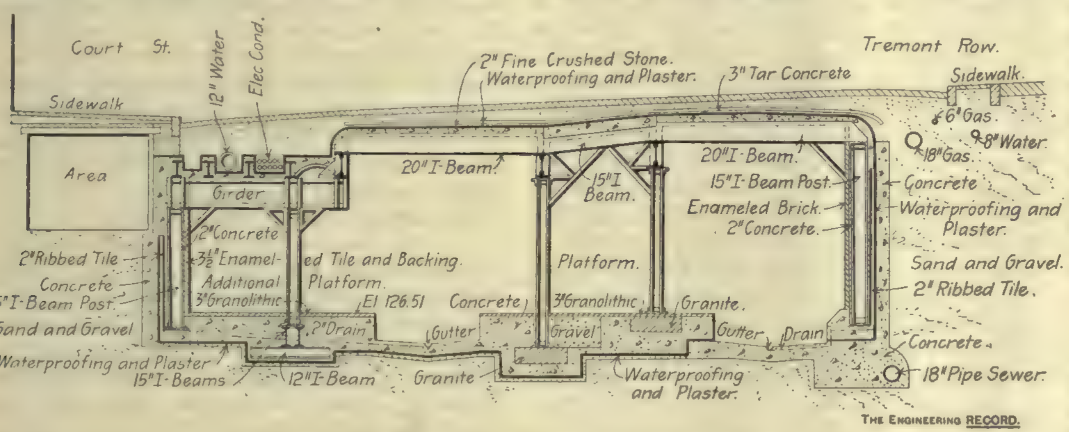
Owing to the badly congested state of many of the Boston streets it was essential to have the construction carried on with as little obstruction to traffic as possible. The authorizing act of the Legislature required the commission "to so conduct the work of construction that all streets or places under or near which a subway is constructed shall be open for traffic between 8 o'clock in the forenoon and 6 o'clock in the afternoon." A great many studies of the best methods of complying with these provisions were made and detailed examinations were made of important tunnel work abroad before the working plans were finally adopted.

Where ample space existed, the work was carried on in open excavation; the earth was taken away as fast as it was excavated and used for grading parts of the public grounds. All of the excavation in the city streets, except on a short section where tunneling was resorted to, was by cut-and-cover methods. The surface was kept bridged over so that traffic suffered little or no interruption; in fact, most of the work was done so that only a few of the people traveling on the surface knew that subway building was going on beneath them. The slice method used on a large part of the work may be best described by quoting a section from the specifications:

"Trenches about 12 feet wide shall be excavated across the street to as great a distance and depth as is necessary for the construction of the subway. The top of this excavation shall be bridged, during the night, by strong beams or timbering, whose upper surface is flush with the surface of the street. The beams shall be used to support the railway track as well as the ordinary traffic. In each trench a small portion or slice of the subway shall be constructed. Each slice of the subway thus built is to be properly joined in due time to the contiguous slices. The contractor shall at all times have as many slice-trenches in process of excavation, in process of being filled with masonry and in process of being back-filled with earth above the completed masonry as is necessary for the even and steady progress of the work toward completion at the time named in the contract." By this method the street railway tracks were not disturbed at all and the whole surface of the street, if desired, was left wholly free for its normal traffic in the daytime.

The other cut and cover method is outlined by Mr. Carson as follows: "A narrow and short length of trench was built at night on each side of the street and bridged over before morning. Short lengths of the side walls of the subway were built in these side trenches. By repetitions of this process the whole side walls were completed. At night a portion of the surface between the two side walls was removed and transverse roof beams placed and the wooden bridging put across before morning. Most of the subsequent operations, such as building the roof, removing the remainder of the earth and constructing the invert, were done from beneath."

The contractors necessarily used some portion of the public streets for shafts and plant. In order to encourage them to use as little as possible, and in order to deal fairly with the contractors using more or less space, each was charged by the square foot for the street surface he used, the charge being varied somewhat according to the supposed value of the street for public use. Employment of a public street inconsistent with the specifications was charged for at a double or triple rate.



THE SCOLLAY SQUARE STATION OF THE BOSTON SUBWAY.

In addition to a number of cross-sections which have already been shown in "The Engineering Record," Mr. Carson gives a general cross-section of the remodeled Scollay Square station which has not heretofore been illustrated in these columns. At this station an additional platform with a staircase to the surface has been built at the request of the Boston Elevated Railway Company, the lessee of the West End Street Railway Company. This has involved removing about 185 feet of the former easterly wall of the subway at this place, tearing down one building and underpinning others in the vicinity, and erecting a new two-story building for an entrance to the underground station. In order to give room for the additional platform the side columns in that wall of the subway have been removed and the ends of the roof girders they supported are now carried on a longitudinal girder. This rests on the cantilever ends of deep transverse plate girders spanning the new platform and carried on two rows of side columns. The principal new columns are seated on grillage beams which give them ample footing, and the cantilever girders are rigidly connected to the columns with solid-web gusset knee braces. Thin layers of tar concrete and sand are interposed between the roof of the station and the pavement to diminish as much as possible the transmission of sound from the street to the station.

The entrance building to this station is built at a site where it is probable that in a short time a large building will be constructed. The structure erected by the Commission has therefore been made of simple character above the sidewalk level, and so arranged that it can be incorporated in almost any style of building. The foundations and steel skeleton of the first story have been made strong enough to support nine additional stories of an office building, if it shall be desirable in the future to so extend the construction after having removed the present second story.

THE FINE GRINDING OF PORTLAND CEMENT.

(Continued from Page 183.)

The foregoing results together suggest that the outer face only of the coarser particle is acted upon or dissolved by the water, and as the finer the particle, the greater the area of such outer surface exposed to the action of the water within a given space the greater is the cementitious value of that particle. At what fineness the particle becomes wholly active, and contains no internal inert matter, has yet to be determined; it seems, however, from these experiments, that those particles which pass through a 120 and are retained on a 180-mesh sieve, nearly approach that point, inasmuch as at 12 months they develop about four-sevenths of the strength of the original cement, notwithstanding the drastic treatment to which they were subjected in order to remove any trace of adhering dust.

It will be noticed in Table II., page 182, that the finer grinding has a marked effect on the setting properties of the cement; sample I, for instance, commencing to set in 20 minutes in its original condition, while, when ground fine, its initial set is quickened to 2 minutes. This induced the author to ascertain the effect of extreme fine grinding upon other samples, the results of which are given in Table IV. It will be seen in each instance that the finer grinding of the sample enormously quickens its setting properties. Although this fact is not generally recognized, its explanation is obvious, for it is evident that the finer the cement, the more readily the water can act upon it, and therefore the quicker the setting takes place. According to Le Chatelier the setting of cement is due to the formation of a supersaturated solution, which gradually deposits crystals until a solid mass is formed; if this theory is correct, it is clear that the finer the cement the more readily it dissolves, and therefore the sooner the super-

Table IV.—The Effect of Extremely Fine Grinding.

Cement.	How Treated.	Fineness-residue per cent on Sieves of Meshes per Lineal Inch. 180	76	50	Setting Properties. Initial Set.	Set Hard.	Increase in Temperature during Setting.	Return to Normal Temperature.	Pat treated in Faija Apparatus for Soundness.
					Minutes.	Mins.	°F. Mins.	Ms.	
J	As received from manufacturer	22.4	6.0	Nil	25	45	22 in 40	120	Sound.
"	Reground	Trace	Nil	Nil	1	5	38 in 5	90	"
K	As received	26.6	10.0	2.7	[illegible]	90	17 in 100	240	"
"	Reground	Trace	Nil	Nil	6	15	32 in 11	150	"
L	As received	24.4	7 6	1.5	[illegible]	120	9 in 60	180	Blown.
"	Reground	Trace	Nil	Nil	7	15	29 in 13	120	Sound.
M	As received	30.0	6.7	1.2	20	60	21 in 34	150	"
"	Reground	Trace	Nil	Nil	2	10	26 in 8	75	"
N	As received	28.4	9.3	1.0	15	30	25 in 21	120	"
"	Reground	0.6	Nil	Nil	1	10	32 in 4	120	"
O	As received	26.4	7.7	0.5	Undefinable	360	2 in 39	160	"
"	Reground	0.4	Nil	Nil	8	25	27 in 12	95	"
P	As received	18.0	3.0	0.8	15	240	15 in 23	120	Badly blown.[1]
"	Reground	0 4	Nil	Nil	2	240	23 in 5	100	Very slightly blown.[1]
"	As received mixed with 2 per cent. gypsum	18 0	3.0	0.8	Undefinable	1,440	1 in 15	35	Blown.[1]
Q	As received	34 8	16 0	3.6	20	30	17 in 35	180	Badly blown.
"	Reground	1.6	Nil	Nil	2	[illegible]	26 in 5	180	Sound.
"	As received mixed with 2 per cent. gypsum	34.8	16.0	3 6	Undefinable	1,440	1 in 15	30	Blown.

[1] A specially-prepared "over-lined" cement; see analysis, Table V.

saturated solution forms, and the quicker the crystals are deposited.

About 15 years ago it was the custom to determine the heat evolved by a cement during setting, as indicating its settling properties, and when the pat had returned to its original temperature, the sample was considered set. This test was shortly afterwards abandoned, and the present test of a weighted needle substituted, which is obviously the truer test for the purpose, for it is not easy to see the relation between the return to normal temperature and the setting of the sample. Mr. G. F. Deacon has advocated the determination of the rise of temperature during the setting as a test for free lime. The author, however, doubts the utility of this test, and has expressed the opinion that the rise of temperature during setting of a cement is due rather to the heat evolved by crystallization or setting than to the presence of free lime, and that such a test therefore only ensures an extremely slow-setting cement, and in no way ensures a sound one. To ascertain the relation between the setting properties of cement and the heat evolved during setting, and also how far the theory was correct, that little or no increase in temperature pointed to the absence of free lime, that is, a sound cement, the rise of temperature during setting of each sample in Table IV. was also noted, and in each case it was found to bear a distinct relation to the time occupied in setting.

Table V.—Analyses of the Principal Cements Used in the Experiments.

	F.	G.	H.	I.	P.	Q.
Water and carbonic acid	1.70	1.55	1 40	1 55	1.25	1.45
Insoluble residue	0.98	1.08	0.77	0 68	1.49	1.17
Soluble silica	20.98	20 75	21.04	20.05	21.43	20.57
Alumina	8.41	7.48	8.17	8.55	5 77	6 46
Oxide of iron	4.02	3 81	4 21	3 94	3 51	5.33
Lime	[illegible]	62 01	61.23	62 19	61 20	62.09
Magnesia	1.29	[illegible]	1.27	1 23	1 08	1 34
Sulphuric acid	1.67	1.83	1.39	1.49	0 68	1.12
Alkalies and loss	0.40	0.35	0.52	0.32	0.59	0.47

Each sample was also tested for soundness in the Faija apparatus and the results recorded; it will be seen that cement L, in its original condition, was unsound, although it only showed an increase of 9 degrees in 60 minutes; when extremely finely ground the heat evolved during setting was 29 degrees in 13 minutes, and the fine grinding had rendered it perfectly sound. The latter result was surprising, and efforts were thereupon made to procure one or two unsound cements, and ascertain the effect of grinding them extremely fine. Cement P was specially prepared for the author as an over-limed, unsound cement; when treated in the Faija apparatus it "blew" badly, and disintegrated almost entirely, but after being ground extremely fine, this "blowing" characteristic had practically disappeared. Cement Q, on the other hand, was a badly manufactured cement, being made from a very hard chalk, insufficiently reduced during the amalgamation of the raw materials. This sample also "blew" very badly when treated in the Faija apparatus, but after being ground extremely fine, these indications disappeared entirely.

To ascertain more conclusively whether the action of setting or the presence of free lime was responsible for the rise in temperature noted, cements P and Q in their coarse condition were mixed with 2 per cent. of gypsum, which, as is well known, retards the setting of cement; the result was that they were thus rendered extremely slow setting, and while still unsound, and giving decided indications of blowing in the Faija apparatus, they showed an increase during setting of only 1 degree. As, therefore, the rise of temperature during setting depends upon the setting properties of the cement, and in no way determines the presence of free lime or other disruptive agencies, the author is strongly of opinion that to enforce such a test, while it certainly ensures the delivery of a very slow-setting cement, which in view of the method of working adopted by Mr. Deacon, was absolutely imperative, in no way guards against an unsound cement, and imposes needless restrictions upon the manufacturer. Unsound over-limed cements are generally slow setting, and therefore evolve little or no heat during setting, while, on the other hand, a case lately came under the author's notice of a cement which withstood the severe hot-water test of Deval, and yet showed an increase of as much as 25 degrees.

That the finer grinding of cement should, to a considerable extent, correct a tendency to "blow," is a most important feature, the reason of which may be readily explained. "Blowing" or unsoundness may generally be traced to one of two distinct faults in manufacture, viz., over-liming or excess of lime, under-burning or insufficient calcination, both giving rise to the presence of free or loosely combined lime. In the first case the cement contains more lime than the silica and alumina can properly combine with, and in the second, insufficient heat has been applied to enable the lime to chemically combine with the other constituents. Of these two forms of unsoundness, by far the most insidious and dangerous is that due to over-liming, as the uncombined lime is confined within the hard-burned coarser particles, and it may be weeks or even months before the water can penetrate sufficiently to cause it to expand and betray its presence. The unsoundness due to under-burning, on the other hand, is comparatively harmless, and is generally detected within a day or two; in contradistinction to the unsoundness due to over-liming, which often causes the cement to crumble and disintegrate entirely, the under-burnt material behaves in much the same way as a fresh hydraulic lime, i. e., a few slight cracks, and nothing further ensues. The beneficial effect of fine grinding, therefore, is that the uncombined lime, which would otherwise be confined within the coarser particles and subsequently cause mischief, is hydrated by the water during the operation of gauging, and thus rendered innocuous, or, if the cement has been previously spread out to mature, the moisture in the atmosphere acts upon it in a similar manner.

The effect of fine grinding on the setting properties of cement is a more serious matter, as in some instances it may render it too quick-setting for proper use. The tendency during the past few years has been to demand a finer cement, and at the same time a slow-setting one. The experiments in Tables II. and IV. show these two characteristics to be absolutely antagonistic, and unless it is rendered slow-setting artificially, a finely-ground cement means a quick-setting one, according to the degree of fineness attained. There are two methods of rendering a cement slow-setting; first, by thorough aeration, by which means the aluminate of lime becomes partially hydrated, and its activity modified; secondly, by the addition of small percentages of gypsum ground up with the clinker, in the course of manufacture. The latter method is largely practiced in Germany, and within 2 per cent. the addition of that material is sanctioned by the German Cement Manufacturers' Association. The ultimate effect of an addition of gypsum has not, in the author's opinion, been sufficiently investigated to authorize its being accepted without reserve; his experience is that the addition of very small quantities, even as little as ½ per cent., will materially modify the quick-setting properties of a cement, but it seems somewhat easy to overstep the mark, inasmuch as 5 per cent. causes decided disintegration. According to certain continental authorities, the addition of gypsum should not be sanctioned where the cement is to be used in sea-water, as the salts contained therein have a very prejudicial effect upon cements containing such admixtures.

The author therefore concludes:

(1) The coarser particles of cement are not inert, but have a certain value, approximately in inverse ratio to their diameter.

(2) The extreme fine grinding of cement decreases its cohesive power, but immensely increases its adhesive power, and consequently its value as cement. Therefore, to ascertain the true constructive value of a sample, it should always be tested with a certain proportion of sand in addition to being tested neat.

(3) The finer grinding of cement immensely quickens its setting properties, and therefore allowance should be made in this respect, unless admixtures of gypsum or other artificial means of rendering it slow setting are to be permitted.

(4) The finer grinding of cement largely corrects a tendency to unsoundness. A cement that would be totally unfit for use on this account when coarsely ground, would be perfectly reliable when extremely fine, owing to the water being able to attack the uncombined lime during the operation of gauging, instead of weeks or, maybe, months afterwards, when confined within the coarse particles.

(5) Increase in temperature during setting is governed by the setting properties of the sample. The setting of cement, being a process of crystallization, evolves heat; and the quicker the setting, the more intense the action, and therefore the greater the rise of temperature. That the cement shall show little or no rise of temperature during setting, ensures an extremely slow-setting cement, but does not guard against an unsound one.

With the exception of cements F, G, H, I, and P, which were chosen for the special reasons stated, the samples used in the experiments were not selected for that purpose, but were ordinary English cements passing through the author's hands for testing in the usual course. Cements B and G were made by the same manufacturers, also samples H and L; but the remainder emanated from different factories.

HYDRAULIC DREDGING IN TIDAL CHANNELS.

Among the many interesting papers presented at the recent Brussels congress on navigation was one by Mr. W. H. Wheeler, M. Inst. C. E., of Boston, England, entitled "The Improvement of Tidal Channels by Pump Dredging." In view of the important position which hydraulic dredging is assuming in river and harbor improvements in the United States, the paper is reprinted in full.

The successful application of the system of suction dredging to the removal of sand, the small cost at which the work can be carried on, and the ease with which suction dredges can be worked in the open sea, and in positions and circumstances which, with the older type of machines, were quite impracticable, has placed at the disposal of engineers facilities for deepening and improving tidal channels in sandy estuaries which did not formerly exist. It is the contention of the writer, and in this contention he is supported by the actual facts:

(1) That channels in sandy estuaries, if placed in such a direction that the currents of the flood and ebb tide act in harmony, and in which the depth of water is sufficient to resist any surface action due to wind and other causes, are of a permanent character, and maintain their depth and direction so long as the circumstances under which they were formed remain unaltered.

(2) That in the case of bars at the mouth of tidal rivers, the chief cause of shoaling and obstruction is the material drifted along the coast by the action of the tides and wind.

(3) That the regular and continuous movement of this littoral drift does not extend far below the line of low-water mark.

(4) That the action of wind and waves in gales in moving the sand of which the sea bed is composed extends only to a limited depth, and its energy decreases rapidly as the depth increases.

(5) That in a deep channel where there is a large volume of tidal water continuously oscillating backwards and forwards the strength of the current is sufficient to remove any material carried into the channel during a disturbance caused by wave action due to gales of wind.

(6) The numerous permanent channels that are everywhere to be found passing through deposits of sand in shallow tidal seas which have maintained their direction and depth for periods as far back as can be traced, prove that the oscillation of the tidal currents is sufficient to maintain these channels.

If these contentions be right, it follows that, if due consideration be given to the direction of the tidal currents, the entrance channels to tidal rivers or harbors passing through sandy estuaries or obstructed by sand bars, if dredged to a sufficient depth, will maintain themselves without the aid of piers or training walls. The examples hereafter given show that this increased depth can be obtained at a reasonable cost, and at far less expense than by attempting to control the direction and increase the scouring power of the tidal current by piers or training walls. As proof of the fact that channels passing through sand beds retain their permanent character, it is only necessary to point to the channels passing through the great mass of sands overlying the bed of the ocean situated between the south and east coasts of England and the coasts of France, Belgium and the Netherlands. The channels used as roadsteads in front of Havre, Calais, Dunkirk and Ostend, and those on the English coast near Yarmouth, one of which extends for over 20 miles, and the deeps known as The Wallet, The Sunk, Barrow Deeps, The East Swin, and others too numerous to mention, with depths varying from 3 to 16 fathoms, have retained their depth and width without any material change, so far as any records exist.

It is unnecessary to refer to examples of deep channels through sandy estuaries, which are known to have retained their permanent character for as long as any record exists, as the writer has already dealt with this part of the subject in his paper contributed to the Institution of Civil Engineers on "Littoral Drift." The views here expressed are also confirmed by the surveys and reports made by the engineers of the Belgian Government on the coast from Dunkirk to Flanders, and fully described in M. De Mey's book on ports on sandy coasts.

A comparison of ancient with modern charts of the coasts of tidal seas where there is a considerable deposit of sand will show that there is little or no movement of sand at a certain depth below low water. Gales that disturb the sand on the bed of the ocean even at a moderate depth occur only occasionally, whereas the scouring action of the tides in the channels which pass through the sand beds is constant and continuous. After the original causes of formation have ceased, and an equilibrium has been set up, the momentum of the volume of water due to tidal action moving in a given direction between two banks of sand is sufficient to overcome any surface action due to winds and waves and to give permanent character to the channels, and will enable them to maintain their original depth, although the sides and bottom are of a mobile character. This even holds good when the channels have a considerable curvature. By deepening a channel, a larger volume of tidal water is caused to oscillate backwards and forwards in one given direction on each tide, and being concentrated within a limited width, its action in maintaining the channel is rendered thoroughly effective. The depth of water in the channel necessary for its permanence varies according to the surrounding circumstances; but the minimum depth may be taken generally as from 2 to 3 fathoms. The following are successful examples where permanent deep-water channels through sandy estuaries and across sand bars have been secured by means of dredging.

Ship Channel through Bay of New York.—The lower bay through which is the approach to New York, covering an area of 30 square miles, is open to the Atlantic Ocean, the tidal range being 5½ feet. Through this bay the main ship channel leads to New York. This channel was obstructed by four long shoals over which the larger class of steamers could only pass at high water. Owing to the vastness of the traffic and the continually increasing size and draught of the steamers, these shoals were the source of very great inconvenience. A commission appointed by the Government to investigate the means of providing a greater depth of water reported that permanent results could only be obtained by means of training walls 4 miles in length, extending across the shoals from Coney Island towards Sandy Hook, the estimated cost of this work being £1,250,000. The feasibility of accomplishing the deepening by dredging having, however, been strongly urged on the authorities by Major Gillespie, the Government consented to tentative experiments, and these being deemed successful, dredging was systematically proceeded with. Between the years 1884-90 the channel was deepened by suction dredges 6½ feet, giving a depth of 30 feet at low water. The total cost of this deepening was £258,551. The quantity of material removed was 4,875,079 cubic yards, principally sand, with a large admixture of alluvial matter, which had to be carried 10½ miles to sea. The work was done by contract at an average cost of 26.4 cents per cubic yard. The material had to be raised from a depth varying from 24 to 35 feet under water, the total lift being 36 to 46 feet. The quantity on which the contractor was paid was that in the barges. This was found to be 27 per cent. less than the actual quantity moved, the remainder being carried away by the current. The material having a large proportion of alluvial matter, a considerable percentage went overboard with the water from the hopper, and was carried away in suspension. The plant consisted of three sea-going dredgers varying in length from 132 to 157 feet, 31 to 37 feet beam, and 8 to 16 feet in depth, their carrying capacity varying from 275 to 650 cubic yards. Each dredger was provided with two pumps, having suction pipes 15 to 18 inches in diameter, capable of lifting 4,200 gallons a minute. In addition to the dredgers there were four large barges and four steam tugs. The dredgers were kept at work in all but the roughest weather, and were not anchored, but were kept continuously steaming ahead while they picked up their load. The lower part of the channel being practically in the Atlantic was very exposed, and the dredgers had frequently to cease working. The average time occupied in filling the largest dredger, carrying 650 cubic yards, was 48.6 minutes; the voyage to and from the dumping ground occupied 1 hour 11 minutes, the time under steam was 16 hours each day, and the quantity moved 6.75 loads, equal to 3,936.65 cubic yards. The time lost by repairs, etc., was 2 hours 24 minutes.

The Bar of the Mersey.—The entrance channel to the River Mersey lies between two wide sand banks which are dry at low water of spring tides, and extend out into Liverpool Bay for a distance of about 9 miles. The sands at the upper end of the bay, which are uncovered at low water, extend over an area of from 60 to 70 square miles. Where the channel emerges from between the sand banks it is shoaled by a bar which extends out from the banks into the bay in a crescent form for a distance of 2½ miles, and on the crest of which formerly for about one-third of a mile there was a depth of only 11 feet at low water of spring tides. The depth on the lower side immediately outside the bar increased from 5½ to 8 fathoms at the bar lightship, two miles below the bar, and beyond this from 8 to 13 fathoms. Above the bar the depth increased from 2½ to 7 fathoms, there being no less depth in the channel up to Liverpool than 4 fathoms. The range of spring tides on the bar is from 29 to 31 feet. This bar was a source of great inconvenience to the traffic passing to and from the docks, and especially to the American liners. In the autumn of 1890 the Mersey Docks and Harbor Board decided to have an attempt made to deepen the water over the bar by dredging. As there appeared to be great doubt on the part of those who advised the board, as to any results obtained being permanent, the works at first were only of a tentative character, two of the steam hopper barges belonging to the board being fitted up as sand pump dredgers for the purpose. These hoppers were 150 feet in length, and each had a capacity of 500 tons. They were fitted with centrifugal pumps with suction pipes, one 22 inches and the other 18 inches in diameter, capable of dredging to a depth of 36 feet. Under favorable conditions they were able to fill the hoppers in 20 minutes, which time in rough weather was increased to 3 hours, the average time being 1 hour. On an average each hopper made 5 trips a day, with a total load of 2,000 tons, the maximum quantity reaching 20,000 tons in a week; the distance the material had to be taken being from 2 to 3 miles.

At first it was intended that the dredgers should pick up their loads while moving under steam. Experience, however, having shown that there was a liability of the nozzles of the pumps burying themselves in the sand, and, when the sea was at all rough, of injury to the suction pipes, the dredgers were afterwards anchored while taking their load. The proportion of water to sand lifted was about 45 per cent., but under favorable conditions this diminished to 25 per cent. The dredging was carried on continuously for 6 hours each tide, or from half ebb to half flood, except during heavy

gales and storms. It was found possible to work when a fresh breeze was blowing from the most exposed quarter, ranging from W.S.W. to N.E., or, say, up to a force of five on the Beaufort scale. The output varied according to the weather, from 10,360 tons in midwinter to 174,160 tons in the summer, and averaged 4½ loads for each tide. The cost of working, including wages of crew, coal, repairs and general expenses, but not depreciation or interest on outlay, was 5 cents per cubic yard. The material raised at first was coarse sand, but as the depth increased the particles of sand became finer and were mixed with silt. Stones of considerable size and other materials were brought up by the pumps without harm, and in one case an iron buoy sinker weighing 20 pounds passed through the pipes.

The result achieved after working for 34 months up to June, 1893, during 22 months of this time only one dredger being at work, was the removal of 2,438,710 tons of wet sand as measured by the hopper capacity, and a deepening of the channel of from 11 to 18 feet, over a width of 1,000 feet, and to a less extent over a greater width. Several heavy gales which occurred during this period had no effect in shoaling the deepened channel, and during an interval when dredging was suspended the deepened channel showed a tendency to improve rather than deteriorate.

The board being satisfied as to the practicability of deepening and maintaining the channel by dredging, determined to provide machinery of greater power and efficiency, and by their order a dredger named the Brancker, designed by Mr. Lyster, the engineer of the board, was supplied by the Naval Construction Company, of Barrow, and set to work in June, 1893; subsequently a duplicate machine named the Crow was obtained. The cost of each of these vessels was about £65,000. The Brancker is a twin-screw hopper dredger of 2,560 tons gross register, 320 feet long, 46 feet 10 inches beam, and 20½ feet deep, having a draught when loaded of 16 feet 4 inches, and being able to steam at the rate of 10 knots. The vessel has 8 hoppers of a total capacity of 3,000 tons, which can be filled in three-quarters of an hour. There are two centrifugal pumps having suction and delivery pipes 36 inches in diameter. The suction pipes pass down through a well in the center of the vessel, and are capable of dredging to a depth of 45 feet. The pumps are driven by a triple-compound engine having cylinders of 11½ inches, 18 inches, and 29 inches diameter, with 18-inch stroke, steam being supplied at a pressure of 160 pounds. The propelling machinery consists of triple-expansion engines. The vessel is fitted with a rudder stem and stern. The cost of the dredging with these machines has been given as about 2.24 cents per cubic yard. From the last report issued by the Mersey Conservator the quantity of material removed up to the end of 1896 was:

By the two dredgers	3.903,090	tons.
By the Brancker	9,398,050	"
By the Crow	3,862,800	"
Total	17,163,910	"

The depth of the channel was increased to 25 feet at low-water spring tides over a width of 1,250 feet, with a lesser depth over a greater width. As the depth increased the material to be raised became of a much finer quality and more mixed with clay, so that a much larger proportion passed away with the water which flowed from the hoppers, so that the time for each load increased to 3½ hours. Dredging with the suction dredgers was then suspended, and a tugboat, the Alarm, was fitted with powerful pumps and flexible pipes, and a strong jet of water directed on to the bed of the channel, which, acting as an eroder, disturbed the fine sand and silt, which thus being placed in suspension, was transported away by the ebb tide. This vessel is worked four hours each tide. Although there is no means of measuring the actual quantity of material so displaced, the result has proved to be satisfactory. Since this increased depth has been obtained the Conservator of the Mersey reports to the effect that the channel maintains its depth, and that during some very heavy gales from the W.S.W. to W.N.W., which lasted from 5 to 30 hours, no shoaling was produced; the only effect that could be traced being the leveling of the sand on the bottom.

The Stroombank.—The "Petite Rade," or outer harbor of Ostend, consists of a long, narrow channel running through the vast mass of sand banks which cover the bed of the sea all over this part of the ocean. The depth of this channel varies from 4½ to 5⅛ fathoms, and it is separated from the outer roadstead or main deep-water sea channel, which has a depth of 5 to 7 fathoms, by the Stroombank, which runs parallel with the coast, and has a depth of only 10 feet on it at low water. The rise of spring tide is 17 feet. This shoal presented great obstacles to the regular running of the steamboats between England and Belgium, and in 1889 the Belgian Government gave instructions for a channel 2,000 feet wide to be dredged across the bank, so as to give an increased depth of 6½ feet, equal to 16½ feet at low-water spring tides. This dredging had to be carried out in the open sea and across the set of the flood and ebb current. The work was commenced in June, 1890, and the first contract finished in January, 1891, when a depth of nearly 14 feet was obtained. A fresh contract was then made, and dredging commenced again in March, 1891, and continued till October, when the required depth of 16½ feet was obtained. The quantity of sand removed under the first contract was 343,000 cubic meters, and under the second contract 339,000 cubic meters. After this one dredger alone was employed in finishing up the work. The total quantity of sand removed was 771,000 cubic meters, equal to 1,008,000 cubic yards. The distance of the deposit ground was 2½ miles. The dredgers were actually engaged in dredging about half the number of working days, the remainder of the time being accounted for by delays from stormy weather and repairs. The dredgers employed were of 220 indicated horse-power, and had a carrying capacity of about 558 cubic yards. Each dredger under favorable conditions was capable of removing and depositing 4,700 cubic yards a day. On an average in summer the dredger made 10 journeys, and in winter 6½ journeys. The time occupied on an average in filling the hoppers during the first contract was 50 minutes, and for transport 35 minutes. Owing to the increased depth and the finer character of the sand raised during the second contract the time occupied was longer, the average quantity raised for each hour of effective work in the first case being 272 cubic meters, and in the second 234 cubic meters. The price under the first contract was 0.5835 franc per cubic meter, and under the second 0.40 franc, equal to 10.66 and 7.32 cents per cubic yard respectively. After the work was completed there occurred several violent gales, but the new channel was not affected, and the increased depth was maintained. The results obtained were considered so satisfactory that it has now been determined to dredge a similar channel through the eastern end of the Stroombank for the use of vessels going northwards.

The Charpentier Bar of the Loire.—The approach to the river Loire is through a large area of sand banks which extend out towards the Bay of Biscay from St. Nazaire, which may be said to be the outfall of the river, for 5 miles, the width where the bar is situated between the two points of the coast being about 6 miles. The bar extends outwards in a crescent form. The depth of the water seaward gradually shoals from 9 to 4½ fathoms in the course of 2 miles, and decreased in the main channel on the seaward side of the bar to 3 fathoms, then for half a mile there was, according to soundings made in 1881, a depth at low water of spring tides of 15 feet for half a mile, of 13 feet for a quarter of a mile, of 13¾ feet for a mile, and then the depth increased again to 36 and 42 feet. The principal obstruction to the navigation then extended over 1¾ miles, the width of the channel being about 1¼ miles. The winds that create the greatest swell on the bar are from the southwest, and in gales the waves attain a height from trough to crest of over 8 feet. Spring tides rise from 17 to 18 feet over the bar. Although upwards of 400,000 cubic meters of alluvial matter are reported as passing down the river annually, the bar is not formed by the deposit of this material, but is composed of the waste of the neighboring cliffs. The sand on the crest of the bar consists principally of large grains of quartz; but at a depth of from 3 to 4 feet the particles become finer, with a mixture of 30 per cent. of chalk and a small portion of argillaceous matter. The best method of obtaining deeper water was under consideration for several years, dredging being considered impracticable by many of the scientific advisers of the Government; and projects for training the channel, and also for directing the scour of the ebb and flood currents on to the bar by groynes and jetties, were advocated. Finally, after strong representation from the Chamber of Commerce as to the inconvenience and delay caused to the shipping, and an offer to be answerable for the cost of tentative experiments in dredging, the work was declared by the Legislature to be of public utility in March, 1889.

In order not to proceed far until the feasibility of dredging in such an exposed position and the permanency of the depth obtained were insured, the work in the first instance was limited to the removal of 196,000 cubic yards. The price fixed was not to exceed 1 franc. Tenders were invited for the work, and that of Messrs. Volker & Bos, a Dutch firm, was accepted at 15 per cent. below the maximum price allowed, equal to 15.54 cents per cubic yard. Two dredgers were employed, and the work was completed in November, 1890, an increased depth of from 10 to 18 inches being obtained. The feasibility of the dredging being thus proved, and the increased depth obtained remaining stable during the winter, up to the spring of 1891, a fresh contract was entered into with the same firm to remove 1,308,000 cubic yards in order to secure a depth of 16½ feet at low water of spring tides over a width of 656 feet, 26 months being allowed for the work to be done. Previous experience having shown that the work could be done at a less rate than was anticipated, the maximum was fixed at 0.80 franc per cubic meter, and the work was taken by the contractors at 20 per cent. below this, equal to 12 cents per cubic yard. Work was commenced in February, 1892, and completed in March, 1893—a period of 14 months.

Four sand pump hopper dredgers were employed, the smallest being 111½ feet long, 25½ feet beam, and drawing when loaded 10 feet, with a carrying capacity of 311 cubic yards. The largest was 144 by 24 feet, and drawing 12½ feet, with a hopper capacity of 437 cubic yards. The distance of the discharging ground was 3 miles. The night anchorage was 2 miles from the bar, and the place for coaling and obtaining food and water where the dredgers went from Saturday to Monday was 5½ miles. Out of the total number of days the dredgers were employed 204 were occupied in resting, on 363 days the working was stopped by bad weather and other causes, 113 days were taken up with repairs, leaving 685 days of effective work out of a total of 1,363, or about 50 per cent. The cost of wages, coal, repairs and incidental expenses averaged 0.22496 franc per cubic meter, about 4.112 cents per cubic yard.

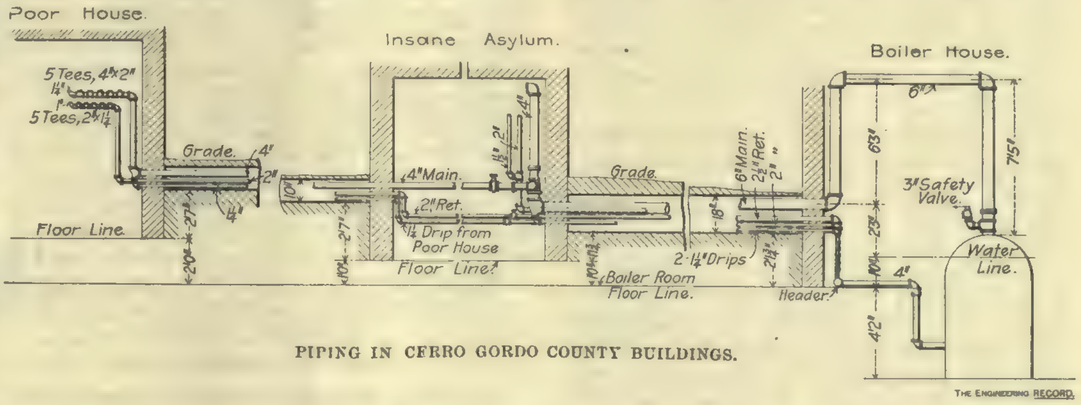
On the completion of the contract, pending the delivery of a new dredger built specially for the purpose, one dredger was kept to complete the work and maintain the channel at a contract price of 0.54 franc per cubic meter, and from January to June, 1894, removed 146,000 cubic meters. The dredger constructed for the Government and since employed is 161 feet long, 29½ feet beam, and draws loaded 10¾ feet, with a hopper capacity of 570 cubic yards. The engines are of 400 indicated horse-power, and the vessel is capable of steaming 7 knots, and dredging to a depth of 41 feet. The pumps can discharge 105 cubic yards. The cost of this dredger was £14,120. Since the completion of the work in opening out the channel this dredger has been employed in widening the channel and maintaining the depth, the quantity removed in 1894 being 243,779 cubic meters, and in 1895 260,795 cubic meters, taken 4 miles to the deposit ground. The annual cost of working the dredger amounts to about £2,000 a year. The average cost for coal, labor and other expenses was 0.197 franc per cubic meter (3.52 cents per cubic yard). The new navigable channel has been well maintained, the depth now varying from 18 to 19½ feet below low water, a gain of 6 feet over the shoalest part.

Port Natal Harbor Entrance.—Although the dredging operations that have been carried out at this port do not assume the importance of the other examples quoted, yet they are sufficient to show that a workable navigable depth cannot be secured by scour obtained by the means of guide walls and piers alone, and that sand bars may be removed in the open sea without the protection afforded by piers. The harbor of Natal forms part of a large tidal lagoon on the southeast coast of Africa, which has been enclosed and protected from the Indian Ocean by a long sandspit known as the Bluff, running nearly parallel with the coast for about two miles. The entrance channel to the harbor is between the Bluff sandspit and another sand bank running out from the shore towards it in a southeasterly direction, leaving an opening about 1,000 feet wide. The channel was kept open by the action of the tidal water running in and out of the lagoon, which covers 7½ square miles. In its natural condition the navigable depth did not exceed 6 feet at low water and 12 feet at high water of spring tides over the bar at the mouth, the low water occasionally decreasing after heavy gales to 2 feet, the depth beyond the bar in the open sea being from 6 to 8 fathoms; only the smaller class of vessels could therefore obtain access to the harbor. As the town of Durban increased in importance, it became necessary to devise means for improving the access to the harbor. With the view of obtaining increased depth, a breakwater was run out in continuation of the Bluff sandspit for a distance of 1,800 feet, and a training wall 1,100 feet long constructed on the other side of the channel, the entrance being contracted to 800 feet. By this means, aided by a certain amount of sand pump dredging, the depth of water was increased to 14 feet at low water. The depth was liable to be decreased during gales so as to leave only from 5 to 7 feet, owing to the drift of sand across the opening between the piers and for some distance up the channel.

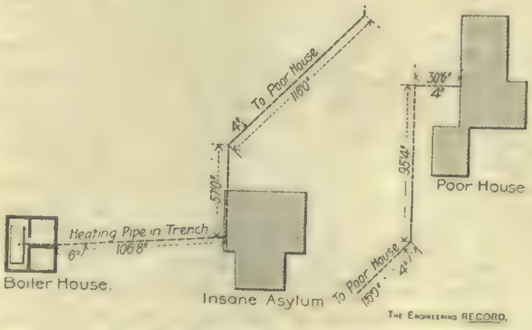
In 1897 the Government procured from Messrs. Symons & Co., of Renfrew, a second dredger of increased power, called the Octopus. The Octopus, which went out to Africa under her own steam, is a twin-screw vessel of 1,300 tons hopper capacity, and provided with two sand pumps having 33-inch suction pipes. When this dredger was first set to work in February, 1896, the bar had shoaled and had only 5 feet depth of water over it. The draught of the Octopus light being 18 feet, she was at first started pumping and discharging the sand over the side, and in about 15 hours had cut a passage through the bar sufficient to work in. After this was accomplished the material was taken out to sea, the vessel making from 7 to 8 journeys a day. In 4 days a depth of 13 feet was secured over a sufficient width to allow of the passage in one day of 9 vessels, the maximum draught being 16 feet, the rise of the tide on that day being 3 feet 9 inches. A depth of 17 feet was subsequently obtained and maintained until the autumn, when on two occasions, owing to the gales, the depth of the channel shoaled on the bar to 8 and 10 feet. These shoals were quickly removed by the Octopus, and the depth increased to 18 feet. To obtain this the dredging had to be carried out in the open sea without any protection from the piers. Recent reports show that the result of the system of sand pump dredging now systematically carried out has given very satisfactory results, and that a depth of 18 feet is maintained in the channel, allowing vessels drawing 22 feet to navigate at high water of neap tides. The last reports received from the Colony show that shoaling does not now take place, and that even after gales the channel has maintained its depth, and the bar, instead of reforming, as was formerly the case under similar circumstances, has practically disappeared.

HEATING OF COUNTY BUILDINGS, MASON CITY, IOWA.

A new heating installation recently completed for the Cerro Gordo County buildings, Iowa, will doubtless prove interesting as an example of heat distribution in a part of the country avowedly subject to severe weather. There are two detached buildings, an insane asylum and a poor house, both heated by direct radiation and supplied with steam from the same outside source. The poor house is not a new building, but was formerly heated by hot water. With the erection of the asylum, it was decided to heat the plant by steam, and a separate boiler house was built.



PIPING IN CERRO GORDO COUNTY BUILDINGS.



PLAN OF COUNTY BUILDINGS.

A plan of the three buildings is shown in the accompanying drawing. Steam is generated in the boiler house and carried through a trench to the asylum building, which is a little over 100 feet distant. The pipes pass through the basement of the asylum to another trench over 250 feet in length, carrying steam to the poor house. In direct line this building is not more than 160 feet beyond the asylum, but the trench is laid with angular changes in direction so that expansion may take place without further provision.

The boiler, which is set up at one side of the boiler house, is a horizontal fire-box boiler with no dome, but a 6-inch flange on top for a live-steam connection and a 3-inch on the bottom for the return of the condensed steam. It is capable of providing for 4,000 square feet of direct radiation. A diagram of the steam connections at various points is shown in the accompanying diagram. Steam is generated at low pressure, and a circulation is maintained on the gravity system. The 6-inch main supplies the whole plant, pitching from the boiler house to the asylum, where a drip connection is made, permitting the steam condensed in transit, as well as what water may be carried over from the boiler, to travel with the live steam. At this point, also, a 6 x 4½ x 4-inch tee is placed, the 4½-inch connection for the asylum and the 4-inch, for the poor house. The asylum supply sub-divides into two mains, which extend in opposite directions near the outside of the basement. Single pipe connections are made with direct radiators, but the mains pitch from the point of subdivision, causing the condensation to flow with the steam. Each of the mains is reduced in size beyond the last radiator connection, and the customary precaution is taken to prevent the lodgment of water in any pockets which are liable to be formed in such a reduction. The return for this system continues, as shown in a separate pipe to a header in the boiler room below the water level of the boiler.

The 4-inch pipe just mentioned passes from the asylum through the trench to the poor house, inclining upwards, so that the condensation occurring between the two buildings returns against the steam, entering a separate return at the asylum. At the poor house, a drip is also placed in the end of the pipe, so that water from the live-steam pipes in this building does not also have to pass against the steam. The small amount condensing in the supply main in the trench, together with the comparatively low value of the velocity of the moving steam doubtless was taken as a justification for the arrangment. The result is that the pitch of the pipes is probably not of necessity as great as otherwise, which is saying, in other words, that less excavation was required. The returns, which are side by side with the main, fall 1 foot for the whole distance between the two buildings. The radiators in the poor house have separate flow and return connections, which are made with separate pairs of tees, as shown in the figure.

The pipes are carried in the trenches in boxes of 2 x 12-inch planks, painted inside and out with coal-tar paint. The pipes are supported by expansion rolls, and the provision mentioned was made for expansion. They are insulated by filling around the pipes with mineral wool. The box in the trench between the boiler house and the asylum is 18 inches deep and horizontal, as the pipes within it pitch in opposite directions. The trench extending from the asylum to the poor house, however, rises with the grade, and the box is 10 inches deep, with the top of it less than 6 inches on the average below the top of the likewise sloping ground.

As regards the calculation of the heating surface, it may be said that a ratio of cubical con-

tents to square feet of radiation was taken at 40 for the poor house, resulting in a total of 1,300 square feet. The asylum is provided with 980 square feet, taking a ratio of the volume of the room to the square feet as 200, adding to this 1 square foot for every 2 square feet of glass, and 1 square foot for every 10 square feet of wall surface. In a recent test of the apparatus, a temperature of 80 degrees in the asylum ,and 85 degrees in the poor house was attained, when the outside temperature was 8 degrees below zero. It might also be of interest to add that when the pressure of the steam at the boiler was 5 pounds, the 6-inch main from the boiler house to the asylum showed a linear expansion of about ⅞ of an inch. The heating plant was designed and installed by the Davis Construction Company, of Chicago, Mr. E. F. Capron being their engineer.

PAPERS AT THE AM. SOC. H. & V. E. CONTION.

(Continued from Page 192.)

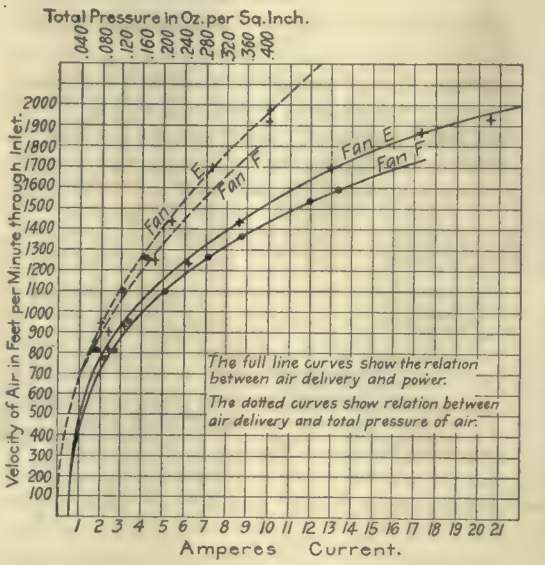
In the last issue of "The Engineering Record" were printed reviews of five of the papers presented at the recent convention of the American Society of Heating and Ventilating Engineers. One of the remaining papers was an interesting description by Mr. William S. Monroe of some experiments made with centrifugal fans in the Chicago Public Library. A part of the data it presented had been previously communicated to the trustees of the library in the report by Mr. George H. Barrus, which was discussed at considerable length in these columns on August 6, 1898. Mr. Monroe presented much new information, which will be most readily understood after reading the description of the plant in the issue mentioned.

The building is heated by direct radiation throughout, figured amply large to take care of all heat radiation by glass and wall surface. The ventilating system, therefore, is intended merely to supply air for ventilation purposes, and not for heating. In the two largest rooms in the building it was found that the ventilation was entirely inadequate for the requirements, and investigation showed that the air delivery from fans was insufficient, the ducts and registers being of ample size. The fans were all run at what would seem to be unusually slow speed, ranging from 45 to 75 revolutions per minute, and after some investigation it was decided to increase the speed of such fans as supplied or exhausted air from these rooms. The fans were all driven by electric motors of five-horse-power capacity, rated for 19 amperes at 220 volts, with the exception of one three-horse-power motor rated at 12 amperes. It was found by investigation with an ammeter that all of the motors were using, at full speed, but a very small percentage of their current capacity, the maximum being about 3.6 amperes.

From the results of the tests it was considered desirable, if possible, to increase the delivery of the three supply fans about two and a quarter times, and to double that of the exhaust fans. Inasmuch as the power required to force air is theoretically proportional, other conditions being the same, to the cube of its velocity, it seemed a matter of doubt whether the capacity of the motors would allow for such increase. Reflection showed that in the case of a fan under speed it was very difficult to ascertain the power due to friction, etc.; and it was evident that a considerable portion of the power at this slow speed was due to such losses. It was therefore decided to take one of the fans and increase the speed of this as much as practicable, and base the increase in speed for the others upon the results obtained for fan tested. A careful calculation was made of the probable friction and other losses of this fan and its connection under the conditions of running. This calculation indicated that the frictional power was equal to that represented by the consumption of 2.3 amperes at 220 volts. The fan using 3.3 amperes at the time of the investigation left one ampere required for driving the air. It was found by experiment that the air delivered increased proportionately to the speed of the fan, and it was assumed that the friction power would also increase proportionately to the speed, while that required to drive the air would increase as the cube of the speed. Therefore in order to increase the speed of the fan two and a quarter times would give the following:

	Amperes.
Current to drive air ($2\ 25^3 \times 1$ amp)	11.5
Current for friction ($2\ 25 \times 2\ 3$ amp.)	6.2
Total	17.7

The belt transmission was therefore designed to increase speed of this fan two and a quarter times at the maximum speed of the motor, and being tested after its installation it was found to attain this increase in velocity required 20.6 amperes, showing that the friction of the fan had been assumed slightly too high, a very small error in this assumption making the considerable difference in the increased power. The speed of the other fans was calculated in due consideration of the results obtained on the fan tested, and the results obtained were very close to the calculations.



TESTS OF TWO 78-INCH FANS.

In thus speeding up these fans an opportunity presented itself to make some investigation under actual working conditions of the relations between speed of air, pressure of air and power required. Some tests were made before the speed was increased and after, with a view to noting these relationships at different speeds. The speed was varied by means of the controlling rheostat within the entire range available, so that taking the tests before and after the increase of speed a considerable range was obtained. The power used was measured in amperes by an ammeter on the mains to the motor, the voltage being accepted as constant at 220, there being but a very slight variation in this. In reading the amperes, however, the voltage lost in the controlling rheostat was also measured, and an equivalent deduction made for this loss, that the efficiency of the motor might be considered the same at all speeds. The speed of the fan was taken by an ordinary speed indicator, and pressure of air under which the fan was working was obtained by means of a Barrus differential draught guage, which multiplied the pressure in inches of water by four. One side of the draught gauge was connected to the main delivery duct of the fan, the other side to the suction chamber between the fan and the heater. The algebraic difference of these two represented the total air pressure under which the fan was working. The speed of the air was taken at the end of the fan by means of an anemometer, this being obtained by an observer who stood in a corner of the space between the heater and fan inlet, and obtained the average velocity by moving the anemometer supported on the end of a wooden arm around the entire area of the inlet.

A fairly complete test was made on each of these fans with the by-pass wide open and the heater cold, the temparature of air through the fan being between 60 and 70. Some few tests were also made with the by-pass closed, with varying amounts of the heating coil turned on so as to observe the effect of closing the by-pass, also of increasing the temperature of air through the fan.

Curves were drawn showing the relation between the velocity of air and the power required, expressed in amperes of current, for the results, with open by-pass, and also for the relation between total pressure and velocity of air. The curves for two fans of the same size are reproduced in the figure. It was pointed out that the velocity curve was very uniform and very regular, and the great increase of power required for small increase in velocity after the curve began to bend toward the horizontal was also noted. The points on the pressure curves are much more irregular, due to the fact, the author said, that the pressure was very small and difficult to measure with the gauge used, on account of a slow vibration. A small error in reading also made a large proportional difference. The pressure curve of one fan, it will be seen from the figure, is higher than its mate for the same velocity, showing, it was stated, that the resistance of the ducts connected with the first fan was greater than the duct resistance of the other.

The author said that the curve showing the relation between the required power and the cubes of the air velocity, which should be a straight line, was practically so. Attention was called to the fact, however, that the curves did not pass through the origin and it was thought that it was doubtless due to the fact that the power recorded included the friction of the mechanism and that the efficiency of the motor increased somewhat with the speed. But the fact of these points indicating straight lines showed also, in the author's opinion, that the friction varied practically in direct proportion to the speed.

Another point which will be of interest will be found in the reduction of air delivery due to closing the by-pass around heater. A comparison of the results on both the air deliveries and power required for open and closed by-pass showed that the air delivery was decreased from 21 to 36 per cent. merely by closing the by-pass. Two tests on one of the fans, with part of the heater turned on and a high temperature through the fan, gave a somewhat less reduction. But even with the by-pass closed, and even at as high temperature as 160 degrees, the delivery was 20 per cent. less than with the by-pass open. The only tests at these high temperatures were made with very low fan speeds, and the test of 160 degrees showed a negative pressure on the blast side of the fan, due to the draft of the hot air in the vertical ducts. It was impossible to repeat these temperature tests at higher fan speeds.

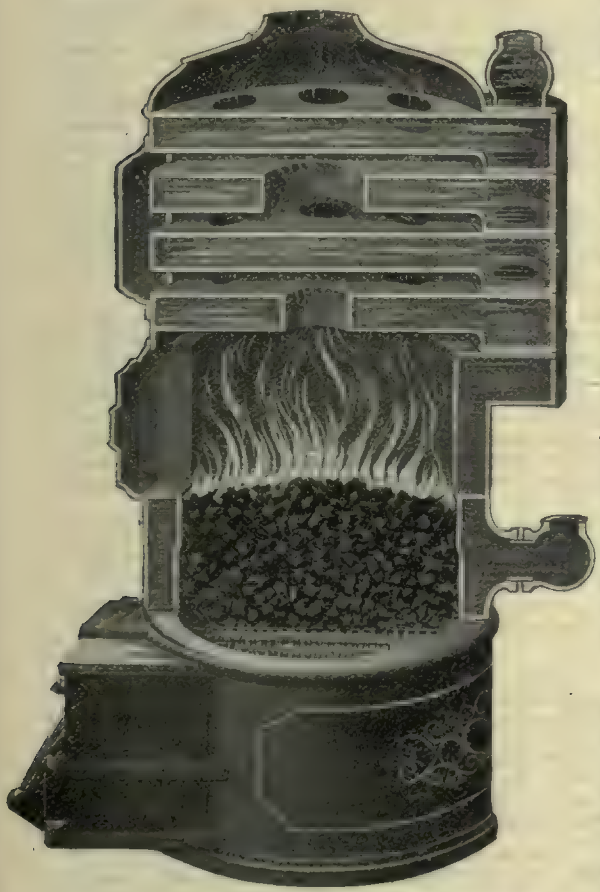
Attention was called to the fact also that, whereas the delivery of air was reduced about 24 per cent. by closing the by-pass, the power required for same speed of fan was reduced from 9 to 22 per cent., while for equal air deliveries the power was increased from 2.3 to 2.44 times by closing the by-pass.

Attention was also called at this point to the fact that even with the by-pass wide open the resistance due to intake and passages through and around the heater, or, in other words, the total resistance on the inlet of the fans, was in all cases quite considerably more than the total resistance of the delivery ducts, dampers and registers. This was a matter of considerable surprise to the author, as the in-take seemed to be of ample size and area of the by-pass large. It was probably due, in his opinion, to the height of intake, and as such resistances were very often but little considered, he thought it would be valuable to note their importance in this case.

THE GURNEY 400-SERIES HOT WATER HEATER.

The "400-series" hot water heaters as made by the Gurney Heater Manufacturing Company, Boston, Mass., are illustrated herewith. They are made in ten sizes, with capacities ranging from 300 to 2,000 square feet of direct radiation. The sections above the fire-pot are connected with each other by means of taper push-nipples, and are held together by short bolts outside the heater. This joint, it is said, cannot be affected either by the heat of the fire or uneven expansion or contraction, and is, therefore, the most permanent and indestructible water joint it is possible to obtain.

The sections are easily accessible for the purpose of cleaning by means of the large cleanout door provided on the front of the heater for that purpose. The fire-pot is deep and large, which enables the maintenance of an even fire for a considerable time without attention, while it promotes perfect combustion of fuel, and consequently greater efficiency and economy are obtained.



THE GURNEY 400-SERIES HOT WATER HEATER.

One of the best and most efficient grates has been incorporated in the "400-series" hot water heaters. The bars being triangular in form and revolving simultaneously, make it easy to operate. By placing the shaker on the shank of the grate in an upright position, the grate can be easily and effectively cleaned, the ashes and clinkers being evenly and completely removed from the bottom of the fire. Another valuable feature is the ease with which any grate bar or other part of the grate can be replaced or repaired at any time that occasion requires, without disturbing the heater. The ash base is large and has all the necessary damper doors for regulating the drafts.

The makers state that the "400-series" heaters have been very carefully designed, are thoroughly reliable in operation and in their construction only the best quality of iron is used. A catalogue of this heater, with full dimensions, etc., will be sent by the manufacturers on request.

NOTES.

Important Errata should be made to the article entitled "A Symposium on Pipe Lines" in the issue of January 14. Mr. Brackett should have been quoted as saying that the specifications for iron pipe for the Metropolitan waterworks call for test bars 1 x 2 inches in section, 26 inches long, laid flatwise on supports 24 inches apart, and broken by a load applied in the middle. Such bars had to support a load of at least 1,900 pounds, and deflect 0.3 inch at the center before breaking. The loads which were supported in this manner were 2,300 and 2,400 pounds and not 23,000 and 24,000 pounds, as printed.

A Deep-Water Column has been recently patented by Mr. F. A. W. Davis, of the Indianapolis Water Company, which consists of a number of concentric metal pipes, preferably held apart by flanges, and provided with cement or other filling in the annular spaces. The flanges are intended to stiffen the tubes against bending, as well as to keep them spaced truly concentric, one within the other. Various forms of shoes are provided, some pointed so as to be driven readily through soft ground and others disk-shaped for rock, with the bottom surface slightly concave. With the latter it is proposed to sink a pintle into the rock and have a hole in the shoe into which the projecting end of the pintle will fit, thus preventing sliding.

A Hint for Water-Works Superintendents in small towns is furnished by the recent experience of Superintendent Wright, of the Warsaw, Wis., plant, which has about 1,300 services. There was an evident waste of water, and it was deemed inexpedient to adopt meters to any extent at the time to make the wasteful consumers pay for their carelessness. So a house to house inspection was made by the superintendent in person. Sixteen dwellings paying no tax whatever were found to be using water, 48 were occupied by two or more families, but paid the rate for only one family. There were 10 houses with bathtubs and 29 with water closets, for which no charge had been made. In many cases there were more rooms than were recorded on the water-works books. The result of the inspection was an increase of about $1,200 in the revenues of the department, and a strong appeal from the superintendent to meter each service.

The Emery Millstones which have been referred to in a number of articles on cement plants, printed in this paper, should not be confounded with emery wheels formed of small grains cemented together. The former are made of blocks of natural emery rock held within a circular rim by a metal filling or matrix, which wears away gradually so as to expose the faces and edges of the blocks. The furrows and bosoms of these millstones are made of Esopus or buhr stone, which can be readily cut away to suit the class of grinding to be done. The abrasive properties and strength of these stones are said to be so great that nails and small bolts do the emery faces no harm, and are sometimes reduced to powder before they escape. The qualities of the rock led the ancient civilized nations to use it for carving stone, and it is an interesting fact that the old mines of Naxos furnish rock for the grinding machinery of today.

The Bureau of Yards and Docks of the Navy Department has just had printed its valuable report for the year ending June 30, 1898. It is elaborately illustrated, and, in addition to descriptions of the Government's property at its yards and stations, contains the following interesting recommendations for changes in the organization of the naval corps of civil engineers, a subject on which Mr. Endicott's long experience in the corps enables him to give good advice: "There should be added to the corps the grade of assistant civil engineer, in order that young men may be appointed to the lower grade first and be promoted to the grade of full civil engineer as vacancies occur in the latter, after some years of experience and after a further examination to test their fitness for such promotion. I would recommend that the number of assistant civil engineers be not fixed by law, but be variable, at the discretion of the President, to suit the requirements of the service. The corps as it now exists is not sufficiently large for the prosecution of the work of designing, constructing and maintaining the public works of the navy without calling to its aid many young civil engineers from private life to temporary appointments at the various yards and stations, under various titles of draftsman, transitman, leveler, rodman, etc., who are paid from the appropriations made by Congress for works of improvement upon which they are engaged. Such assistants, being commissioned officers, would have the requisite authority and status to perform any duty assigned to them in connection with public works, and take charge of the same and represent the civil engineer of the yard in his absence. There would also be the manifest advantage of having young officers in training in the subordinate grade in the line of public works under the cognizance of this Bureau, to fit them in an especial degree for the vacancies occurring in the grade of civil engineer. Such commissioned officers would probably have a greater interest in the work than temporarily employed civilians, thus insuring a more efficient administration and better results. The importance of some such reorganization has been laid before the Department in previous years by a former chief of this Bureau, Commodore N. H. Farquhar. At that time the proposition contemplated the selection of the appointees from graduates of the Naval Academy, who were to be selected from those showing an aptitude and preference for the profession of civil engineering. It was also contemplated that they should be given a post-graduate course in civil engineering at some engineering school of good repute in this country, and upon taking the degree of civil engineer from such institution they were to be detailed to the Corps of Civil Engineers. At that time appointments were being made directly from civil life, frequently without any test as to the professional qualifications of the appointees, and it was deemed better that appointments should be made in the manner indicated above, in order to insure officers educated and qualified in the profession. Graduates of the Naval Academy, who have completed the two years' cruise and the final examination, and are naturally fitted and inclined to become civil engineers, might be assigned about the first of June to duty under the civil engineer of some navy yard. After three months of such duty, if found qualified, the Chief of the Bureau of Yards and Docks would then recommend to the Department that such officers be ordered to some engineering school to take such a post-graduate course of study as will fit them for the duties of a civil engineer in the navy. Upon the completion of such post-graduate course the officers would be commissioned assistant civil engineers."

Underpinning Tunnel Walls was recently accomplished in an interesting manner on the line of the Western & Atlantic Railroad, which crosses a ridge of the Chattanooga Mountains by a tunnel 1,477 feet long and about 13 feet wide, built in 1848 and 1849. It was lined with a full-centered brick arch, built on masonry side walls 10 feet high. It was recently necessary to rebuild portions to secure increased clearance for rolling stock, and this work was accomplished in intervals of two hours or less between trains, without interrupting traffic, by the use of a three-car construction train. All supplies were kept on this and brought to the work, which was usually conducted at two or three points simultaneously, so that the bricklayers could prosecute their work continuously. The construction train also carried the lighting apparatus and removed spoil and débris as fast as taken out of the old walls. Renewals at

different places were commenced by cutting out a few bricks in the first three courses of the arch, just above the masonry side wall, and removing the upper stones successively as released. When the opening became 4 or 5 feet long a jack was placed in the center to support the brick work above, and when it had increased to 7 to 10 feet the jack was replaced by a horizontal 8x16-inch timber. Below this bridge piece the old wall was torn down and replaced by brick in successive sections. The minimum thickness of the new brick wall was 4 feet at the base, and in dry ground it was easily built with a screen plank back of the bridge timber to prevent loose earth and stones from rattling down. Where the earth was saturated, lagging had to be driven behind the old wall and concrete footings constructed several feet below the base of the rail. The old arch sustained itself without signs of failure when the old side walls were removed for distances of as much as 10 feet, but it was not allowed to remain unsupported more than a few minutes. Portions of the old arch were replaced with new brickwork, built in sections from 2 to 4½ feet long. At the ends of the tunnel the stiff clay above the tunnel roof was self-sustaining, but in the middle it was mixed with gravel and saturated so as to fall continuously and cause much difficult work in blocking up the 2x10-inch oak lagging to the required height above the old arch. A space 18 inches square was left open at the crown of each section of the new arch work and keyed up after the succeeding section of the old arch had been removed. In the last sections this plan could not be followed, and the hole was reduced to 10x18 inches and the top ring filled in first. The bricks were held in place by the adhesion of the mortar till the key could be driven in, then the next course was keyed the same way, and so on till the soffit course was completed. The clearance between the car roof and the arch was so small that special arch centers had to be used. These were made of strips of 4x1-inch iron ribs, bent flatwise to the curve of the intrados. A 6x¼-inch plate was riveted to the underside of the rib, and its projection of 1 inch each side formed a ledge or rebate to support the end of 8x1-inch oak lagging strips about 2 feet long. In no place was the old arch entirely removed from wall to wall, but the sections varied from 5 to 15 feet in width. Four hundred and twelve lineal feet of the old side walls and 178 of the arch were rebuilt at a total cost of $7,440, inclusive of freight charges. Three hundred thousand bricks were used in the repairs, and work was in progress eight months. It was executed by contractors J. D. Gray & Company, under the direction of Chief Engineer W. L. Mitchell and the supervision of Assistant Engineers B. C. Morse and B. E. Wells. A fuller description will be found in a paper by Mr. W. H. Whorley in the "Proceedings" of the Engineering Association of the South.

SOCIETY AFFAIRS.

The American Society of Civil Engineers met February 1 to listen to a discussion of Mr. John W. Hill's paper on water meters, in which Messrs. John Thomson, J. Waldo Smith and Clemens Herschel took part. Written communications on the subject from Messrs. James H. Harlow and William C. Hawley were also presented. The following names of successful candidates for admission to various grades were announced: As members: John Charles Churchill, Jr., Oswego, N. Y.; Thomas Amory Coffin, New York City; George William Frank, New York City; Edward Macaulay Hartrick, Galveston, Tex.; George Hill, New York City; Frank McMillan Stanton, Atlantic Mine, Houghton County, Mich.; Ellis Dunn Thompson, Philadelphia, Pa. As associate members: Frederic William Andros, Chihuahua, Mexico; Edwin James Beugler, Bridgeport, Conn.; Clinton Sumner Burns, Kansas City, Mo.; Theodore Lincoln Condron, Chicago, Ill.; John Thompson Eastwood, New Orleans, La.; Thomas J. Foster, New York City; George Rockwell Putnam, Washington, D. C.; Nicholas Doremus Wortendyke, Jersey City, N. J. As associates: Clarence Marvin Foster, Chicago, Ill.; Lawrence Cowle Phipps, Pittsburg, Pa. As juniors: George Corrie Bartram, Boston, Mass.; Frederick Edwards, Hudson, N. Y.; James Peter Whiskeman, New York City. On the evening of February 10 there will be an informal discussion on the subject of dry docks.

The Architectural League of New York will begin its fourteenth annual exhibition at the American Fine Arts Society's Building on February 11. The usual reception will be held on the evening of February 10.

The Michigan Engineering Society held its twentieth annual convention at Lansing January 24 to 26. In addition to a banquet, anniversary exercises and reports of committees, papers were presented by Messrs. H. E. Riggs, Harry Hodgman, A. L. Holmes, Owen Morris, O. H. Todd, Charles Holmes, J. J. Hubbell, A. L. Reed, T. O. Williams, J. G. McElroy, S. G. Jenks, R. W. Hawley and A. W. Barber. The convention was a very enjoyable one, and the report of the secretary shows that the society is in a prosperous condition. The officers nominated for the year are as follows: President, J. J. Hubbell, Manistee; vice-president, H. E. Riggs, Toledo, Ohio; secretary and treasurer, F. Hodgman, Climax.

The New England Water-Works Association will hold a meeting at Tremont Temple, Boston, on February 8, at which the subject of water filtration will be discussed by Messrs. G. W. Fuller, Allen Hazen, H. W. Clark and others.

PERSONAL NOTES.

Mr. T. Howard Barnes has been reappointed city engineer of Medford, Mass.

Mr. C. H. Keefer, of Ottawa, Canada, has been selected as engineer of the Hintonburg, Canada, water-works.

Mr. Alfred L. Maggi has been elected city engineer of Chelsea, Mass., and Mr. George E. Mitchell, water commissioner.

Mr. F. C. Prindle, M. Am. Soc. C. E., of the corps of engineers of the U. S. navy, has been stationed at Yerba Buena Island, California.

Mr. Clarence W. Marsh, recently in the volunteer engineer corps, has opened an office as civil and consulting engineer at 489 Fifth Avenue, New York.

Mr. William Twining has been promoted from the position of civil engineer of the Mauch Chunk division of the Jersey Central Railroad to that of assistant chief engineer of the entire road, with headquarters in Jersey City.

Mr. Nathaniel Roberts, M. Am. Soc. C. E., designing and consulting engineer, has removed his office from 120 Liberty Street to more commodious quarters in the Bowling Green Building, 11 Broadway, New York.

Mr. Reuben Shirreffs, M. Am. Soc. C. E., has been appointed chief hydraulic engineer of the Virginia Electric Railway & Development Company, of Richmond, and Mr. E. J. Willis has been appointed steam and electric engineer.

Mr. John McGhie has resigned his position as the head of the publication bureau of the General Electric Company to become the western representative of the "American Machinist." In the years which Mr. McGhie spent in the office he has just left, he made for himself an enviable reputation in the offices of technical journals for the courtesy and tact with which his difficult and important work was carried out. "The Engineering Record" feels sure that it voices the feeling of the technical press as a whole in congratulating its esteemed contemporary on securing this gentleman's services.

CONTRACTING NEWS

OF SPECIAL INTEREST TO

CONTRACTORS, BUILDERS, ENGINEERS, AND MANUFACTURERS

OF ENGINEERING AND BUILDING SUPPLIES.

For Proposals see pages 224, xi and xii.

WATER.

Redwood City, Cal.—The proposition to issue $14,000 bonds for relaying water mains and purchasing additional electric machinery is to be voted upon, according to reports.

Reidsville, N. C.—W. T. Wootton writes that a vote will probably be taken March 15 on the issue of bonds for water-works construction; estimated cost, $29,000. Surveys have been made by Henry E. Knox, Jr., of Charlotte, N. C. The tube well system is proposed and 9,000 ft. of 4-in., 16,000 ft. of 6-in. and 5,000 ft. of 8-in. pipe, with hydrants, valves, etc., will be required.

West Springfield, Mass.—At a special town meeting held Jan. 30 it was voted to issue $23,000 bonds for the extension of water mains, hydrants, etc.

Cripple Creek, Colo.—Local press reports state that there is a movement on foot to issue $250,000 bonds for the purchase of the water plant.

White Plains, N. Y.—Engr. John M. Farley of the Water Board has completed a map showing lands to be condemned as proposed site for the new reservoir.

Cleveland, O.—Local reports state that, in answer to a readvertisement for repairing the Worthington pump at the Division St. pumping station, the only bid received was from Henry R. Worthington, N. Y. City, for $11,000.

Fort Branch, Ind.—Press reports state that the question of constructing water-works and an electric light plant is under consideration.

Bay City, Mich.—Plans of the city water-works system and estimates for the water intake pipe have been submitted to the Council. The estimates place the cost of the intake pipe, with pumping station and water mains through the city, at $116,818.55.

Albany, N. Y.—It is stated that $100,000 water bonds and $30,000 public bath bonds will be sold Feb. 8 at the Chamberlain's office.

Clayton, N. Y.—Bids are wanted Feb. 10 for water-works and sewers. H. W. Morse, Village Clk.

Pine Island, Minn.—The Recorder has been authorized to advertise the sale of $6,000 water-works bonds.

Orchard Park, N. Y.—The Town Clerk writes that the Crystal Springs Water Co. of Buffalo, N. Y., has been granted a franchise to furnish water for the year ending Jan. 1, 1900.

Doylestown, Pa.—Wm. J. Wintzen, Engr. of the Water-Works, writes that bids will probably be asked about April 1 for the following work and supplies: 3 to 6 wells, 8 in. in diameter, air lift, 75-H. P. boiler, air compressor and pipe.

Rocky Mount, N. C.—J. C. Braswell, City Clk., writes that application will be made to the State Legislature, now in session, for authority to issue $40,000 water-works bonds.

McConnellsville, O.—Mayor L. J. Weber writes that bids will be readvertised for the $20,000 water bonds which were to have been sold Jan. 25.

Auburn, Me.—F. E. Bisbee, Supt. of Water-Works, writes that probably an extension of 1,700 ft. of 20-in. pipe will be required.

Allison, Ia.—It is stated that the Town Council is having plans prepared for a water system and will ask for bids at once.

Plymouth, N. H.—An amendment to the charter has been asked which will give the town the right to go outside the town's limits for a water supply.

Golden, Colo.—Local press reports state that $40,000 water bonds have been voted by the City Council for refunding and rebuilding.

Jefferson, Wis.—Julius Fix, Supt. of the Watertown water-works, is stated to be preparing plans for a standpipe system of water-works to be put in for the County Insane Asylum at Jefferson.

Antelope, Ore.—It is stated that the village has been authorized by the Legislature to issue $5,000 water-works bonds.

Stockton, Cal.—The property of the Woodbridge Canal and Irrigation Co. has been purchased by R. E. Wilhoit and W. D. Buckley of this city. According to local press reports, the new owners propose to build a pumping plant on the Mokelumne River.

Lestershire, N. Y.—The Water Board is stated to have awarded the contract for building a brick pumping station to E. W. Van Slyke of Lestershire at $2,296.

Rancho de Pader, Ariz.—The Cibola Canal Co. has been incorporated, with a capital of $25,000, for the purpose of irrigating by canals. Incorporators: C. O. McCarroll, M. Morris, E. G. Morris.

Brockton, Mass.—The City Clerk writes that it has been voted to ask the Legislature for the right to take water from Silver Lake. Chas. R. Felton, City Engr.

Tuskegee, Ala.—Bids are wanted Feb. 15 for a complete system of water-works, as advertised in "The Engineering Record."

Greensboro, N. C.—The City Clerk writes that the Legislature has granted the city authority to submit to a vote the question of issuing bonds to the amount of $300,000 for the purpose of buying present or constructing new water-works and electric light plant, completing the sewerage system; also curbing and macadamizing the streets.

Austin, Minn.—It is stated that the Council is considering various plans for securing a permanent water supply.

Niagara Falls, N. Y.—S. F. Arkush, City Clk., writes: "The authorities are considering the improvement of the water plant at a cost of $100,000, and if authorized a tax election will be called for early in March to vote on the issue of bonds. The improvements contemplated are a filtering plant, pumps, motors, boilers, buildings, etc."

Sedalia, Mo.—L. P. Andrews, Mgr. of the Sedalia Water & Light Co., writes that the proposed $40,000 electric light plant will not be built before next summer, as considerable work on the water plant will have to be completed before the light plant is built.

Lakeview, Ore.—The citizens have petitioned Legislature for authority to issue $20,000 water-works bonds.

Minneapolis, Minn.—Bids are wanted Feb. 10 for furnishing the Water Department with cast iron water pipe, special castings, fire hydrants, etc., for 1899. L. A. Lydiard, City Clk.

Cleveland, O.—Bids are wanted Feb. 24 for furnishing valves, fire hydrants, stop cocks, etc., for 1899. George R. Warden, Dir. Pub. Wks.

Waverly, Ia.—Bids are wanted Feb. 7 for sinking an artesian well. D. A. Long, City Clk.

Goldsboro, N. C.—The Goldsboro Water Supply Co. has been organized for the purpose of constructing and operating water works, with $100,000 capital stock. The officers are: Pres., James C. Fox; Treas., Harry M. Merrill, both of Portland, Me.

Glouster, O.—Local press reports state that a system of water works is to be built.

Oshawa, Ont.—The property owners have voted to issue $110,000 bonds for water works and a sewerage system.

Coopersburg, Pa.—It is stated that a vote will be taken at the February election on the issue of $20,000 bonds for the establishment of a water plant.

Utica, N. Y.—Local press reports state that the West Canada Water Works Co. has purchased 200 acres of land with a view to building a dam, which it is said will be nearly five miles in length.

Elgin, Ore.—It is stated that H. V. Gates, of Hillsboro, Ore., has secured the contract for a gravity water system and an electric light plant.

Alliance, O.—J. H. McConnell, City Clk., writes that the $81.000 water works bonds have been sold to W. J. Hayes & Sons, of Cleveland.

Fayetteville, Tenn.—It is stated that the Board of Aldermen has ordered the issue of $30,000 bonds for water works.

Grand Rapids, Mich.—The Board of Public Works has contracted with the Lake Shore Foundry Co. of Cleveland, O., to furnish all the water pipe which it shall need during the present year at $17.40 a ton.

New York, N. Y.—Bids are wanted Feb. 16 for laying water mains in several streets in the Boroughs of Manhattan and the Bronx. Wm. Dalton, Commr. Water Supply.

Albany, N. Y.—Chamberlain James Rooney on Feb. 8 will offer for sale $100,000 water bonds and $30,000 free public bath bonds.

Sacramento, Cal.—The Corporation Counsel has been instructed to prepare an ordinance providing for the submission to the people of the question of bonding for high school, wharf, sewers and water mains.

Silverton, Colo.—The City Council has appointed a committee to investigate and secure estimates on machinery, building, piping, etc., for a water-works and electric light plant, to be owned by the city.

Winnipeg, Man.—Bids are wanted April 3 for two pumping engines of 5,000,000 gals. capacity a day, as advertised in "The Engineering Record."

Amsterdam, N. Y.—Bids are wanted March 1 for an extension to the present water-works system, consisting of about 5 miles of 36 to 6-in. iron and vitrified pipe, as advertised in "The Engineering Record."

Springfield, Mass.—Local reports state that the contract for 1,070,100 pounds of piping and 22,400 pounds of special castings has been awarded to R. D. Wood & Co., Philadelphia, Pa., for $10,170.

Walla Walla, Wash.—The City Council has passed a resolution requesting the Fire & Water Committee to investigate the advisability of purchasing the water-works and constructing a sewerage system.

Columbus, O.—The City Board of Public Works has voted to advertise again for bids for a storage dam.

Jersey City, N. J.—Mayor Hoos on Feb. 1 signed the resolution awarding to Patrick H. Flynn, of Brooklyn, the contract for a new permanent water supply, to cost $7,595,000.

Philadelphia, Pa.—The Common Council has passed a bill appropriating $3,200,000 to be used to increase and improve, by filtration, the city's water supply, and the Select Council has passed the ordinance authorizing the Director of Public Safety to advertise for bids for the construction of a new pumping station, with a sedimentation basin and filtration beds, and a daily capacity of 150,000,000 gals., to be located on the Delaawre River above Lardner's Point.

Florence, Colo.—Local press reports state that the following bids were received Jan. 19 for the construction of water-works: Florence Construction Co., $102,000. R. P. McDonald Building Co., $100,925. Orman & Crook, Pueblo, $106,511.65. Mitchell Bros., cast-iron pipe, $132,000. Holmes & Allen, Denver, complete system, with cast-iron pipe, $104,697. Shutt Implement Co., system complete, cast-iron and sewer pipe, $103,000. Gettes & Seerie Stone Co., cast-iron and sewer pipe, *99,500; spiral riveted pipe, $88,500. H. C. McCreery, system complete, without dam, $89,786; tank, $6,650; reservoir, $17,400. Queen City Construction Co., cast-iron and sewer pipe, $135,000; tank, $7,000; reservoir, $11,800. H. M. Fox bid $6,700 for a supply tank, and the Stearns-Roger Manufacturing Co. $6,200 for same.

*Contract awarded.

Baltimore, Md.—The following bids for water-works for the Tuxedo & Emia Parks Water & Light Co. were opened Jan. 30 by D. G. Adelsberger, Engr., Baltimore, Md.; *a*, steel tower; *b*, pump house and tower foundations; *c*, specials, hydrants, valves, etc.: Broomell, Schmidt & Co., York, Pa., *a*, $5,075. New Jersey Steel & Iron Co., Trenton, N. J., *a*, $6,195. Tippett & Wood, Phillipsburg, N. J., *a*, $6,700. Albert Weber, Baltimore, *b*, $1,575. Julian P. Smith, Baltimore, Md., *b* and *c*, $2,806.28. Wheeler & Boody, Philadelphia, Pa., *a*, *b* and *c*, $12,776.09. W. Riley Weaver Co., Baltimore, *a*, *b* and *c*, $6,584.81. Van D. Hitesmith, Knoxville, Tenn., *a*, *b* and *c*, $11,567.62.

Canby, Minn.—Local press reports state that the following bids were opened Jan. 24 for a system of water-works: T. M. McGuire, St. Paul (including water tower), $10,992; Hess & Powell, Watertown, S. D., $6,976; John Degmann, Winona, $6,552.90; E. T. Webster, Dubuque, Ia., $6,661.98; S. N. O'Shea, Lincoln, Neb., $7,668; W. I. Gray & Co., Minneapolis, $7,500; Jackson, Moss & Co., Des Moines, Ia., $6,817; Mankato Plumbing & Heating Co., Mankato, Minn., *$6,389. The following bids were received for the water tower: J. A. Quirkenbush, Webster City, Ia., $3,444; Jackson, Moss & Co., $3.165; St. Paul Foundry Co., $3,375; W. I. Gray & Co., $2.823; Chicago Bridge & Iron Co., Chicago, $2.967; Mankato Plumbing & Heating Co., $2,784; E. T. Webster, $2,690.

*Contract awarded.

Goshen, Ind.—The following bids have been received by the Water Works and Light Committee for furnishing and laying water mains extension, (*a*, steel riveted pipe; *b*, cast iron pipe; *c*, valves and hydrants): C. W. Snyder & Son, Dayton, O., *a*, $8,504.26; *b*, $8,395.58. *H. D. Hallett, Aurora, Ill., *a*, $7,624.57; *b*, $7,632.51. Kinney & Swinehart, Elkhart, Ind., *a*, $8,870.89; *b*, $8,889.86. W. W. Hatch & Son, Goshen, *a*, $9,007.38; *b*, $9,226.66. Hawks Hardware Co., Goshen, *a*, $8,663.01; *b*, 8,954.79. T. C. Brooks & Son, Jackson, Mich., *a*, $8,988; *b*, $8,413. J. B. Gingley, Greenville, O., *b*, $8,137.32. Abendroth & Root Mfg. Co., N. Y. City, material only, *a*, $5,048.30. Law & Barber, Mendota, Ill., *a*, $11,470.80; *b*, $10,695.58. American Pipe & Fdy. Co., Chattanooga, Tenn., material only, *b*, $5,326.50. R. D. Wood & Co., Philadelphia, Pa., *c*, $427.25. Michigan Brass & Iron Works, Detroit, Mich., *c*, $471.75.

*Contract awarded.

SEWERAGE AND SEWAGE DISPOSAL.

Guthrie, Okla.—G. M. DeGroff, City Clk., writes that the proposition to issue $45,000 bonds for sewer purposes will probably be voted upon at the general election in April.

Massillon, O.—D. C. Barton, City Engr., writes that an extension of the sewer system is contemplated.

Clayton, N. Y.—See "Water."

Ann Arbor, Mich.—A bill has passed the House, authorizing the construction of a system of sewers.

Ft. Wayne, Ind.—Local press reports state that the Board of Public Works has decided to build an intercepting sewer, at an estimated cost of $150,000.

Hagerstown, Md.—Mayor Schnidel has appointed a committee to devise a plan for sewerage best adapted for Hagerstown.

Cleburne, Tex.—The City Council has granted a franchise to J. Steele, P. C. Chambers and E. T. Kelly to build a terra cotta pipe sewer.

Boston, Mass.—The Board of Aldermen has passed the order authorizing the appropriation of $1,000,000 for the construction of sewerage works.

San Francisco, Cal.—The Board of Supervisors has passed a resolution declaring its intention to construct pipe and brick sewers in numerous streets.

Syracuse, N. Y.—As the result of the investigation made by the City Engineer of the plan of deepening Harbor Brook south of the Erie Canal so as to provide for the sewerage of the southern part of the Ninth Ward, it is estimated that the improvement would cost $131,000.

Walla Walla, Wash.—See "Water."

Rochester, N. Y.—Local press reports state that the contract for building East Ave. sewer has been awarded to Thomas F. Kearney for $20,946.60.

Mt. Vernon, N. Y.—It is stated that bids are wanted Feb. 21 by the Common Council for $30,000 sewerage bonds.

Dayton, O.—City Engineer F. M. Turner has submitted plans and specifications for the construction of sanitary sewers on Grafton and Rockwood Aves., being part of sewer district No. 8.

Howell, Mich.—It is stated that plans are being prepared for a sewerage system. Estimated cost, $20,000.

Cambridge, Mass.—The Mayor has been authorized to ask the Legislature for power to borrow $400,000 outside the debt limit for sewers, and $500,000 for park purposes.

Taunton, Mass.—The Sewer Commissioners recommend the appropriation of $100,000 for sewer construction.

Waseca, Minn.—Press reports states that it is proposed to build a complete system of sewers in the spring.

Lacrosse, Wis.—The city is considering the proposition to issue $20,000 bonds for an intercepting sewer.

Victor, Colo.—It is stated that the Victor Sewer Co. will commence work March 1 on the construction of 4½ miles of sewerage. Cleary Bros., 32-69 Dearborn St., Chicago, are said to be interested.

Greensboro, N. C.—See "Water."

St. Louis, Mo.—E. E. Wall, Engr. of the Sewer Department, has reported that several sections of Mill Creek sewer are in need of reconstruction.

Salem, O.—It is stated that the lowest bid received Jan. 23 for a sewer in Lincoln Ave. was from Burt & Gunn, 1,000 cu. yds. of excavation, 25 cts.; 2,100 ft. of sewer pipe, 14 cts.

Denver, Colo.—According to local press reports the Board of Public Works has decided to award the contract for Capitol Hill storm sewer to James J. Fleetford. See our issue of Jan. 28 for list of bids received.

Woonsocket, R. I.—Bids are wanted March 6 for constructing section 4 of the sewerage system, as advertised in "The Engineerong Record."

Dunmore, Pa.—M. S. Knight, Boro Engr., writes: "We are contemplating the construction of a general sewer system, covering an area of about 850 acres and taking about 25 miles of sewer pipe and 1 mile of brick sewers. The plans and details of the brick sewer are already finished. The construction of this system depends upon the vote of the people at the spring elections."

Seattle, Wash.—Local press reports state that work on sewer contracts aggregating $100,000 will be started in a few weeks.

Niagara Falls, N. Y.—The Common Council on Jan. 30 authorized the construction of 16 short sections of sewers, to cost about $28,000. S. F. Arkush, City Clk.; Walter Jones, Engr. in Charge, room 52 Gluck Bldg.

Buffalo, N. Y.—Bids are wanted Feb. 15 for a 20 and 18 in. tile sewer. R. G. Parsons, Secy. Bd. Pub. Wks.

Neenan, Wis.—Bids are wanted Feb. 11 for an outfall sewer in Little Lake Butte des Morts in connection with the sewerage system of Dist. No. 1. W. L. Davis, Chmn, B. Pub. Wks.

New Orleans, La.—Bids are wanted by the Drainage Commission Feb. 8 for $250,000 bonds. R. M. Walmsley, Pres. Drainage Com.

Syracuse, N. Y.—Bids are wanted Feb. 6 for 12, 18 and 24-in. brick sewers. M. Z. Haven, City Clk.

Grass Valley, Cal.—It is stated that bids are wanted Feb. 14 by the Clerk Board of City Affairs for $40,000 sewerage bonds.

Hamilton, Ont.—The Sewer Committee will ask the Council for $30,000 for sewer construction. The Engineer has recommended the establishment of an incinerator in connection with the sewage disposal works and the laying out of filter beds.

Buffalo, N. Y.—The Board of Public Works has been directed to have prepared plans for a system of sewers in the territory bounded by Main St., the Erie R. R. and Kenmore Ave.

Cleveland, O.—The Board of Control has recommended that Director of Public Works Warden be authorized to advertise for bids for the construction of the fourth and last section of the Walworth Run sewer.

Sioux City, Ia.—It is stated that City Engineer Lewis has completed plans for the sewerage system at Smith's Villa.

Little Falls, N. Y.—The following bids for sewer work on the south side were opened Jan. 18 by P. S. Herlehy, City Clk.; Engineer in Charge, S. E. Babcock; Halliman Bros. & Fenton, Little Falls, N. Y., $22,396; Geo. W. Van Vranken, Schenectady, N. Y., *$17,870.
*Contract awarded.

Elkhart, Ind.—The following bids for 3,335 ft. of 12 to 18-in, pipe sewers in Middlebury St. were opened Jan. 26 by Kit McKean, City Clk. Engineer in Charge, D. F. Cordrey: Kinney & Swinehart, Elkhart, Ind., *$2,555.02; Smith & Madlem, Goshen, Ind., $2,731.55; Jno. W. L. Moran, Elkhart, Ind., $3,182.35; W. W. Hatch & Son, Goshen, Ind., $2,984.98; Norton & Gilmore, Terre Haute, Ind., $3,018.62.
*Contract awarded.

Toledo, O.—The following bids for 2,200 ft. of pipe sewers, from 12 to 24 in. in diameter, were opened Jan. 30 by Lem. P. Harris, City Clk.; Engineer in Charge, W. F. Brown; *a*, sewer 726; *b*, sewer 727: James Sheehan, *a*, $1,740.80; *b*, $760.56. Wm. J. McMahon, *a*, $2,549.30; *b*, $774.60. H. J. Bower, *a*, $2,037.50; *b*, $864. G. H. Bodette, *a*, $2,541.48; *b*, $817.68. Thomas Kelley, *a*, $2,005.54; *b*, $895.08. O'Sullivan & Sheehan, *b*, $763.44.
Bidders all of Toledo.

BRIDGES.

Carleton, N. Y.—The question of constructing an iron highway bridge to cross Oak Orchard Creek at Waterport is to be submitted to the voters at the town meeting in March. Estimated cost of bridge, about $12,000.

Osage, Ia.—The Chicago Bridge & Iron Co., Chicago, Ill., is stated to have received the contract for two bridges. Amount of contract, $5,000.

Williston, N. D.—County bridge bonds to the amount of $3,000 have been sold.

Otranto, Ia.—The Board of Supervisors will construct a steel bridge across Cedar River, to replace the present structure.

Independence, Kan.—It is stated that the Montgomery County Board has decided to build a steel bridge over Irish Creek in West Cherry Township.

Savannah, Ga.—It is stated that the Directors of the Georgia & Alabama R.R. Co. and the Georgia & Alabama Terminal Co. authorized President J. S. Williams to contract for the construction of a steel drawbridge across the Savannah River between Savannah and Hutchinson's Island. Estimated cost, $250,000.

Binghamton, N. Y.—Plans for a bridge across the Susquehanna River at Tompkins St., submitted by the Groton Bridge Co., Groton, N. Y., have been accepted. The committee appointed by Council recommends the appropriation of $40,000 for its construction.

Franklin, N. H.—The construction of a steel bridge over Pemigewasset River at Central St. is under consideration.

Wilmington, Del.—The Edge Moor Bridge Wks., Wilmington, Del., are stated to have received the contract for an iron bridge over the race at Market St. for $3,100.

Waterville, Me.—Local press reports state that the Ticonic Foot-bridge Co. will petition the Legislature for a charter to construct a steel bridge over the Kennebec River, between Waterville and Winslow, at an estimated cost of $20,000. Incorporators: William T. Haines, Harvey D. Eaton and others.

Shreveport, La.—The Council granted to the Shreveport Bridge & Terminal Co. the right to build, maintain and operate its bridge, approaches and railroad tracks across the Red River.

Washington, D. C.—A bill passed the House of Representatives, granting to the Rutland Canadian R. R. the right to construct bridges across Lake Champlain.

Council Bluffs, Ia.—It is stated that the Chicago, Rock Island & Pacific R. R. will construct 5 steel bridges over Indian Creek. R. R. Cable, Pres., Chicago, Ill.

Birmingham, O.—We are informed that plans are being prepared for the proposed bridge at Birmingham. J. C. Hausen, Pres. Board of County Commrs., Sandusky, O.

Hamilton, O.—Bids are wanted Feb. 24 (re-advertisement) for repairing Main and High St. bridge. H. C. Gray, Co. Aud.

New York, N. Y.—The Board of Aldermen has authorized the Controller to issue $1,500,000 bonds, to be used in finishing the work on the new East River bridge.

Valley City, N. D.—Bids are wanted Feb. 7 for a 100-ft. steel span bridge on iron piers. Homer Pike, Chmn. Road & Bridge Com.

New York, N. Y.—Bids are wanted Feb. 16 (change of date) for reconstructing the Blissville bridge over Newtown Creek. John L. Shea, Com. of Bridges.

Walmer, Ont.—It is stated that bids are wanted Feb. 10 for steel superstructure and stone abutments of a 70-ft. bridge over the Thames River in East Zorra Township. Address Thomas Lockart.

Monticello, Mo.—It is stated that bids are wanted Feb. 27 for 2 iron bridges, 100-ft. span each. George H. Roberts, Chmn. Co. Commrs.

Syracuse, N. Y.—A bill has passed the Senate authorizing the appropriation of $10,000 for a steel girder bridge over Onondaga Creek at Rich St. A bill has passed the Assembly appropriating $6,000 for a steel girder bridge over Onondaga Creek at West Fayette St.

Rockland, Mich.—The following bids for a steel bridge across the Ontonagon River were opened Jan. 23 by M. McKay, Township Clk.: R. D. Wheaton Bridge Co., Chicago, Ill., 83-ft. span, *$1,479; 90-ft. span, $1,495. King Bridge Co., Cleveland, O., 83-ft. span, $1,450; 90-ft. span, $1,675; 90-ft. span, $1,465. Wisconsin Bridge Co., Milwaukee, Wis., 79-ft. span, $1,480; 90-ft. span, $1,492.
*Contract awarded.

Torrington, Conn.—Walter Holcombe, Town Clk., writes that action will probably be taken at the annual town meeting, to be held Feb. 6, on the request for a bridge over the Naugatuck River between Torrington and Harwinton; the latter town has voted to pay one-half the cost of building.

Waverly, Ia.—The following bids for a steel girder bridge across Cedar River at Bremer Ave. were opened Jan. 24 by the County Auditor: *a*, complete structure; *b*, complete structure except woodwork: Toledo Bridge Co., Toledo, O., *a*, $18,983; *b*, $15,990. King Bridge Co., Cleveland, O., *a*, $22,198; *b*, $19,598. Wabash Bridge Co., *a*, $20,577; *b*, $18,077.95. Clinton Bridge & Iron Wks., Clinton, Ia., *a*, $24,332; *b*, $21,316. Canton Bridge Co., Canton, O., *a*, $23,000; *b*, $21,000. B. F. Parks & Co., *a*, $19,873. J. B. Marsh & Co., *a*, $21,550; *b*, $19,200. Wisconsin Bridge & Iron Co., Milwaukee, Wis., *a*, $20,885; *b*, $17,475. A. E. Shorthill & Co., Marshalltown, Ia., *a*, $22,500. Wagner Bridge Co., Milwaukee, Wis., *a*, $21,900; *b*, $19,160.

Buffalo, N. Y.—The following bids were opened for bridge work in connection with the deepening and widening of Buffalo River and Cazenovia Creek:

Bidders.	Abbott Road Abut'nts and Pier.	Bailey Ave. Abut'nts and Pier.	South Park Ave Abut'ts.	South Ogden St. Abut'ts.
The Donnelly Contracting Co....	$34,943.71	$45,442.07	$22,875.91	......
B. I. Crooker	21,315.00	30,624.00	15,534.06	$9,145.00
Geo. Parks & Sons	20,612.00	28,295.00	17,045.06	9,983.00
W. F. Boysen.....	16,500.00	21,475.00	15,300.00	9,260.00
Rumill & Carter...	20,301.00	25,377.00	17,168.00	10,141.00
Dwyer & Huntington..........	21,183.00	28,216.00	17,582.00	11,215.00
Chas. Mosier.....	25,976.00	33,071.00	24,554.00	15,556.00
Craigie, Cristiana & Co......	26,063.49	....	14,269.00	....
Brown, Stabell & Griffiths.........	20,779.00	28,768.00	17,985.00	10,279.00
Chas. Steinwachs.	......	....	14,290.00	8,490.00
Wm H. Fitzpatrick	....	......	15,316.00	8,897.00
Sapienza & Maggio	...	....	17,900.00	....

Bidders all of Buffalo, N. Y.

Bids received for the superstructures were as follows: *a*, Abbott Road New Bridge; *b*, Abbott Road Removal; *c*, Bailey Ave.; *d*, South Park Ave. Kellogg Iron Wks., Buffalo, N. Y., *b*, $3,700. Buffalo Bridge and Iron Wks., Buffalo, N. Y., *a*, $15,404; *b*, $2,400; *c*, $13,995; *d*, $7,316. Frank Snyder, Buffalo, N. Y., *b*, $3,480. Henry Clark, *a*, $19,273; *b*, $2,936; *d*, $8,600. Toledo Bridge Co., Toledo, O., *a*, $18,145; *b*, $2,425; *d*, $8,735.

PAVING AND ROADMAKING.

Kokomo, Ind.—City Clerk Chas. R. Ford writes that the contract for 11,000 yds. of brick paving and 5,000 ft. of curbing has been awarded to the Capitol Paving Co., Indianapolis, Ind., for $17,720.

Washington, D. C.—Bids are wanted March 4 for paving B St. with vitrified block, as advertised in "The Engineering Record."

Jackson, Miss.—Walter G. Kirkpatrick, City Engr., writes that estimates have been ordered prepared for paving Capitol St. with vitrified brick. D. P. Porter, Jr., City Clk.

Bridgeport, O.—Paving bonds to the amount of $75,000 are to be sold March 1. Hoge & Hix, Engrs., Wheeling, W. Va.

Denver, Colo.—It is stated that bids are wanted Feb. 6 by the Board of Public Works for repairing asphalt paved streets and alleys during 1899.

Portsmouth, O.—Bids are wanted Feb. 27 for paving about 23,000 sq. yds. with brick. J. C. Adams, City Clk.

Pueblo, Colo.—E. W. Hathaway, City Engr., writes that a bill has been introduced in the Legislature granting Pueblo the right to pave the streets.

Reading, Pa.—Bids are wanted Feb. 8 for $100,000 paving bonds. H. H. Hammer, City Clk.

Albany, N. Y.—Superintendent of Parks Egerton has prepared plans for a boulevard from Delaware Ave. to a point on the New Scotland road; cost about $10,000.

Cleveland, O.—Bids are wanted March 2 for paving several streets with asphalt, brick, Medina common stone and dressed block pavement. George R. Warden, Dir. Pub. Wks.

Rockledge, Pa.—It is stated that the citizens have under consideration the proposition to issue $20,000 bonds for the purpose of macadamizing.

Grand Rapids, Mich.—The City Engineer has estimated the total cost of paving Canal St. with brick at about $36,000.

Sherman, Tex.—It is stated that Travis St. is to be repaved.

Hartford, Conn.—The following bids for sewers were opened February 1, by Chas. H. Northam, Pres. Bd. of St. Commrs., as advertised in "The Engineering Record:" *a*, Michael O'Neil, Hartford, Ct.; *b*, M. Russo & Co., Boston, Mass.; *c*, P. H. Harrison & Sons, New York City; *d*, James C. Smith, Hartford, Ct.; *e*, Thos. F. Maher, New Haven, Ct.; *f*, Maloney & Peterson, Springfield, Mass.; *g*, E. R. Patterson Cons. Co., New York City; *h*, Edw'd McManus, Waterbuty, Ct.

Buckingham St. Sewer.

	42-in. Oval Brick.	30-in. Oval Brick.	24-in. Tile.	18-in. Tile.	13 ft. House Connections.	20 ft. House Connections.	Manholes.	Total.
a,	$4.32	$3.58	$1.87	$1.52	$11.50	$13 00	$33.00	$5,961.90
b,	7.65	6.90	2.89	2.42	10 00	15.00	35.00	9,902.50
c,	3.50	2.90	2.00	1.35	6.00	8.00	30 00	4,788.50
d,	4.39	3.25	1.50	1.26	6.00	8 00	32.00	5,161.30
e,	3.79	3.15	1.47	0.96	7.50	10.05	30.00	5,028.55
f,	4 60	4.30	2.00	1.80	6.00	7.00	27.50	6,368.50
g,	4.50	3.70	2.25	1.83	4.87	7.50	30.00	5,839.41

Vine & Capen St. Sewer.

	24-in. Tile.	20-in. Tile.	18-in. Tile.	15-in. Tile.	12-in. Tile.	10-in. Tile	Man-Holes.	Plank.	House Connections.	Total.
a,	$2.85	$2 67	$2.35	$1 67	$1.10	$0.95	$33.00	$23.00	$11.00	$10,637.40
b,	2.96	1.99	2.75	1.84	1 63	1 55	40.00	20.00	15.00	11,870.90
c,	1.75	1.20	1.25	1.00	.65	.60	30.00	20.00	5.00	6,305.50
d,	1.81	1.49	1.31	.94	.74	.69	32.00	20.00	7.00	6,908.40
f,	1.85	1 75	1.80	1.15	1.05	0.95	27.50	20.00	6.00	7,482.00
g,	2.40	1.55	1.75	1.16	.81	1 00	35.00	25.00	9.44	8,670.68
h,	3.50	2.95	2.75	1.67	1.49	1.35	62.00	25.00	12.00	12,692.90

Fulton, N. Y.—Plans and specifications prepared by O. C. Breed, Village Engr., for Second St. improvement, have been approved by the Chief Engr. of the N. Y., O. & W. R. R. Co.

Mobile, Ala.—The House has passed a bill authorizing Mobile to issue bonds for paving and street improvements.

Quincy, Ill.—The Board of Local Improvements has adopted the resolution for paving 46 blocks with brick. Estimated cost, $109,200.

Rochester, N. Y.—Local press reports state that the contract for paving So. Fitzhugh St. with asphalt has been awarded to Whitmore, Rauber & Vicinus, of Rochester, for $8,298.95.

Bloomfield, N. J.—Bids are wanted Feb. 6 for paving Broad St. with Telford. Thomas McGowan, Dir. Com. on Roads and Assessments of Bd. Freeholders, Essex Co.

Gloversville, N. Y.—The Council has under consideration brick paving for 1899 estimated to cost about $33,000.

Chicago, Ill.—Property-owners are desirous of having Haymarket Sq. paved with granite block. Estimated cost, $2.75 a yd.

Maysville, Ky.—It is proposed to pave the principal streets with brick or asphalt.

Frankfort, Ind.—Local press reports state that West Clinton St. is to be paved.

Chicago, Ill.—A bill is about to be introduced in the Legislature, authorizing the building of a lake shore boulevard on the South Side, connecting the South Side parks with the North Side boulevard system.

Shamokin, Pa.—An ordinance has been passed authorizing the paving with brick and curbing of portions of Shamokin St. M. C. Farrow, Chief Burgess.

Baltimore, Md.—The Board of Public Improvements has decided to report favorably ordinances to macadamize several streets.

Anderson, Ind.—It is stated that bids are wanted Feb. 20 for paving several streets with brick, asphalt or block pavement.

Joplin, Mo.—Bids are wanted March 7 for asphalt paving. S. J. McKee, City Engr.

Cleveland, O.—Bids are wanted Feb. 16 for paving several streets with brick. George R. Warden, Dir. Pub. Wks.

Buffalo, N. Y.—The following bids were received for paving approaches to bridges to be built in connection with the widening and deepening of Buffalo River (a, price per yard of 42,205 cu. yds. of embankment; *b*, price per yd. of 7,150 sq. yds. of paving): The German Rock Asphalt Paving & Cement Co., Buffalo, *a*, 49c.; total, $20,680.45; *b*, $2.79; total, $19,948.51. The Barber Asphalt Paving Co., of New York City and Buffalo, *a*, 40c.; total, $16,882; *b*, $2.73; total, $19,519.

POWER PLANTS, GAS AND ELECTRICITY.

Torrington, Conn.—We are informed that the Torrington Electric Light Co. proposes to construct a gas plant at a probable cost of $100,000. Chas. H. Nettleton, Engr. in Charge, Derby, Conn.

Perry, Ia.—John Swearingen and Frank Dobson have purchased the plant of the Perry Electric Light Co. It is stated that it is proposed to extend the system.

Camden, N. Y.—The Camden Gas Light Co. has been formed; capital, $2,000. Stockholders: John P. Dorrance, of Camden; E. Chapman, of Oneida, and others.

Rome, Ga.—The Council is stated to have appointed a committee to investigate the question of constructing an electric light plant.

Grayson, Ky.—There is talk of constructing an electric light plant.

Baltimore, Md.—The American Vitrified Conduit Co., of New York City, is stated to have received the contract for 1,000,000 ft. of multiple duct, to be used in the city subways during 1899, at prices ranging from 4⅝ to 7 cts. a ft. a duct; contract said to amount to about $60,000.

Sedalia, Mo.—See "Water."

Corsicana, Tex.—The Council is stated to have granted franchises to L. C. Garrett & Co. to erect a gas plant to manufacture and sell gas; and to W. L. Gatlin & Co. to erect a gas plant for the purpose of storing and using natural gas; also for the laying of pipes, etc.

Darlington, O. T.—Bids are wanted Feb. 28 for a gasoline-gas plant at the Arapahoe Boarding School, Cheyenne & Arapahoe Agency. W. A. Jones, Commr. Indian Affairs, Dept. of the Interior, Washington, D. C.

Frankfort, Ky.—The Franklin Electric Co. has been incorporated to furnish electric lights in the town; capital, $15,000. Stockholders: Benjamin F. Gardner, W. H. Isbell and J. E. Potter.

Pottsville, Pa.—See "Government Work."

Monticello, Ark.—The Monticello Electric Light & Power Co. is stated to have received a franchise for an electric light plant.

Whitman, Mass.—John R. Graham, of Quincy, is reported to have purchased the electric light plant. It is stated that the system will be improved and extended.

Glenwood, Ill.—See "New Schools."

Greensboro, N. C.—See "Water."

Chicago, Ill.—The Warren Electric Mfg. Co., of Sandusky, is stated to have received the contract for the electrical machinery for the new lighting plant to be placed in the stockyards of the Armour Co.

Des Moines, Ia.—It is reported that the Des Moines Electric Co. will expend about $300,000 on improvements and extensions.

Akron, O.—See "Government Work."

Hagerstown, Md.—M. L. Byers, City Clk., writes that the municipal ownership of the electric light plant is under consideration.

Oswego, N. Y.—The plant of the People's Electric Light Co. is said to have been sold to a new company. According to reports, it is proposed to improve the plant, purchase new machinery, etc.

Fredericksburg, Va.—An election will be held Feb. 28 to vote on the question of constructing an electric light plant.

St. Albans, Vt.—See "Government Work."

Lynchburg, Va.—It is stated that the Board of Electrical Control will receive applications Feb. 10 for an electrical engineer. He must be a competent and experienced electrician and a graduate of a technical school. J. M. B. Lewis, 9th St., Secy. Pro Tem.

Pine City, Minn.—F. McCormack, of Duluth, is stated to have received a franchise for an electric light plant.

Ulen, Minn.—It is stated that there is a proposition before the Council for an electric light plant.

Madelia, Minn.—The question of putting in an electric light plant, to cost about $5,000, will probably be voted on at the spring election.

Penn Yan, N. Y.—It is stated that the plant of the Penn Yan Electric Light & Power Co., at Seneca Mills, will be improved. Calvin Russell, Pres.

Bradford, Ill.—A. M. Deyo, H. B. Hinman and J. P. Code are stated to have been appointed a committee to purchase additional electric machinery.

Atkinson, Ill.—A petition is stated to have been presented to Council for an electric light plant.

Waterloo, Ia.—The Citizens' Heat, Light & Power Co. has been incorporated; capital, $100,000. C. W. Mullan, Pres.; J. E. Sedgwick, Secy.

Albany, N. Y.—Harry H. Bender, Supt. Pub. Bldgs., is stated to have been directed to investigate the cost of installing and maintaining an electric light plant for the Capitol and other State buildings.

Port Huron, Mich.—The Michigan Development Co. is stated to have received a franchise for a gas plant.

Baltimore, Md.—Bids are wanted Feb. 8 for incandescent gas burners and fixtures. Wm. H. Swindell, Gen. Supt. of Lamps, etc.

Columbus, Ga.—The Stanley Electric Mfg. Co., 39 Cortlandt St., New York city, has received the contract for furnishing 3 generators to the Columbus Power Co. The contract price is about $60,000.

Tuskegee, Ala.—Bids are wanted Feb. 15 for a complete electric light plant, as advertised in "The Engineering Record."

Portland, Me.—See "Government Work."

Lake Charles, La.—H. B. Milligan writes that in April he proposes to build an electric light plant, to cost $3,500, in connection with the ice and cold storage plant.

Sidney, O.—At the coming election the citizens will probably be asked to vote on the question of issuing $15,000 for a city electric light plant.

Louis Kah, Jr., is stated to have applied for a franchise for an electric light plant.

San Francisco, Cal.—The Board of Supervisors on Jan. 23 is stated to have adopted a resolution authorizing the Mayor to employ an expert to prepare a report on the question of constructing a municipal electric light plant, the report to be submitted within 60 days.

Baltimore, Md.—Bids are wanted Feb. 15 for a complete electric lighting plant for the Mount Royal Pumping Station, as advertised in "The Engineering Record."

Fond du Lac, Wis.—M. B. Helmer is said to be considering the matter of putting in an electric power plant.

Lonetree, Ia.—Morse & Zimmerman are stated to have received a franchise for an electric light plant.

Cheyenne, Wyo.—It is proposed to construct an electric light plant at an estimated cost of $14,000. H. B. Patton, City Engr.

Boscobel, Wis.—Bids are wanted Feb. 10 for an electric light plant. C. W. Menkhausen, City Clk.

Matawan, N. J.—It is stated that bids are wanted Feb. 10 by the Middlesex & Monmouth Electric Light, Heat & Power Co., New York, N. Y., for furnishing a 250 H.-P. Corless engine, 250 H.-P. boilers, 150 K.-W. alternating dynamos, etc., for its proposed light and power plant.

Butler, Pa.—Bids are wanted Feb. 7 for between 70 and 80 electric lights of 1,200 and 2,000 c. p. for lighting the streets. J. W. Graham, Chmn. Light Com. of the Town Council.

Silverton, Colo.—See "Water."

New York, N. Y.—Bids are wanted Feb. 20 for supplying gas to the Correction Institutions on Blackwell's Island for 1899, to the Kings County Penitentiary, Brooklyn Borough, for city prisons, etc., under the control of the Dept. of Correction for 1899, and for the electric current necessary to supply the electric lights of the City Prison for 1899. Francis J. Lantry, Commr. of Correction.

ELECTRIC RAILWAYS.

Norwalk, Conn.—We are informed that the Norwalk Tramway Co. proposes to make extensions that will cost about $60,000. Bids for same will probably be asked in March. C. N. Wood, C. E., of Norwalk, Engr. in Charge.

Kansas City, Mo.—The Brooklyn Ave. Ry. Co. is stated to have applied for a franchise on Grand Ave.

Florence, Colo.—It is stated that a survey is about to be made for an electric railway between this place and Canon City. Thos. Robinson of Florence, Supt. United Oil Co., is said to be interested.

York, Pa.—The York St. Ry. Co. is stated to have petitioned the Council for permission to extend its line.

Marysville, O.—The Marysville, Richwood, Magnetic Springs & Delaware Electric Ry. Co. is stated to have petitioned the County Commissioners for a franchise. J. P. Eubanks, Secy. Magnetic Springs.

Schuylkill Haven, Pa.—It is stated that surveys are being made for extending the Schuylkill Electric Railway system from this place to Pine Grove, a distance of about 20 miles.

Fort Smith, Ark.—W. D. Boye & Co., Engrs., of St. Louis, Mo., have secured a contract from the Ft. Smith Traction, Light & Power Co. to build an electric railway, with power house, etc.

Cleveland, O.—The County Commissioners are stated to have granted W. H. Ford a franchise for a belt street railway line.

Glendale, O.—The Millcreek Valley St. Ry. Co. is stated to have received a franchise.

Doylestown, Pa.—The Quakertown Traction Co. is stated to have petitioned for a right of way through the borough.

Hamilton, O.—The County Commissioners are stated to have granted a franchise to the Hamilton & Eaton Electric St. R. R. Co.

Burlington, Ia.—The St. Ry. & Electric Light Co. will probably extend its line to West Burlington the coming season.

Warsaw, Ind.—Noah J. Clodfelter is stated to have received a franchise.

Atlanta, Ga.—The County Commissioners are stated to have granted the Consolidated St. Ry. Co. a franchise to extend its line along East Point and Howell's mill roads.

Portsmouth, Va.—The Portsmouth & Smithfield R. R. Co. has been organized to construct a line about 35 miles long; capital $20,000. R. E. Boykin, of Smithfield, is one of the incorporators.

Dayton, O.—It is stated that the Dayton & Eastern Traction Co. has been organized to construct and operate an electric railway between Dayton and Xenia.

Rochester, N. Y.—The State Railroad Commissioners are stated to have granted the Sodus Electric Ry. Co. a franchise to construct a railway from Rochester to Sodus Point; the road will be about 40 miles long. Thos. J. Nicholl, Pres.; Chas. Van Voorhis, Secy.

Rockford, Ill.—A charter has been granted to the Rockford & Belvidere Electric Ry. Co. to construct an electric railway between Rockford and Belvidere; capital $50,000. Incorporators: H. L. Jewell, W. H. Vorhis and others.

Kokomo, Ind.—W. P. Stevens, of Detroit, owner of the Kokomo Electric Light Works, is stated to have purchased the Kokomo Electric Railway. It is stated that the road will be bonded for $90,000 and the system improved and extended.

Palmer, Mass.—C. D. Shepard, Supt. of the Palmer & Monson Street Ry. Co., writes that the company intends to extend its line from Palmer to Monson and from Forest Lake to Ware, a total length of 10 miles. W. E. Brainerd, Engr.

Breslau, Germany.—The "Washington Star" states that United States Consul Erdman at Breslau, Germany, has informed the State Department for the benefit of American manufacturers of and dealers in street car rails, electric motors, wire and electic supplies, that the street car company of Breslau, which has been using horse power, has been granted the privilege by the city authorities to employ electric motive power at the expiration of its present charter, which will be in 1902.

Philadelphia, Pa.—The Lindley Ave. Ry. Co. and the Fisher's Lane Ry. Co. have been incorporated, to construct two electric railways within the city limits. The incorporators of both companies are: Geo. W. Elkins, Michael Ehret, David C. Golden and others.

Bridgeton, N. J.—The Lawrence Township Committee is stated to have passed an ordinance granting the Bridgeton & Millville Trolley Co. a franchise to extend its line to Cedarville.

Lake Geneva, Wis.—The Chicago, Harvard & Geneva Lake R. R. Co. has been incorporated, to build an electric line from Harvard to the Wisconsin Summer resort lakes in the neighborhood of Lake Geneva; capital, $150,000. Incorporators: C. T. Bundy, of Eau Claire, and L. C. Church, of Walworth.

White Plains, N. Y.—The New York, Westchester & Connecticut Traction Co., on Jan. 28, filed with the Secretary of State a certificate of the extension of its route from Mount Vernon to White Plains and Bronxville.

Brooklyn, N. Y.—The Brooklyn Union Elevated R. R. Co. has been incorporated with a capital of $18,000,000. It is organized to operate the franchises of the Brooklyn Elevated R. R. Co., the Union Elevated R. R. Co. and the Seaside & Brooklyn Bridge Elevated R. R. Co. Directors: Fredk. P. Olcott, of Bernardsville, N. J.; James T. Woodward and Edw. Lauterbach, of New York city; William Halls, Jr., of Summit, N. J., and others.

Boulder, Colo.—E. K. Stafford, City Clk., writes that W. C. Dyer, Guy D. Duncan, E. C. Allen and J. W. Deane hold a franchise from the city to build a line to the Chautauqua Grounds by June 1.

Greenwich, N. Y.—The Greenwich & Schuylerville Electric R. R. Co., on Jan. 30, filed a certificate with the Secretary of State for an extension of its line.

RAILROADS.

Loganville, Wis.—It is stated that a company has been formed to construct a railroad from this place to connect with the Chicago & Northwestern Railroad at Ableman, a distance of about 16 miles.

Portsmouth, O.—The Portsmouth & Ohio Valley R. R. Co. has been incorporated to build a railroad on the west side; capital $30,000. Incorporators: I. Reitz, Geo. E. Kricker and others.

Minneapolis, Minn.—It is reported that the Minneapolis & St. Louis Road will build about 150 miles of new road this year. A. L. Mohler, Gen. Mgr., Minneapolis.

Chattanooga, Tenn.—The Tennessee & Round Mountain R. R. Co. has been formed to build a line from the terminus of the Chattanooga & Lookout Mountain Railroad to a point on Round Mountain, a distance of about 12 miles; capital $50,000. Incorporators: Wm. L. Frierson, Lewis Shepherd and others, of Chattanooga.

Denison, Ia.—The Chicago & Northwestern R. R. Co. is stated to have completed plans for a new line from Denison to Wall Lake, Ia. An extension will also be built to Mondamin, on the Sioux City & Pacific. The entire length of the two additions will be 101 miles. Marvin Hugitt, Pres., Chicago.

Little Rock, Ark.—The City Council on Jan. 26 passed an ordinance granting the Choctaw & Memphis R. R. Co. right of way through the city. Mr. Wood, Gen. Mgr.

Carrollton, Ill.—The Quincy, Carrollton & St. Louis R. R. Co. has been incorporated, to construct a line from Quincy to Vandalia; capital $500,000. General office to be at this place. Incorporators: L. P. Peebles, Carlinville; Ornan Pierson, Carrollton; David R. Francis, St. Louis, and others.

PUBLIC BUILDINGS.

Birmingham, Ala.—Bids are wanted Feb. 13 for an administration building and northeast wing for St. Vincent's Hospital. T. U. Walter & Ullman, Archts.

Des Moines, Ia.—The plans of Smith & Gutterson, of Des Moines, have been accepted for the proposed city library.

Carrollton, Mo.—It is reported that Carroll County will vote on issuing $60,000 court house bonds.

Keokuk, Ia.—John W. Young, of Keokuk, is stated to have received the contract for the Y. M. C. A. building at $21,100.

Alexandria, La.—Plans, specifications and bids are wanted Feb. 22 for a jail to cost between $15,000 and $25,000. W. C. James, Pres. Police Jury, Boyce, La.

Albany, N. Y.—See "Water."

Cambridge, Mass.—A. W. Strauss, 151 Franklin St., Boston, will build an apartment house on Massachusetts Ave. Estimated cost $150,000. No contracts let.

White Plains, N. Y.—It is reported that the Board of Supervisors will receive plans Feb. 14 from architects in Westchester County for the proposed $100,000 addition to the county buildings. Mr. Secor, Chmn. Bldg. Com.

Mercersburg, Pa.—The Board of Regents of the Mercersburg Academy are stated to have decided to erect a $20,000 building. John Shook, of Greencastle, and A. R. Schnebly, of Mercersburg, are on the board.

Fort Worth, Tex.—It is stated that the contract for the construction of a $200,000 union station will be awarded Feb. 10 by the Texas & Pacific R. R. Co.

Holly Springs, Miss.—St. Thomas Hall, recently burned, will be rebuilt at a cost of $25,000. Address Rev. P. G. Sears.

Petoskey, Mich.—A 3-story brick hotel is to be erected by N. J. Perry, of Petoskey, at an estimated cost of $20,000. Mead & White, Lansing, Archts.

Pittsburg, Pa.—Wm. Miller & Sons, Carnegie Bldg., Pittsburg, are stated to have received the contract for remodeling the Blakewell Law Building; contract price said to be $50,000.

Iowa City, Ia.—The plans of Proudfoot & Bird, of Des Moines, are stated to have been accepted for a $200,000 college for the State University of Iowa.

Holyoke, Mass.—It is stated that a $50,000 public library is to be erected here.

Boston, Mass.—David S. Hammond, of the Murray Hill Hotel, New York City, is reported to be interested in the erection of an $850,000 hotel on East and Essex Sts.

Greensburg, Ind.—Phillip Jeckyle, of Anderson, is stated to have received the contract for the Indiana Odd Fellows' Home; probable cost, $25,000.

Piqua, O.—It is stated that a new edifice, to cost about $20,000, will be erected for the St. James' Episcopal Church.

New York, N. Y.—Whitney Warren, 160 5th Ave., is stated to have completed plans for a 6-story building for the New York Yacht Club.

Chicago, Ill.—A committee composed of Dr. W. H. Thompson, Dr. S. G. West and others is stated to have been appointed to consider the question of rebuilding the Frances Willard hospital, 1619 Diversey Ave., at a probable cost of $100,000.

Sleepyeye, Minn.—It is stated that the St. Mary's congregation will erect a $30,000 edifice. Rev. Mr. Plut, Pastor.

Chicago, Ill.—Patton, Fisher & Miller, of Chicago, are stated to have prepared plans for a $40,000 edifice for the Memorial Baptist Church.

Elwood, Ind.—The City Council is stated to have decided to erect a $28,000 city building.

Cambridge, Mass.—It is stated that a $150,000 building will be erected for the scientific department of the Harvard University.

Providence, R. I.—The question of erecting an addition to the court house is said to be under consideration. The estimated cost of site and building is $95,000.

Cambridge, Mass.—S. Sirk is reported to have had plans prepared for a $250,000 dormitory to be erected on Brattle Square.

Lafayette, Ala.—P. Yearger [illegible], of Atlanta, Ga., are stated to have received the contract for the court house, at $27,650.

Milwaukee, Wis.—It is stated that bids are wanted by the Board of Supervisors Feb. 11 for remodeling the court house.

Pittsburg, Pa.—Bids are wanted Feb. 8 for engine house No. 29. J. O. Brown, Dir. Dept. Pub. Safety.

Washington, D. C.—The Evening Star Newspaper Co. opened the following bids Jan. 30 for the erection and completion of a new building: Pennock & Co., Philadelphia, Pa., $349,000; Richardson & Burgess, $364,399; G. A. Fuller & Co., New York city, $377,341; Jno. McGregor, $379,000; Woodbury & Leighton, Boston, Mass., $389,874; F. L. Hanvey, $390,000; J. L. Parsons, $396,189; J. F. Manning & Co., $399,350; F. N. Carver, $414,688; Galloway & Son, $445,612. Address of bidders Washington unless otherwise stated.

Philadelphia, Pa.—The following bids were opened Jan. 27 by Frank M. Riter, Dir. Dept. of Pub. Safety, for the erection of fire stations in two wards (*a*, 36th Ward; *b*, 31st Ward): Thomas Gamon, 1629 Christian St., *a*, $22,384. George C. Dietrich, 935 N. 7th St., *a*, $21,923; *b*, $18,143. H. B. Shoemaker Co., 200 S. 10th St., *a*, $19,000; *b*, $15,500. Thomas J. Seeds, Jr., 1216 Race St., *a*, $16,883; *b*, $14,038; Doyle & Doak, 133 S. 15th St., *a*, $19,497; *b*, $16,741. William R. Dougherty, 1604 Sansom St., *a*, $19,700; *b*, $15,-615. John R. Wiggins, 1215 Filbert St., *a*, $18,-700. Philip Anns Co., Bourse Bldg., *a*, $22,512; *b*, $16,123. William J. Smith, 622 Mifflin St., *a*, $22,300. James A. Davis, 116 Sumac St., *b*, $17,-500. Macey, Henderson & Co., 1215 Filbert St., *a*, $17,949; *b*, $15,840. H. C. Nichols Co., 2030 Market St., *a*, $19,315; *b*, $16,836.

Oshkosh, Wis.—The following bids are stated to have been opened Jan. 30 for the Public Library: Hackworthy Construction Co., of Appleton, $42,452; Houle & Siefert, of Oshkosh, $48,-499; Carl Schneider, of Oshkosh, $39,870; Raycraft & Gill, of Oshkosh, $37,994; Hinkley & Powers, of Fond du Lac, $42,695; A. E. Mallery, of Oshkosh, $44,973; Meyer & Dombke, of Oshkosh, $42,830; Charles W. Gingele, of Chicago, $35,700.

NEW INDUSTRIAL PLANTS.

W. P. Glover, Juliette, Ga., writes that he will put up a cotton yarn mill with 1,000 to 2,500 spindles, to be operated by water power. He will need water-wheels, governors, rope transmission plant and shafting.

The Unity Collar & Cuff Co., North Bennington, Vt., is planning to build a 3-story 70x100-ft. factory.

The Vermilion Sugar Co., Abbeville, La., will erect a 60x160-ft. building with a 60x100-ft. wing, and install a 1,000 H.-P. plant.

The Scotten Tobacco Co., 411 Boulevard West, Detroit, Mich., will build a 62x180-ft. factory. The power plant will comprise two 6x16-ft. boilers and a 70 to 90 H.-P. engine.

The Wolverine Sugar Co., Benton Harbor, Mich., will erect a beet sugar plant of 350 tons daily capacity. Secy. H. C. Rockwell refers to the Machinenfabrik Grevenbroich, 11 Broadway, New York, as a possible builder of the works.

The Atchison, Kan., Saddlery Co. will put up a 25x150-ft. building with a 25x50-ft. addition. A 6 H.-P. plant will be needed.

The Planters' Cotton Oil Co., Bonham, Tex., has completed arrangements to put up a 90-ton cotton seed oil mill with a 200 H.-P. plant at Farmersville, Tex., and a 60-ton mill with a 150 H.-P. plant at Durant, I. T.

Cyrus Sharp, Jr., Forsyth, Ga., will put up a knitting mill during the summer; the plans are not yet completed.

BUILDING INTELLIGENCE.

NEW, YORK, N. Y.

120-122 Lewis st, 2 br stores and flats; cost, $40,000 all; o, Elizabeth Schlesinger; a, Nathan Langer.

Henry st, n e cor Rutgers, br stores and flat; cost, $32,000; o, Fay & Stacom; a, Chas. Rentz.

70 to 74 Pike st, br store and flat; cost, $50,000; o, Jacob Fischel; a, Horenburger & Straub.

135 W 24th st, br stores and tenement; cost, $18,000; o, Casey & Hutkoff; a, Max Muller.

Lexington av, n w cor 100th st, 4 br stores and flats; cost, $75,000 all; o, G. W. Arthur; a, Thos. Graham.

233-235 E 112th st, br store and flat; cost, $32,-000; o, Max Vogel; a, G. F. Pelham.

304-306 E 123d st, br tenem't; cost, $60,000; o, Cornelia B. Drew; a, George S. Drew, Jr.

S s 119th st, 225 e 1st av, br stores and tenem't; cost, $16,000; o and b, John T. Brady; a, James W. Cole.

West End av, n w cor 105th st, br flat; cost, $140,000; o, H. M. Wood; a, James & Leo.

8th av, n w cor 112th st, br stores and flat; cost, $35,000; o, Wm. Cunningham, Jr.; a, G. F. Pelham.

84th st and Riverside Drive, n e cor, br and stone flat; cost, $180,000; o, James M. & W. R. Stewart; a, Geo. Keister.

313 to 323 W 86th st, 6 br and stone dwellings; cost, $114,000 all; o and a, Alonzo B. Kight.

8th av, n e cor 112th st, br stores and flat; cost, $35,000; o, Alex McDowell; a, G. A. Schellenger.

8th av, s e cor 112th st, br stores and flat; cost, $35,000; o, Robt. Ferguson; a, G. F. Pelham.

S s 142d st, 100 w Convent av, 13 br dwellings; cost, $208,000 all; o, Della Stevens; a, Geo. W. Spitzer.

N s 137th st, 256 e Alexander av, 3 br flats; cost, $120,000 all; o, Auke Dooper; a, A. F. A. Schmitt.

N s 146th st, 340 w Brook av, br flat; cost, $22,000; o, Martin Tully; a, Harry T. Howell.

S s 144th st, 100 w 3d av, 4 br flats; cost, $96,-000 all; o, Ragette & Wolff; a, Edw. Wenz.

PROPOSALS OPEN.

Bids Close. — See Eng. RECORD.

WATER-WORKS.

Feb. 6. Bonds, Berea, O .... Dec. 31
Feb. 7. Pipe, etc., St. Louis, Mo........ Jan. 28
Feb. 7. Bonds, Huntsville, Ala........ Jan. 14
Feb. 7. Bonds, Columbus, Miss........ Jan. 14
Feb. 7. Waverly, Ia........ Feb. 4
Feb. 8. Bonds, Albany, N. Y........ Feb. 4
Feb. 9. Exeter, Cal........ Jan. 28
Feb. 10. Clayton, N. Y........ Feb. 4
Feb. 10. Pipe, etc., Minneapolis, Minn........ Feb. 4
Feb. 13. Bonds, Reno, Nev........ Dec. 24
Feb. 13. Pipe, etc., Hastings, Neb........ Jan. 28
Feb. 15. Tuskegee, Ala........ Feb. 4
Adv., Eng. RECORD, Feb. 4.
Feb. 16. New York, N. Y........ Feb. 4
Feb. 18. Fort Meade, S. Dak........ Jan. 28
Feb. 18. Spring Lake, N. J........ Jan. 28
Adv., Eng. RECORD, Jan. 28, Feb. 4.
Feb 20. Elhart Lake, Wis........ Jan. 28
Adv., Eng. RECORD, Feb. 4.
Feb. 21. Honolulu, Hawaiian Is........ Jan. 14
Feb. 24. Valves, etc., Cleveland, O........ Feb. 4
Adv., Eng. RECORD, Jan. 14 to 28.
Mar. 1. Oto, Ia........ Jan. 21
Mar. 1. Amsterdam, N. Y........ Feb. 4
Mar. 15. Belem, Para, Brazil........ Nov. 26
Apr. 8. Winnepeg, Man........ Feb. 4
Adv., Eng. RECORD, Feb. 4.

SEWERAGE AND SEWAGE DISPOSAL.

Feb. 6. Atlanta, Ga........ Jan. 28
Feb. 6. Bonds, Glenville, O........ Jan. 14
Feb. 6. Ottawa, Ont........ Jan. 21
Feb. 6. Syracuse, N. Y........ Feb. 4
Feb. 7. Bonds, Columbus, Miss........ Jan. 14
Feb. 7. East Grand Forks, Minn........ Jan. 21
Feb. 8. Lime, Brooklyn, N. Y........ Jan. 28
Feb. 8. Steelton, Pa........ Jan. 28
Adv., Eng. RECORD, Jan. 28, Feb. 4.
Feb. 8. Bonds, New Orleans, La........ Feb 4
Feb. 9. Stockton, N. J........ Jan. 28
Feb. 10. Clayton, N. Y........ Feb. 4
Feb. 11. Neenan, Wis........ Feb. 4
Feb. 14. Bonds, Grass Valley, Cal........ Feb. 4
Feb. 15. Buffalo, N. Y........ Feb. 4
Feb. 20. Bonds, Cleveland, O........ Jan. 14
Feb. 21. Bonds, Mt. Vernon, N. Y........ Feb. 4
Mar. 6. Woonsocket, R. I........ Feb. 4
Adv., Eng. RECORD, Feb. 4.

BRIDGES.

Feb. 6. Frumet, Mo........ Jan. 21
Feb. 6. David City, Neb........ Jan. 28
Feb. 7. Valley City, N D........ Feb. 4
Feb. 9. Nebraska City, Neb........ Jan. 21
Feb. 9. Arcadia, Neb........ Jan. 28
Feb. 10. Walmer, Ont........ Feb. 4
Feb. 15. Seneca, Kan........ Jan. 28
Feb. 15. Adrian, N. Dak........ Jan. 28
Feb. 15. Helena, Ark........ Jan. 28
Feb. 16. New York, N. Y........ Feb. 4
Feb. 20. Rockford, Ill........ Jan. 28
Adv., Eng. RECORD, Jan. 28.
Feb. 20. Chicago, Ill........ Dec. 31
Adv., Eng. RECORD, Dec. 31.
Feb. 24. Hamilton, O........ Feb. 4
Feb. 27. Monticello, Mo........ Feb. 4
Mar. 1. Quebec, Que........ Jan. 7
Mar. 2. Shreveport, La........ Jan. 21
Mar. 15. Chicago, Ill........ Jan. 21
Adv., Eng. RECORD, Jan. 21.
Apr. 1. Substructure, St. Joseph, Mo........ Jan. 7
——— Spring Lake, N. J........ Jan. 7

PAVING AND ROADMAKING.

Feb. 6. Plainfield, N. J........ Jan. 28
Feb. 6. Albany, N. Y........ Jan. 28
Feb. 6. Darby, Pa........ Jan. 28
Feb. 6. Toledo, O........ Jan. 14
Feb. 6. Vevay, Ind........ Jan. 21
Feb. 6. Denver, Colo........ Feb. 4
Feb. 6. Bloomfield, N. J........ Feb. 4
Feb. 8. Bonds, Reading, Pa........ Feb. 4
Feb. 14. St. Louis, Mo........ Jan. 21
Feb. 15. Cleveland, O........ Jan. 21
Feb. 16. Decatur, Ind........ Jan. 14
Feb. 16. Cleveland, O........ Feb. 4
Feb. 17. Cleveland, O........ Jan. 28
Feb. 20. Geneva, N. Y........ Jan. 28
Adv., Eng. RECORD, Jan. 28, Feb. 4.
Feb. 20. Anderson, Ind........ Feb. 4
Feb. 22. Bedford, Ind........ Jan. 28
Feb. 27. Yonkers, N. Y........ Dec. 3
Feb. 27. Portsmouth, Pa........ Feb. 4
Mar. 1. Bonds, Bridgeport, O........ Feb. 4
Mar. 2. Cleveland, O........ Feb. 4
Mar. 4. Washington, D. C........ Feb. 4
Adv., Eng. RECORD, Feb 4.
Mar. 7. Joplin, Mo........ Feb. 4

POWER, GAS AND ELECTRICITY

Feb. 6. Hull, P. Q........ Jan. 28
Feb. 6. Johnstown, N. Y........ Jan. 21
Feb. 7. Woodsfield, O........ Jan. 14
Feb. 7. Trenton, N. J........ Jan. 21
Feb. 7. Butler, Pa........ Feb. 4
Feb. 8. Gasfixtures, Baltimore, Md........ Feb. 4
Feb. 9. Exeter, Cal........ Jan. 28
Feb. 9. Thibodeaux, La........ Jan. 21
Feb. 10. York, Pa........ Jan. 21
Feb. 10. Boscobel, Wis........ Feb. 4
Feb. 10. Engine, etc., Matawan, N. J........ Fab. 4
Feb. 13. Gas plant, Pawhuska, O. T........ Jan. 21
Feb. 14. Wiring, etc., St. Albans, Vt........ Feb. 4
Feb. 14. Conduits, etc., Akron, O........ Feb. 4
Feb. 14. Conduits, etc., Pottsville, Pa........ Feb. 4
Feb. 15. Tuskegee, Ala........ Feb. 4
Adv., Eng. RECORD, Feb. 4.
Feb. 15. Baltimore, Md........ Feb. 4
Adv., Eng. RECORD, Feb. 4.
Feb. 20. New York, N. Y........ Feb. 4
Feb. 28. Darlington, O. T........ Feb. 4
Mar. 1. Sault Ste. Marie, Mich........ Dec. 24
Mar. 1. Spartanburg, S. C........ Jan. 14
Adv., Eng. RECORD, Jan. 14 to Feb. 4.
Mar. 6. Portland, Me........ Feb. 4
Adv., Eng. RECORD, Feb. 4.
Mar. 31. Telephone, Shanghai, China........ Nov. 19
——— Pleasantville, O........ Dec. 24

GOVERNMENT WORK.

Feb. 13. New Orleans, La........ Jan. 14
Adv., Eng. RECORD, Jan. 14 to 28.
Feb. 14. Wiring, etc., St. Albans, Vt........ Feb. 4
Feb. 14. Conduits, etc., Pottsville, Pa........ Feb. 4
Feb. 14. Conduits, etc. Akron, O........ Feb. 4
Feb. 16. Buildings, Annapolis, Md........ Jan. 28
Feb. 16. Duluth, Minn........ Jan. 21
Adv., Eng. RECORD, Jan. 21 to Feb. 4.
Feb. 18. Philadelphia, Pa........ Feb. 4
Feb. 21. Wreck, Boston, Mass........ Jan. 21
Feb. 21. Savannah, Ga........ Jan. 28
Adv., Eng. RECORD, Jan. 28, Feb. 4.
Feb. 23. Kansas City, Mo........ Jan. 28
Adv., Eng. RECORD, Jan. 28, Feb. 4.
Mar. 1. New York City........ Feb 4
Adv., ENG. RECORD, Feb. 4.
Mar. 6. Portland, Me........ Feb. 4
Adv., Eng. RECORD, Feb. 3.

BUILDINGS.

Feb. 6. Ventilating, etc., School, New York, N. Y........ Jan. 28
Feb. 6. Hospital, New York, N. Y........ Jan. 28
Feb. 6. Ventilating, etc., school, Burlington, Vt........ Jan. 21
Feb. 6. Beloit, Wis........ Jan. 28
Feb. 6. Ventilating, etc., school, Kansas City, Kan........ Jan. 28
Feb. 7. Schools, Philadelphia, Pa........ Feb. 4
Feb. 8. Bonds, Albany, N. Y........ Feb. 4
Feb. 8. Pittsburg, Pa........ Feb. 4
Feb. 9. San Antonio, Tex........ Jan. 28
Feb. 10. Keyser, W. Va........ Nov. 5
Feb. 10. Fort Worth, Tex........ Feb. 4
Feb. 11. Ventilating, etc., St. Louis, Mo........ Feb. 4
Feb. 11. Milwaukee, Wis........ Feb. 4
Feb. 11. School, Algona, Ia........ Jan. 28
Feb. 11. School, Cleveland, O........ Jan. 21
Feb. 13. Rock Springs, Tex........ Jan. 14
Feb 13. Birmingham, Ala........ Feb. 4
Feb. 14, School, New York, N. Y........ Feb. 4
Feb. 14. Plans, White Plains, N. Y........ Feb. 4
Feb 15 School, Ironton, Mich........ Feb. 4
Feb. 16. School, Ellendale, N. D........ Jan. 7
Feb. 16. Buckhannon, W. Va........ Jan. 21
Feb. 16. School, Piermont, N. Y........ Feb. 4
Feb. 22. Plans, etc., Alexandria, La........ Feb. 4
Feb. 23. School, Flandreau, S. D........ Feb. 4
Feb. 25. School, Cleveland, O........ Feb. 4
Feb. 25. Douglass, Ga........ Dec. 31
Mar. 1. Arkadelphia, Ark........ Jan. 14
Mar. 6. School, Eau Claire, Wis........ Jan. 28
Mar. 8. Aberdeen, S. Dak........ Jan. 28
Mar. 15. Plans, Wilkesbarre, Pa........ Jan. 28
Apr. 3. Many, La........ Jan. 21
Apr. 14. Plans, Bradford, England........ Jan. 21

MISCELLANEOUS.

Feb. 6. Levee work, Pointé a la Hache, La. Jan. 14
Feb. 6. Levee work, Pueblo, Colo........ Feb 4
Feb. 8. R. R. Work, Rutland, Vt........ Jan. 28
Adv., Eng. RECORD, Jan. 28.
Feb. 8. Baltimore, Md........ Jan. 28
Feb. 11. Levee work, Newport, Ark........ Feb. 4
Feb. 13. Ditches, New Madrid, Mo........ Feb. 4
Feb. 15. Canal, Albuquerque, N. Mex........ Jan. 21
Feb. 15. Shaft, Centralia, Pa........ Feb. 4
Feb. 16. Columbus, O........ Feb. 4
Adv., Eng. RECORD, Feb. 4.
Feb. 20. Newark, N. J........ Jan. 21
Adv., Eng. RECORD, Jan. 21 to Feb. 4.
Feb. 20. Boston, Mass........ Feb. 4
Feb. 21. Boston, Mass........ Feb. 4
Adv., Eng. RECORD, Feb. 4.
Mar. 7. Street cleaning, Cleveland O........ Feb. 4
Mar. 15. El. Ry., Shanghai, China........ Nov. 19

NEW SCHOOLS.

Philadelphia, Pa.—Bids are wanted Feb. 7 for building two schools and repairing several schools. A. F. Hammond, Secy. Com. on Property, Bd. of Public Educ.

Mercer, Pa.—The high school building has been condemned and a new one to cost about $12,000 will be built.

Philadelphia, Pa.—The Select Council on Jan. 26 passed a bill apportioning $300,000 for new schools.

McKeesport, Pa.—The Wills Heating Co., of Pittsburg, is stated to have received the contract for the heating system for the high school at $12,120.

Flandreau, S. D.—Bids are wanted Feb. 23 for a school. W. A. Jones, Commr. Indian Affairs, Dept. of the Interior, Washington, D. C.

New Albany, Ind.—The question of erecting a new high school is stated to be under consideration.

Aberdeen, S. D.—In the Senate the Committee on State Affairs is stated to have reported favorably on the bill for a normal school here.

Fitchburg, Mass.—The Council is stated to have appropriated $20,000 for a 10-room school.

Utica, N. Y.—A bill has been passed by the Assembly authorizing the city to issue $60,000 bonds for new schools.

Bloomfield, N. J.—The Building Committee is stated to have under consideration plans for two schools; estimated cost of each $30,000.

Boston, Mass.—The following bids were opened Jan. 31, by Commodore M. C. Endicott, Chief of the Bureau of Yards and Docks, Navy Dept., Washington, D. C., for th construction of a Dry Dock at the Navy Yard. Boston, Mass., as advertised in "The Engineering Record." Item 1. For the dock constructed entirely of stone, the linin being of cut granite and the backing of rubble, not including the machinery. Item 2. For the dry dock constructed of concrete and lined with cut stone, but not includin the machinery. Item 3. For the dry dock constructed of concrete and lined with cut stone, having an invert of granite or limestone in the floor of the body of the dock not including the machinery. Item 4. For the machinery, including steam generators in the central power house, the pumps, the engines, dynamos, and motors, cap stans, winches, and all piping and conductors connected therewith, and foundations, but not not including machinery in the caisson. Item 1a. For a dry dock constructe entirely of stone, the lining being of granite, with the face rough pointed, floors and altar treads fine pointed, and the backing of rubble, not including the machinery. Iten 2a. For a dry dock constructed of concrete, lined with cut granite, with the face rough pointed, and floors and altar treads fine pointed, but not including the machinery Item 3a. For a dry dock constructed of concrete and lined with cut granite, with the face rough pointed, and floors and altar treads fine pointed, having an invert of granit or limestone in the floor of the body of the dock, not including the machinery.

Name of Bidder.	Item No 1.	Item No. 2.	Item No. 3.	Item No. 4.	Deduct for Piling.	Item No. 1a.	Item 2a.	Item 3a
Griffith & McDermott	$1,565,000	$1,357 200	1,201,000	175,000	15,000	$1,000,525	$1,315,000	$1,175,00
George Pierce, Bangor, Me	1,249,375	1,179,112	1,049,737	213,000	7,000	1,224,375	1,159,112	1,019,73
Southwark Foundry & Machine Co., Philadelphia, Pa	....	....	.....	168,125	......	....	....	....
Degnon-McLean Construction Co , New York City	1,538,500	1,310,250	1,146,159	168,000	......	1,558,500	1,270,150	1,121,00
Holbrook, Cabot & Daly	1,356,045	1,267,876	1,160,665	170,750	35,000	1,312,354	1,224,185	1,136,24
Norcross Bros., Worcester, Mass	1,190,000	1,090,000	970,000	187,000	..	1,45,000	1,045,000	945,00
O'Brien & Sheehan, New York City	1,115,600	975,600	857,200	170,900	15,000	1,082,700	942,700	842,40
Webb Granite & Construction Co . Marlborough, N. H.	1,257,000	1,240,000	1,140,000	......	10,000	1,211,000	1,194,000	1,120,00
J. J. McCarthy & Co., Boston, Mass	1,599,387	1,548,371	1,429,187	......	......	1,559,000	1,499,100	1,394,32
Woodbury & Leighton, Boston, Mass	1,429,774	1,227,034	1,115,592	180,000	......	1,400,495	1,196,656	1,124,79
Curtis & Driscoll, Springfield, Mass	1,100,0.0	1,150,000	1,050,000	......	15,000	. ...	.. ....	....
Eng Contract Co., New York City	1,780,000	1,480,000	1,358,000	169,800	28,000	1,740,000	1,438,000	1,337,00
Thresher Electric Co., Dayton, O.	....	....	....	149,892	......	. ...	....	......
Patrick H. Flynn, Brooklyn, N. Y	1,460,000	1,410,000	1,340,000	......	......	1,410,000	1,360,000	1,315,00
Washburn & Washburn, New York City	1,580,000	1 370,000	1,225,000	185,000	......	1,556 000	1,346,000	1,262,00
John Pierce, New York City	....	....	....	175,000	......	1,299,000	....	1,024,00
	... .	....	....	195,000	......	....	....	....
Prindle Pump Co., New York City	... .	....	....	and	......	....	....	....
	....	....	....	175,000	......	....	....	....
John H. Furney, Washington, D. C	....	....	....	170,980	......	....	... .	....
Farrel, Hopper & Co., New York City	1,720,637	1,493,120	1,371 292	130,000	18,462	1,653,746	1,426,229	1,337,12

Buffalo, N. Y.—The following bids were opened Jan. 26 by the Board of Public Works for deepening and widening Buffalo River from Hamburgh St. to city line Cazenovia Creek from junction with Buffalo River to Cazenovia St.:

A. price per cub. yd. for rock excavation and disposal near Hamburgh St.; B, price per cub. yd. for similar work near Cazenovia St. in Cazenovia Creek; C, price pe cub. yd. for loose rock, measured in pile taken from bank on Section 1 and deposited as riprap or bulkhead filling on Sections 2, 3 and 4; D, price per cub. yd. for excavatio and disposal of material other than bed rock; E, price per lin, ft. for pile protection, single row, including ties; F, price per lin. ft. for pile protection, double row or bulk head construction, including ties. Rock filling for this included under A, B or C, or of other filling under D; G, price for construction of bottom protection of Buffalo Rive near city line, complete, except rock filling, which is to be furnished under B or C.

	Section 1. A.	D.	E.	F.	Total.	Section 2. C.	D.	E.	F.	Total.
Quantities	9,000	1,029,000	100	50		4,000	869,000	200	100	
The Donnelly Contracting Co , Buffalo, N. Y.	$3.40	$0.12	$5.00	$11.50	$155,655.00	$0 50	$0 12	$5.00	$11.50	$108,130.00
Brown, Stabell & Griffiths, Buffalo, N. Y.	2.75	.13	6.00	12.00	160,320.00	1.50	.135	6.00	12.00	125,715 00
Christopher Smith, Buffalo, whole work, four sections	1.95	.1325	5.50	12.50	155,617.50	0.50	.1325	5.50	12.50	119,492.50
Christopher Smith, any one section singly	1.95	.18	5.50	12.50	204,495.00	0.50	.18	5.50	12.50	160,770.00
The L. P. & J. R. Smith Co., Cleveland, O.	2.85	.14	7.50	14.00	171,910.00	0.55	14	7.50	14.00	126,760 00
The Buffalo Dredging Co	2.70	.1525	4.20	8.10	182,467.50	0.60	.1525	4 20	8.10	136,572.50
Hingston & Woods, Buffalo, N. Y.	2.60	.14	4.00	8.00	168,660.00	0.50	.1625	4.00	8.00	144,812.50

	Section 3. C.	D.	E.	F.	Total.	Section 4. B.	C.	D.	E.	F.	G.	Total.
Quantities	6,000	907,000	1,200	1,000		7,000	500	1,022,000	800	400		
The Donnelly Contracting Co , Buffalo, N. Y.	$0.50	$0.12	$5.00	$11.50	$129,340.00							
Brown, Stabell & Griffiths, Buffalo, N. Y.	1.50	.125	6.00	12.00	141,575.00	$1.50	$1.50	$0.125	$6.00	$12 00	$1000.	$149,60
Christopher Smith, Buffalo, whole work, four sections	0.50	.1325	5.50	12.50	142,277.50	1.75	0.50	.1325	5 50	12 50	1200.	158,57
Christopher Smith, any one section singly	0 50	.18	5.50	12.50	185,360.00	1 75	0.50	.18	5 50	12.50	1200.	207,06
The L. P. & J. R. Smith Co., Cleveland, O.	0.55	.1475	7 50	14.00	160,082 50	1.75	0.55	.1425	7 50	14.00	400.	170,16
The Buffalo Dredging Co	0.60	.1575	4.20	8.10	159.592.50	1.40	0.60	.155	4 20	8.10	675.	175,78
Hingston & Woods, Buffalo, N. Y.	0.50	.1625	4.00	8.00	163,187.50	1.60	0.50	.1525	4 00	8.00	500.	174,20

For other bids received for work in connection with the above see "Bridges" and "Paving and Roadmaking."

Glenwood, Ill.—The Illinois School of Agriculture and Manual Training is stated to have received a gift of $50,000 to be used in the erection of a manual training school and steam power plant. Edw. B. Butler, Pres.

New York, N. Y.—Bids are wanted Feb. 14 for a school. John E. Eustis, Chmn. Com. on Bldgs, Bd. of Educ.

St. Johnsbury, Vt.—The citizens are stated to have voted to erect a $20,000 school in Summerville.

Cleveland, O.—Bids are wanted Feb. 25 for an addition to the Union school. H. I. Sargent, School Dir.

St. Louis, Mo.—It is stated that bids are wanted by the Board of Education Feb. 11 for a ventilating and heating apparatus in Simmons, Jackson and Rock Spring schools.

Ironton, Mich.—It is stated that bids are wanted Feb. 15 for a school. A. D. Garner, Dir. Pub. Schools, Charlton, Mich.

Piermont, N. Y.—Bids are wanted Feb. 16 for a school. Charles Haring, Clk. Bd. Educ.

Washington, D. C.—The following bids were opened Jan. 30 for the building for the Hearst school for girls to be erected on the grounds of the Episcopal Cathedral: D. J. Macarty, Washington, D. C., $225,000; John McGregor, Washington, D. C., $174,789; Emmert & Heisey, Washington, D. C., $189.246; James H. Parsons, Washington, D. C., $178,494; Norcross Bros., Worcester, Mass., $175,000; Moulton & Starrett Co., Chicago, Ill., $169,516; George A. Fuller Co., New York city, $171,700; John H. Parker Co., New York city, $189,000.

STREET CLEANING AND GARBAGE DISPOSAL.

Parkersburg, W. Va.—The City Council has under consideration the construction of a garbage crematory.

Lowell, Mass.—The Board of Health is stated to have taken preliminary steps for the construction of a garbage crematory.

Cleveland, O.—Bids are wanted March 7 for cleaning the paved streets and alleys for 8 months. Geo. R. Warden, Dir. Pub. Wks.

Chicago, Ill.—It is stated that the contract for the collection and incineration of garbage, ashes, etc., has been awarded to the Thackeray Incinerating and Fertilizer Co., of San Francisco, for $500,460.

Dayton, O.—The following bids were received, according to local press reports, for the removal of ashes and garbage for the ensuing year (*a*, for ashes, etc.; *b*, for garbage): Spohr & Armantrout, *a*, $4,289; Robert Paul, *a*, $3,960; *b*, $3,600. R. S. Mowlray, *a*, $6,995. John Martz, *a*, $5,230. William Turner, *a*, $6,800; *b*, $4,300. Frank and Charles Spohn, *b*, $3,590.

GOVERNMENT WORK.

New York, N. Y.—Bids are wanted March 1 at the U. S. Engineer Office for the delivery of broken stone, sand and cement at Fort Hamilton, N. Y., as advertised in "The Engineering Record."

St. Albans, Vt.—Bids are wanted Feb. 14 for a system of conduits and wiring for electric lighting in the U. S. Custom House. W. B. Howell, Asst. Secy., Treas. Dept., Washington, D. C.

New Brighton, Pa.—The United States Senate has passed a bill providing for the purchase of a site and the erection of a public building thereon at a cost not to exceed $75,000.

Pottsville, Pa.—Bids are wanted Feb. 14 for a system of conduits and wiring for electric lighting in the U. S. Postoffice. W. B. Howell, Asst. Secy., Treas. Dept., Washington, D. C.

Akron, O.—Bids are wanted Feb. 14 for a system of conduits and wiring for electric lighting in the U. S. Postoffice. W. B. Howell, Asst. Secy., Treas. Dept., Washington, D. C.

Portland, Me.—Bids are wanted March 6 at the U. S. Engineer's Office for an electric light plant at Fort Preble, Me., as advertised in "The Engineering Record."

Philadelphia, Pa.—Bids are wanted Feb. 18 for a workshop and boiler house for ordnance at the navy yard, League Island. Mordecai T. Endicott, Ch. Bureau Yards and Docks, Navy Dept., Washington, D. C.

MISCELLANEOUS.

New York, N. Y.—A charter has been granted in Charleston, W. Va., to the Marigold Dredging Co., principal office in N. Y. city. Authorized capital $300,000. Shareholders: John C. Platt, of Montclair, N. J.; Bond V. Thomas, of New York City; Clement S. Houghton, of Boston, and others.

Cambridge, Mass.—See "Sewers and Sewage Disposal."

Newport, Ark.—Bids are wanted Feb. 11 for 37,000 cu. yds. levee work. A. D. Bailey, Secy. Bd. Levee Commrs.

New Madrid, Mo.—It is stated that bids are wanted Feb. 13 for digging about 75 miles of ditches in New Madrid County. L. C. Phillips, Co. Clk.

Centralia, Pa.—It is stated that bids are wanted Feb. 15 by the Lehigh Valley Coal Co. for sinking a shaft about 225 ft. at Continental Colliery.

Worcester, Mass.—The Commission on the Abolition of Grade Crossings has made its report to the Common Council, estimating the total cost of elevating tracks at $2,292,400.

Boston, Mass.—Bids are wanted Feb. 20 for surfacing and other work on the Charles River reservation. William B. De Las Casas, Chmn. Metropolitan Park Com.

Boston, Mass.—Bids are wanted Feb. 21 for building pile platform on South Boston Flats, as advertised in "The Engineering Record."

Pueblo, Colo.—Bids are wanted Feb. 6 for a slag and stone levee on the south side of Arkansas River. E. W. Hathaway, City Engr.

New York, N. Y.—The Board of Estimate has authorized the appropriation of $30,000 for the improvement of Riverside Park, and $10,000 for Hamilton Fish Park.

Columbus, O.—Bids are wanted Feb. 1 for a concrete masonry dam, as adver tised in "The Engineering Record."

Baleshed, Miss.—The lowest bid re ceived for 30,000 cu. yds. of levee work was from Robert Johnson, at 15 7-10 cts per yd.

PROPOSALS.

Tenders for Pumping Engines and Boilers.

Sealed tenders, addressed to the Chair man of the Fire, Water and Light Com mittee, for the supply and delivery in Win nipeg of 2 pumping engines, each having pumping capacity of 5,000,000 imperial gal lons per day, will be received at the offic of the undersigned up to 8.30 p. m. on Mon day, April 3, 1899.

Specifications may be seen at the offic of H. N. Ruttan, City Engineer, from whom forms of tender and full informatio may be obtained.

Each tender must be accompanied by a accepted cheque or cash deposit for th sum called for in form of tender supplied which will be subject to forfeiture in cas of failure to enter into a written contrac if called upon to do so.

No tender necessarily accepted.

C. J. BROWN, City Clerk.

City Clerk's Office, Winnipeg, Can., Jan. 28, 1899.

Notice to Contractors.

Sealed proposals will be received at th office of the Board of Water Commission ers, Amsterdam, N. Y., until Wednesday March 1st, 1899, 10 A. M., for the labor the construction of an extension to th present system of Water Works, consistin of about five (5) miles of iron and vitrifie pipe from 36 in., 24 in., 20 in., 18 in. to 6 in

Also the building of two (2) stone dam and stone foundations. The work will divided up into five contracts, and con tractors may bid for one or all. Certifie check must accompany each bid. Copy maps and specifications will be on exhib tion at the office of the board, Amsterdam N. Y., on and after Feb. 10th, 1899.

JAMES R. SNELL, Supt.

S. E. BABCOCK, Consulting Engr.

Proposals continued on pages xi and xii.

THE ENGINEERING RECORD.
Volume XXXIX. Number 11.

TABLE OF LEADING ARTICLES.

The Engineering Record, conducted by Henry C. Meyer, is published every Saturday at 100 William Street, New York. Its opinions on technical subjects are either prepared or revised by specialists.
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MASONRY DRY-DOCKS.

At the last session of Congress an appropriation was made for constructing dry-docks at the Navy Yards at Portsmouth, Boston, League Island and Mare Island. These were to be built of timber and to cost not more than $825,000 each, although the Secretary of the Navy was authorized to build one of them of masonry at an additional cost of $200,000 if he deemed it advisable. Secretary Long took advantage of the latter provision to authorize the construction of the masonry dock at Boston, which was described last week. The bids for building the dock, which were printed in the same issue, were unexpectedly low and have led Mr. M. T. Endicott, chief of the Bureau of Yards and Docks, to advise abandoning all plans for timber structures.

The Navy Department's dry-dock facilities were notoriously inadequate for many years. The masonry docks in its charge had been built by day labor when Congress saw fit to make appropriations. The work accordingly progressed in a fitful manner and was very expensive. The timber docks were, however, built by contract. Hence the relative cost of the two systems of construction, as shown by the Bureau's records, was strongly in favor of timber until the bids for the Boston dock were received. These put a different aspect on the subject. The lowest bid for the masonry dock was $842,400 and for the machinery $130,000, a total of $972,400. This is $52,600 less than the appropriation, which was so small that the Bureau was doubtful if the work could be done for the sum, in view of past experience. Inasmuch as these figures show that by increasing the present appropriations about 25 per cent. masonry docks can be substituted for the timber type, Mr. Endicott strongly advises the department to request this change, for which he advances the following arguments:

"A timber dry-dock is a temporary structure, and the distinctive material of which it is built, wood, requires very extensive renewal at the end of 25 years, amounting in some instances and in some climates to a practical rebuilding. While the first cost of a timber dry-dock is considerably less than that of a masonry dry-dock, the annual expenditure for its repairs and maintenance, having reference to the dry-dock structure proper, which is the only proper basis for comparison, is many times larger than that of a masonry dock. This is not mere speculation, but the condition of the timber dry-docks heretofore built for the navy, no one of which exceeds ten years in age, shows that they have already entered upon a period when the perishable material, wood, has so far deteriorated as to require considerable repairs, and the repairs already made and those provided for in special appropriations made by Congress for the purpose show that what was claimed to be a cheap dock is really proving to be a very expensive one in the end.

"Another and important consideration is that of the stability and safety of the structure. Of two timber dry-docks of the same general design and construction, differing in depth, the one of greater draught is subjected to much more unfavorable conditions, and the hydrostatic pressure, which is the force to be met and provided for more than any other in graving docks, is very much greater. The stability and safety of such a structure against this force, tending to rupture the bottom or sides, decrease with the depth, and while the question of stability and safety of such a dock may be a comparatively simple one where the depth is shallow, it becomes one of great importance, magnitude and risk in the very deep docks which it is now necessary for the navy to provide for its deep-draught cruisers and battleships. Accidents of this character have occurred, more or less serious, in several of the timber dry-docks owned by the Government, extending from the bursting in of the altar system, as at League Island, Port Royal and New York, to the distortion of the floor of the dock, as at Port Royal, and the partial collapse in the case of Dry-dock No. 3 at New York.

"Dry-docks are structures about which, when built, there should be no doubt, and it is quite safe to say that such freedom from risk in the case of a very deep dock can only be obtained from one built of masonry. A timber dry-dock, for its integrity, depends upon the success of pinning it down to the soil, or in admitting the water so freely to its interior as to relieve the pressure, making it a very leaky dry-dock, and even with these precautions safety cannot be considered as assured. A masonry dock is designed to resist the dangerous force referred to above by its own weight, and when so designed and well built, making a water-tight structure, it is absolutely safe.

"The highest authorities upon the construction of dry-docks state that the preference is given to those dry-docks because of their stability. The masonry docks built for the navy vary in age from ten to about sixty-five years. They have been entirely successful, and, with the exception of one, the repairs to the dry-dock structure proper may be said to have been insignificant. The only considerable individual repair to a masonry dry-dock in the history of the navy was to the one at the New York Navy Yard, amounting to about $100,000, during its life of forty-five years, while the repairs to one of the two timber dry-docks at the New York yard have cost $171,000 in one instance, and the other will soon receive an outlay of $300,000 to repair natural deterioration and substitute a masonry for a timber entrance, all within an age of ten years.

"The records of the cost of repairs to the masonry docks have not been compiled with great exactness because of the difficulty of consulting fully all the old records in connection with them, but sufficient has been obtained to show that what is herein stated is substantially correct."

There is no question that this is a very important subject. Americans had to blush when the Indiana went to Halifax for docking facilities lacking in the United States. It was a pitiful affair in every way, for it showed to the world that while the American navy could design as fine battleships as any afloat, yet it could not keep them clean when they were built. Then the Spanish war came on and rubbed the lesson in still harder, so that Congress speedily provided the money for works which had not previously seemed necessary to the naval experts from the interior States.

The recent achievements of the navy have endeared it more than ever to the general public, which has made its opinion so evident that the country has entered on a ship-building program of considerable magnitude. But after a ship has been built it must be cared for if it is to be of use, and dry-docks must be built for this purpose. A war vessel lies at anchor so much of the time that the bottom becomes foul more quickly than that of a merchant liner and should be cleaned more often in consequence. But the docking of a large war vessel in some of the timber docks in this country is hazardous. A battleship costing several millions of dollars and requiring a number of years to build should not be risked to save a relatively small sum. Now that it is known the cost of the masonry type is only a quarter more than that of timber, there seems to be no reason, not even the old one of excessive expense, which can be urged against Mr. Endicott's application for permission to give the American navy as good docks as the fleets of other countries enjoy.

HYDROGRAPHIC STUDIES.

Ever since the winter of 1888 the United States Geological Survey has been collecting information concerning stream flow. To the designer of works for the supply of water for any purpose, this inquiry has been of unusual value. The streams of the United States have never been studied and gauged like those of Europe. Their yield during dry years, particularly their yield during a succession of dry years, which is a still more important subject, has been unknown except in a few instances. Moreover, the development of ground water has been studied in but few portions of the country, for it was only a few years ago that the importance of this source of supply came into general recognition. Mr. F. H. Newell, who has been in charge of the Division of Hydrography for a number of years, has recently elaborated a plan for making the results of far greater utility than would be possible were he to depend solely on the observation of Government engineers. His idea is to collect and collate all the information on the subjects studied by the division which has been gathered by private engineers, boards of health, chemists and others interested in water supply. He therefore desires to enter into correspondence with every person in the country who can assist the Division with information along the following lines:

All measurements of flowing streams may have value and should be recorded. It is desirable, therefore, to have notice called to examinations of various streams, whether large or small, and whether the results of the examinations are applicable to questions of irrigation, power or municipal supply. This is particularly the case where the water resources are yet to be developed or where a supply exists for use in agriculture or for manufacturing purposes.

The amount and character of the material in solution or suspension are of importance not only in geologic and sanitary investigations, but also in many industrial undertakings. Examinations more or less complete have been and are being made by a number of persons, and, although it may be impracticable to assemble all of these, it is believed that a considerable body of useful information can be brought together by correspondence. The Division of Hydrography is attempting to collect typical samples of river and other waters for examination and to make measurements of the material carried in sus-

pension or rolled along the bottom of the streams.

The utilization of the streams of the country for power and the means adopted for the transmission of this are topics which are discussed, as briefly as possible in the annual reports. It is desired to obtain information concerning the degree to which the water power of various streams is now employed and facts which bear upon the more complete utilization of this power, and particularly of opportunities not yet taken advantage of, so that public attention may be drawn to sources of water power which as yet are little known.

With the increase of population and the development of industries a new problem arises—that of disposing of refuse water and of preserving the purity of the streams, so that their waters may continue to be of value. In the course of the hydrographic surveys examinations are being made of various drainage basins and note taken of the character and amount of pollution. Any items of general public interest which bear upon this matter may well be noted.

BRIDGE MEMORANDA.

A Novel Piece of Bridge Erection is shown in the two large illustrations of the Bukkar bridge across the Indus River. A combination of peculiar methods was used in building the falsework. For one span, temporary iron towers were erected on intermediate channel piers, and the intervening 150 feet spanned by the fan-shaped falsework which was so conspicuous in the illustrations of the erection of the Attok bridge in the issue of January 28. The tops of the falsework were anchored back to the bottoms of the masonry piers by several lines of rope, adjusted by tackle. Between the iron towers and the masonry piers there were intermediate piers made of light iron cylinders with 30-foot queen post trusses between their tops. In assembling the trusses the bottom chords and vertical posts were connected, and the latter guyed in both directions. Then the top-chord sections were put in place one by one, and the diagonal members riveted up, the material being handled by hand derricks on two strident girder cranes traveling on the falsework. Another span of the same bridge was erected wholly from cylinder pier falsework, as shown in the smaller of the two illustrations.

The Old Croton Aqueduct of the New York water-works crosses a small stream at Sing Sing on a single 85-foot masonry arch which withstood for about 60 years the wear and tear of time and service without perceptible deterioration. On the morning of December 12, 1898, it was found that a portion of the face wall at one end had broken away from the masonry and was considerably bulged outwards. The arch and adjacent masonry was built of first-class granite ashlar, and, up to the time of the accident, was apparently in good condition. The vertical face wall over the haunches was continued for some distance beyond the arch as a side wall under the aqueduct, supporting it on the adjoining hillside, and just beyond each skewback it was reinforced by a buttress about 2 feet thick and 8 feet wide. The lower part of one of these buttresses had bulged outwards for a foot or more across its entire

width, and had carried part of the spandrel face wall with it, moving it all the way back to the voussoirs, whose face was split off in places by the pressure and displacement. These

THE ERECTION OF THE BUKKAR BRIDGE OVER THE INDUS RIVER.

courses of the face remained in an apparently vertical plane oblique to that of the remainder of the face, and adhered to the buttress part of the way down, but were separated from it towards the bottom, where the buttress sprung out several inches clear of the main wall, leaving an open space through which one could see. The buttress had been well bonded to the body of the masonry, and its headers were seen to have been torn square across about in the plane of the face of the wall. Except the buttress, the small part of the spandrel wall and the chipped voussoirs, the masonry appeared undisturbed and uninjured. Where the aqueduct crosses the highway the invert and side walls up to above the flow line have an iron trough built into them and lined with two courses of brick. This waterproofing is carried across the arch span, but does not extend to the ends of the side walls, and it is to be supposed that in the long time that it has been in service a leak developed at the junction of the iron and masonry, allowing percolation into the voids in the substructure. Just before the accident the temperature was very low. A considerable amount of ice formed on the surface of the injured and adjacent masonry, and its expansion in the cavities behind the buttress and face stones evidently forced them off as described.

RECONSTRUCTION OF THE HOME INSURANCE BUILDING, N. Y.

An elaborate illustrated description of the result of the recent fire in the Home Life Insurance Building in New York was published in "The Engineering Record" of December 10, 1898. Since that time the repairs of the building have been commenced, and, although not of an unusual or very remarkable nature, are of interest as affording an example of methods of carrying on such reconstruction on a large scale. The great height of the building, its location on the sidewalk line of the busy part of one of the most crowded thoroughfares in the world, the absence of any ground space for storage or working, and the requirement that street traffic and the business of numerous tenants in the lower part of the building should not be interrupted, increased the difficulty and expense of the work.

The Home Building is 55½ feet front, 104 feet deep, and 15 stories high, exclusive of a mezzannine floor and a roof house. There is a flat roof 206 feet above the curb, which is surmounted by a pyramidal tower rising to a height of 260 feet. In the middle of each long side is a light court about 20 feet wide. That on the south side extends about 10 feet into the Home Building and has its fourth side closed by an adjacent tall building. On the north side the court was about 24 feet deep, and was open above the top of an old five-story building which closed it at the bottom. The building was of fireproof construction with steel beams and columns, brick and stone walls, hollow tile floors, and hollow porous terra-cotta block partitions. It contained a large amount of very combustible cabinet work and office furniture, and had large surfaces of unprotected windows.

On the night of December 4, 1898, the adjacent five-story building on the north was burned, and the fierce flames were driven by a strong wind against the exposed wall of the Home Building and especially into the deep court, which served as a flue to draw the flames to the roof. The great heat broke the upper court windows, and the combustible contents of adjacent rooms were ignited and the fire spread more or less through the separate stories by means of the wooden and glazed upper parts of some partitions. The flames also broke out of the front windows of some floors and entered again through the windows in the stories above. The fire was apparently started separately on most of the stories, and in no case appeared to have spread through the stairways, elevators or floors. It did not extend below the eighth floor. Above it a large part of the contents and trim of the rooms, particularly that adjacent to the court, was destroyed, some of the partitions were knocked down, some floor arches injured, and plaster and steel protection stripped off. The court window casings were damaged, but did not show complete failure; the marble facing and ornamental work was very badly cracked, chipped and split. One set of unprotected girders was warped, but the steel framework and brick walls were practically uninjured.

Within a few days after the fire the tenants in the seven lower stories were able to resume their business, some of the elevators were got in running order, insurance inspection was made, and surveys and examinations were hastened to decide on the nature and extent of repairs required. It was desirable to restore the building and have it ready for occupation at the earliest possible moment, so a large force of men has been employed on every floor by the different contractors to carry on simultaneously the various repairs now in progress. As soon as the fire was extinguished a hasty examination was made by the architects and building and fire departments, and unsafe parts of the structure were torn down or securely braced. The principal shoring was done in the fourteenth story, where the ornamental marble columns in front were very badly shattered. Here a heavy timber post was wedged up beside each column to carry the wall above.

REPAIRING THE HOME INSURANCE BUILDING.

In general, the front wall had to be taken down and rebuilt above the seventh story. Complete systems of pipes, wires, etc., must be installed in the damaged rooms. Nearly all the cabinet work, trim and plastering must be replaced, partitions and floors must be repaired and replaced, the cast-iron window casings require renewals and repairs, and parts of the elevator iron work in two stories must be strengthened or replaced. The original designs are closely adhered to in the reconstruction, most of which is being executed from the original drawings or from large scale details prepared for the workmen from the original general plans and specifications. Some changes and slight modifications are, of course, introduced. Solid longitudinal and transverse concrete fire stops are built at short intervals from the tops of the floor arches to the tops of the sleepers, and the spaces between them are filled up to the floor line. All girders have their top flanges fire-proofed. All partitions are carried down to the floor arches, and their door openings are spanned by terra-cotta block arches. Air spaces between the steel work and its fire-proof protection are carefully sealed at short intervals. The glazing and woodwork in partitions has been practically eliminated, so that where there were formerly 32 windows in the corridor partitions of one story, there are now but four, and they are located so that flames coming through them can do no injury. Iron shutters will be placed on the rear windows, and fixtures for them will be set in the court windows in readiness to receive shutters if the adjacent building is rebuilt to threaten it. An additional 4-inch fire line standpipe is to be run to the roof in the east end of the corridors; it will be fitted with hose reels at every floor, and connected in the basement to the power line in the west end of the corridors, and will have a sidewalk branch terminating in a siamese connection for fire engines.

In front of the building a very heavy timber platform has been built to cover the whole width of the sidewalk. It is supported on 12 x 12-inch posts set close together and rigidly braced to heavy transverse and longitudinal deck timbers that carry the upper platform of double plank. This platform is surrounded by a solid board fence or bulkhead around its sides, and underneath it is a slightly inclined roof of tarred paper and matched boards protecting the sidewalk from drip. On the main platform is set a two-drum hoisting engine supplied with steam from the boilers in the building, which operates the boom and fall lines of a derrick set in the base of the tower, and commanding the whole front. The derrick is rigged with a manila boom line and 1,000 feet of wire cable for the hoist line, which can either be used single for rapid, light work or with tackle for heavy work. The foot block of the derrick is set about in line with the face wall, and rests on a pair of heavy wooden cantilever beams 20 feet long which lie on the floor of the roof house, and project 10 feet into the street. The reactions of this beam are taken up by vertical shores from the inner end to the cross beams in the tower above, and by two pairs of clamps lashed to it near the foot of the shores, and engaging the top flanges of the roof beams below. Two snatch blocks are lashed to the overhanging end of the cantilever and through them the fall lines are carried down to the engine, well away from the face of the building. In each of the upper stories the windows have been filled with canvas on frames and a tight partition of matched boards has been built across the front, parallel to and about 8 feet back of the face wall. This encloses the main part of each story for the men to carry on the different works required, and leaves an open gallery-like space in front free for work on the face wall. Platforms are built out in front as required on cantilever beams projecting through the windows, and on them and the inner floors the workmen removed the whole of the face wall down to the seventh story. The large marble blocks were first loosened by steel wedges driven into their horizontal and vertical joints. Then they were worked out by thicker wooden wedges and lowered to the elevated platform below, sometimes in rope slings, but generally in wooden scale pans suspended by four chains. Great care was taken in lowering the stones and in securing them, to prevent objects from falling to the street below, but the heavy platform is strong enough to protect the sidewalk from small chips, mortar, etc., that may accidentally drop.

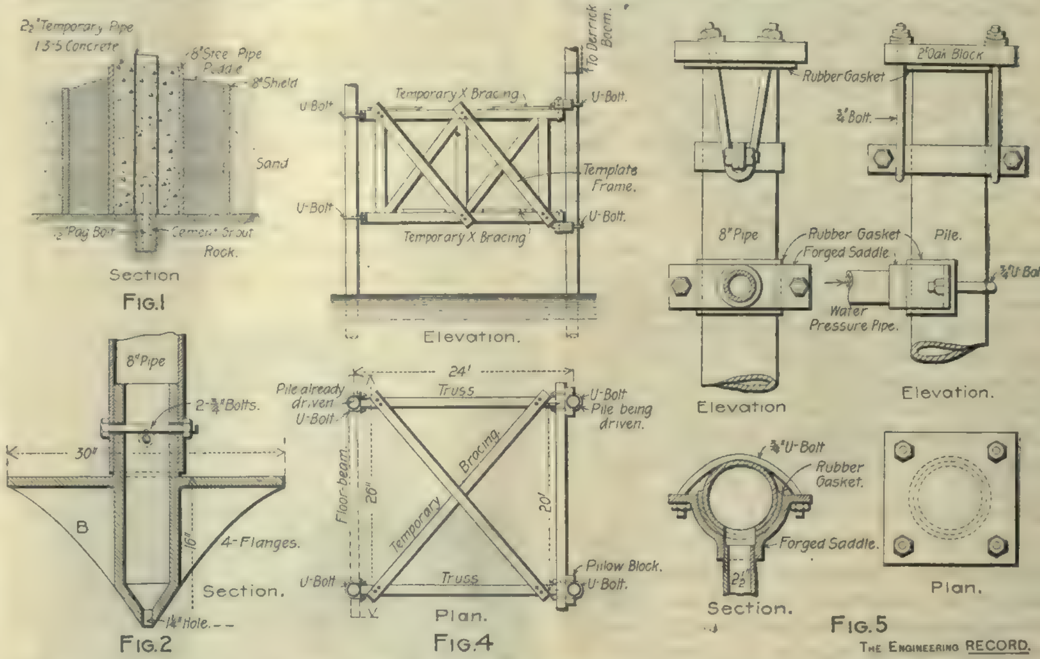
Some of the stones are only a little marred and may be used again, but as the whole face wall is built of solid marble cut to dimensions on all sides and accurately fitted, a little spalling practically destroys a stone. Some stones appear intact, but are found to be unsound by reason of soft calcined spots not easily detected at first, so that all are rigidly inspected and few of them are accepted. The stone was lowered to the platform and stored there until night when the street was comparatively free from traffic and it could be conveniently removed by cart. Similarly this platform will serve for storing and dressing the new stone, which it is hoped can be placed as fast as in the original wall, which was built at the rate of about one story a week. The debris from the upper stories is dumped to the eighth floor through chutes inside the building, and is then wheeled out on a platform that covers the whole area of the north court at that level, forming a storage and working place and protecting the lower part of the court. From this platform the debris is dumped through an outside chute to the ground on the site of the burned corner building and thence carted away at convenience. Plastering, trimming and fitting will follow as for new work, all materials being at present hoisted from the street and taken in through the open front, so as not to obstruct the halls or elevators.

It was found that a good deal of the cast-iron window casing in the court was warped, bent or cracked. Light scaffolds have been swung outside, and on them and on inside platforms the iron workers are carefully inspecting and repairing these parts. All the old bolts are renewed, pieces slightly bent or twisted are taken out, straightened in screw presses and replaced. In some places cracked portions are cut out with chisels, the joints filed up carefully and new pieces set in flush with splice plates on the back side, and countersunk bolts. In other places the injured pieces are replaced by new ones, made from the original patterns by the former builders, who are now the contractors for this part of the repairs.

It is estimated by the insurance companies and appraisers that the repairs will cost about $200,000, and will be completed about May. 1. They are directed by Messrs. N. Le Brun & Sons, the architects of the building, and in most cases the different classes of work are being executed by the same parties who were originally employed for them. Mr. John Downey is the general contractor, and contracts for separate portions of the work have been let as follows: Plumbing, Mr. Alexander Bryant; steam heating, Baker, Smith & Company; elevator work, Otis Brothers; structural iron work, J. B. & J. M. Cornell; the marble front, Norcross Brothers; wiring, the Western Electric Company.

CONSTRUCTION OF THE OLD ORCHARD PIER.

The promenade pier at Old Orchard Beach, Me., has a platform 26 feet wide and 1,800 feet long, 12 feet above extreme high water, supported on two rows of 8-inch steel piles 20 feet apart. The pile bents are 24 feet apart longitudinally, and at intervals of 400 feet an additional row of four piles is placed on the outside of each main row to support an extension 66 feet wide over all, and 72 feet, or three panels in length, for pavilions. At the ocean end of the pier additional piles are also driven to support an extension of the platform 100 feet square, carrying a pavilion. Across each pile bent in the regular structure is a latticed girder floor beam, with its bottom chord connected to flanged collars on the piles, and the top chord is bolted to cast-iron caps. The beam extends continuously across the tops of the piles to form cantilever brackets, the outer ends of which are knee-braced to the lower chord collars. There are diagonal rods 1 inch in diameter, with sleeve nut adjustments, in every panel of the floor beams, in the longitudinal vertical planes of the outside piles at the pavilions, and in the vertical transverse planes of all pile bents. The transverse vertical diagonals are connected at the upper end to the pile collars at the under side of the floor beams and at their lower ends to similar collars near the water level. The pile caps had their bolt holes drilled in the shop, and after they were leveled and adjusted in the field were used as templates for drilling the tops of the piles. At the top of each row of piles there is a continuous longitudinal strut, with pin connections at the ends for the horizontal diagonal rods. On top of the floor beams are 14 lines of 3x12-inch wooden stringers carrying the 2-inch transverse floor plank. Three of the stringers in each panel are bolted to angle clips riveted on the floor beams, and the remainder are spaced regularly between them. Where the pier is widened at intermediate points and at the end, pavilions are built as separate structures on its finished platform.



The maximum depth of water was 12 feet at low tide at the ocean end of the pier. The tides were 14 feet high, and about 200 feet of the beach under the shore end of the pier is dry at low tide. Here the sand was 6 feet deep, underlaid by a stratum of rock, and each pile was set on the rock at low tide by means of a shield made of 18-inch steel pipe, that was heavily loaded and jarred down in approximate position by striking it with sledges. After it had reached the bottom and was firmly set, the sand was pumped out of the inside by a simple ejector, made by connecting a 1-inch steam pipe into a 2-inch tee, in the opposite horizontal end of which the discharge pipe was screwed, while from the lower vertical branch a 2-inch suction pipe was carried to the bottom of the shield. This device operated very satisfactorily, though it was wasteful of steam. After excavating the sand from the interior of the shield, the 8-inch steel pile was set in position inside of it and centered by a transit. It was secured at the bottom by puddling the annular space with clay, and at the top by cross-pieces and wedges. Then the clear water was pumped out of it and a 2½-inch pipe was put down in the center to serve as an extra shield to exclude the sand from a 1¾-inch hand drill that was churned in it to bore a hole 18 inches deep in the rock. The drill had a 1¼-inch shank 2 feet long, and was screwed to a 20-foot gas pipe. A 1½-inch rag bolt, 3½ feet long, was set with cement grout in the hole, as shown in Figure 1. Then the pile was filled with concrete and the shield pipe was pulled up by the hoisting engine.

CONSTRUCTING THE OLD ORCHARD PIER.

Beyond the low water mark, the piles were sunk from 14 to 16 feet in the sand by hydraulic jetting, and were furnished with circular cast-iron shoes about 3 feet in diameter, as indicated in Figure 2. Each shoe had four vertical reinforcing webs, about 15 inches high, and

a 1¼-inch jet orifice at the bottom of a central tube. The shoulder of the shoe was wound with oakum and calked as well as possible when attached to the pile, and oakum was wound around the connecting bolts under the heads and nuts, so as to prevent as much as possible the escape of water pressure, excepting through the point of the shoe. The piles had a maximum length of about 60 feet, and were made in 20-foot sections, connected up complete with outside screwed sleeves before setting. The piles were handled by a traveling derrick with two 42-foot booms and two 27-foot masts braced to the engine platform, as shown in Figure 3. This traveler was erected on a trestle built for the purpose on shore, upon which it remained until it had set the first four piles. The floor joists were then laid across their floor beams and covered with plank and the traveler was run out upon the platform to handle the next pair of piles. The joists were doubled temporarily under the traveler track and afterward slipped back to their regular spacing without removing the floor boards. Material was delivered on a service track at the rear of the traveler, and was handled from there by the booms, which could swing nearly 270 degrees horizontally.

In order to hold the piles securely, guide them in sinking, and preserve an accurate spacing, they were set by means of a special timber frame or trussed template, as indicated in Figure 4. This consisted substantially of two heavy timber trusses, about 15 feet deep and 24 feet long. Each truss was hinged top and bottom to one pile in the last bent set, by means of flanged collars, bolted on so that it could swing like a door upon its vertical axis. The front ends of these trusses were connected by horizontal cross timbers top and bottom, each of which was hollowed out at each end to receive a pair of piles exactly 20 feet apart that were secured to them by U bolts. The templates were handled by the booms and their outer ends were supported after being set by independent tackles from the tops of the masts. Then the piles were put in their sockets in the outer ends and left hanging from the booms until they were lined up by the transit. When exactly in position, the two trusses of the template were connected and rigidly secured against revolving or lateral displacement by fastening on top and bottom temporary horizontal diagonal braces of plank. When not in use the templates were unshipped, lifted by the derrick, swung around and laid on the deck in the rear of the traveler. When it was necessary to leave them attached to the piles over night care was taken to have the front ends secured to a new pile that was driven or partly driven in position for the purpose. These trusses were found efficient and convenient.

The piles were sunk by a hydraulic jet at 100 pounds pressure delivered through a 2½-inch hole to the interior of the pipe and escaping through a 1¼-inch orifice at the point of the shoe. This jet was aided, if necessary, by two movable outside jets at the same pressure through 1-inch nozzles, attached to 2½-inch steel pipes, which were suspended from single blocks on the booms and were worked by hand. They were pushed down outside the pile to scour away any obstruction, and with them large boulders could be rapidly sunk below the bottom of the pile. The piles were at first hung loose in the boom falls and jetted freely, aided by occasional jarring with sledges at their bearings in the templates until they were nearly deep enough, when they were leveled by an instrument on shore and marks were made on the guide timbers. Then the pile was slowly sunk exactly to the mark with the falls tightened up to take part of the weight. When the mark was reached the piles were checked by the level, and if found too low were pulled up a little by the boom falls before the jet was taken off. Fifteen minutes after removing the jet the falls were unhooked, and in an hour the bent would be firm enough in the fine sand to sustain without settlement or displacement its share of the 15-ton load from the floor timber and the traveler.

It was at first intended to frame these pile bents complete with the floor beams and transverse diagonals connected before sinking, but it was found more expedient to sink the piles separately, although it was generally done simultaneously for each bent. About 70 wooden fender piles 70 feet long were driven at the ocean end of the pier by the same process, using a 1¼-inch jet with its pipe slipped loosely through staples driven into the piles. Water pressure was furnished by a Knowles pump with an 18-inch steam cylinder and 16-inch stroke and a 12-inch water cylinder. It was set on a depressed platform, just above high tide, so as to reduce the maximum suction to 19 feet, and delivered through a 5-inch steel discharge pipe to a manifold with four 2½-inch outlets, from which flexible hose pipes were carried for the different jets required. The suction was through 32 feet of 5-inch flexible hose, and the discharge pipe was lengthened by adding successive sections as the work advanced until it attained a maximum length of 400 feet. Then it was cut off and the pump moved forward. The pump was operated by a 40-horse power upright boiler, set on the pier platform above, which furnished sufficient steam at 100 pounds pressure to provide 100-pound water pressure for two continuous 1¼-inch hydraulic jets. The traveler booms were operated by a standard Lidgerwood hoisting engine, with two capstan heads and two drums.

The general appearance of the erection plant is shown in Figure 3, where the rigging of the traveler and the different tackles used for handling the piles and the templates may be seen. Underneath the traveler a tackle is shown attached to the lower right hand corner of the template to pull it into line as indicated by signals from the man standing on top. The pump is here shown moved up close to the traveler, with its suction pipe lying on the beach. One panel of longitudinal diagonal bracing is shown temporarily attached to the piles to stiffen them against vibration from the pump, and one panel of transverse diagonals is shown in advance of this, but does not appear in the succeeding bents, because the work had been no further completed when the photograph was taken. On one pair of piles the connection collars for the lower ends of the transverse diagonals are shown above their final position. Figure 5 shows the method of closing the top of the open pile tubes to retain the heavy hydraulic pressure for jetting them down. A 2-inch oak cover with a rubber gasket was secured by a pair of oblique vertical U bolts to the flanges of the upper connection collars that were temporarily fastened near the top of the piles to receive them. Just below this collar a cast-iron saddle piece was clamped to the pile by a horizontal U bolt, and in it was screwed a nipple to receive the water pressure pipe.

The site of this pier was in an exposed position subject to strong winds that were blowing on shore nearly all the time, making the water too rough for a small boat to land on the beach, and preventing the use of scows for working platforms, as was at first intended. One was indeed anchored at the work, but was knocked about so violently that it had to be removed as soon as possible to prevent injury to the structure. The work was carried on through the bad weather in March and April, when the men were frequently deluged with high waves. While the work was in progress the unfinished pier was exposed to one severe storm which it endured without injury.

The pier was built for the Old Orchard Beach Pier Company by the Berlin Iron Bridge Company, East Berlin, Conn., Charles M. Jarvis, M. Am. Soc. C. E., president, and J. H. Edwards, M. Am. Soc. C. E., chief engineer. The erection was planned and supervised by Mr. John Devin, superintendent of erection of the company, who developed the scheme for handling and sinking the piles, and to whom acknowledgment is made for data from which this description has been prepared.

THE CHAMPAIGN SEPTIC TANK.

The biological sewage disposal system which employs what is known as the septic tank is generally believed to have been first used in this country by Professor A. N. Talbot at Urbana, Ill., in 1894. In the following year he designed one for the Champaign, Ill., sewerage system, which has been in use since November 1, 1897. Its working has been studied somewhat, and at the recent meeting of the Illinois Society of Engineers and Surveyors, Professor Talbot presented the following important paper on the results of these observations:

For the benefit of those who may not have seen the description of the Champaign septic tank, it may be well briefly to describe the plant. Two masonry tanks 8 feet wide, 37 feet long and having a depth of 5 feet of water, lie side by side. The sewage flows into each through a diverging channel arranged to distribute the flow well over the cross-section of the tank, and flows out of the opposite end, perhaps a half inch deep, over a weir the full width of the tanks. The effluent then flows through sewer into the creek. Across the tanks at intervals are partitions which go down 2 to 3 feet below the surface, trapping the floating solids and preventing surface currents. These tanks are inclosed in a brick building which is dark and without ventilation. A centrifugal pump, run by a steam engine, is used to pump out the accumulated sludge whenever necessary. The action of the tank is continuous and no attendance is necessary.

The action of this tank seems to involve the following operations: 1. The mechanical separation of suspended solids, the heavier matter settling and the lighter floating. 2. The reduction of the retained organic matter by bacterial action, gases being given off and the ash settling, leaving some inorganic compounds to be carried off in the effluent. 3. A similar reduction in organic matter in solution, though to a smaller degree. 4. A breaking down of the compounds so that a further purification is made in the stream after leaving the tank much faster than would otherwise be effected.

A number of chemical analyses of the sewage and the effient have been made by the Department of Chemistry of the University of Illinois. Difficulty is encountered in getting samples of sewage typical of the general flow, since its composition is so changeable. The effluent is much more uniform in character. To avoid this objection several samples were taken on some days. The most satisfactory method, however, is to take composite samples by mixing samples of sewage taken hourly through 24 hours in amounts proportional to the rate of flow at the time the sample is taken. A composite sample of the effluent was also taken.

From the results of these analyses it appears that from 80 to 90 per cent. of the organic matter represented by the albuminoid ammonia, the oxygen consumed and the total organic nitrogen, is taken out. A still larger percentage of the organic matter in suspension is taken out. It may be said that these results are better than the results ordinarily obtained by the chemical precipitation process, and nearly as good as the winter results of some of the intermittent downward filtration processes. The chlorine and the volatile matter are not distinctive of results, since both these are very high in the ground water reaching the sewer.

The effluent during the time this study has

been made (since September, 1898) has been fairly clear, free from odor, and unobjectionable. Part of the time the sewage has been considerably diluted with ground water which leaks into the sewer. Analyses at such times of course show an effluent much better than if only sewage reached the tank—a water chemically better than that of some shallow wells in this city. The effluent at the time when little ground water was coming in was reasonably good—1.3 part of albuminoid ammonia per 1,000,000. This effluent may be discharged into a small stream without objectionable results. Analyses also indicate that there is a further reduction within a short distance as the water passes down the stream, but this is not fully established.

The sludge at the bottom is a thick, black mud; that at the top is a light matty mass. The tanks have been pumped out at least partially, three times. The discharge is into a pit near the bank of the creek. Only a slight odor arises from the discharge, that of dirty water. No trouble is anticipated from this.

During the winter the cold ground water has reduced the temperature of the sewage to about 47 Fahrenheit and at this temperature the bacterial action seems to be materially checked. Without the cold addition to the sewage, it is probable that the efficiency of the septic tank will be nearly as great in winter as in summer. In the autumn the temperature of the sewage in the tank averaged about 54 Fahrenheit.

To those intending to design such tanks, a few suggestions may be given. In general, the design of this tank is satisfactory. The weir at the effluent end is efficient, and probably the building is sufficiently dark and tight. The depth of water may profitably be greater, at least 6 feet and better 7 feet of depth. A somewhat longer tank would be advantageous, giving opportunity for another detaining partition. As to the width, it is probable that with widths greater than 10 feet there would be difficulty in getting uniform flow; that is, when the tank became partially obstructed, there would be more opportunity of a tortuous channel being formed through the tank.

Experience with the Champaign septic tank has shown that this method is applicable in many places when the sewage would cause objectionable nuisance if discharged into a small stream. It is believed that the method, if properly developed, will prove to be an important one. Of course, in many instances it may be necessary to provide further means of purification, but even then as a preliminary process this method would be valuable.

WATER FILTRATION EXPERIMENTS, PITTSBURG, PA.

The report of the filtration commission of the city of Pittsburg was presented to a joint session of the city councils this week. This commission, of which Mr. Robert Pitcairn was chairman, Mr. William McConway vice-chairman, Mr. George L. Holliday secretary, and Messrs. Henry P. Ford, S. D. Warmcastle, J. R. Vincent, W. J. Holland, E. M. Bigelow, James M. Bailey, J. Guy McCandless and William Flinn were the other members, was authorized by the councils in June, 1896, and was charged with the following duties: 1. To thoroughly investigate the character of the existing water supply of the city in its relations to public health; 2, to ascertain the effect of sand filtration; 3, to ascertain the advisability of sand filtration for Pittsburg; 4 to present an estimate of its cost; 5, to investigate the feasibility and advisability of seeking other sources of supply; 6, to report its findings and recommendations to the councils. The commission secured the services of the following gentlemen: Consulting engineer, Mr. Allen Hazen, Assoc. M. Am. Soc. C. E., of New York city; resident engineer, Mr. Morris Knowles, Assoc. M. Am. Soc. C. E., of Lawrence, Mass.; chemist, Dr. Walther Riddle, of Pittsburg; bacteriologist, Mr. William R. Copeland, of Lawrence, Mass. Prof. William T. Sedgwick, of the Massachusetts Institute of Technology, was retained to investigate the causes of typhoid fever in the city; Mr. Emil Kuichling, M. Am. Soc. C. E., was retained to investigate plans for furnishing a new supply by gravity. Dr. Eugene Wasdin, surgeon, United States Marine Hospital Service, made bacteriological examinations of the city water, and Mr. A. B. Shepherd, superintendent of the Bureau of Water of Pittsburg, made an investigation of a possible source of supply from driven wells. The commission as a body visited the city of Lawrence, Mass., for the purpose of thoroughly inspecting the filtration beds in operation in that city, and on their return inspected in New York city various plants engaged in mechanically filtering private water supplies. The cities of Louisville and Covington, Ky., and Cincinnati, Ohio, were also visited by a part of the commission and the filtration work being done there was investigated. Individual members of the commission also visited various cities in Europe where filtration plants were in operation.

There are two main sources of supply for furnishing the city with water, the Allegheny River and the Monongahela River. The present estimated population of the city is 320,000, of which the Allegheny River supplies about 234,000, the Monongahela River supplies about 78,000, and the remaining 8,000 are supplied from small private water companies.

Above the pumping stations and intake at Brilliant, which is about 6 miles above the city hall, the Allegheny River has a drainage area of about 11,400 square miles, upon which there are 59 cities and towns. The population of these places in 1890 was 185,939, equal to 16 per square mile, and the estimated population for 1900 is 277,693, which is equal to 24 per square mile. The drainage area is one of quick discharge. The velocity at low water is from 1 to 2 miles per hour, and during high water it is 7 to 8 miles per hour, with an average of about 3½ miles. There is a regular decline from Oil City to Pittsburg, a distance of over 100 miles, with no mill dam or quiet pools between the two cities, and with little or no opportunity for effective sedimentation. The velocity of the river and the character of its bed are such that polluted water introduced at Oil City may reach the water intake at Pittsburg in 15 hours, and must reach there in a few days.

The drainage area of the Monongahela River is about 7,600 square miles, and has situated upon it 34 towns and cities having a population in 1890 of 108,768, equal to 14 per square mile, and an estimated population for 1900 of 181,365, equal to 24 per square mile. The population per square mile is the same as that on the Allegheny River watershed, but it is situated much nearer the intake. The water of the Allegheny River as compared with that from the Monongahela River has a little more color, less alkalinity, less solid matter, less suspended matter, is softer, has less sulphuric acid, less iron, less free and albuminoid ammonia, less nitrates and fewer bacteria. The report says that from every standpoint the water of the Allegheny River is more desirable, and it was considered probable that the present supply for the south side, now drawn from the Monongahela River, would ultimately be abandoned and the Allegheny River supply extended to this portion of the city.

The water of the Allegheny is more or less turbid, and occasionally becomes very muddy. To test it for muddiness a platinum wire fastened to a long stick was dropped into it. At the point where the wire is just about to disappear the depth is read, and for convenience the reciprocal is taken. Thus if the wire disappears at a depth of 33 inches the turbidity is 0.03. A turbidity as low as this occurs during very low water in dry seasons. At other seasons, with ordinary low water, a turbidity of 0.10 is common. After summer rains it rises to 0.20 to 0.50, and heavy rains cause a turbidity of 1.00 or more. On three occasions it exceeded 1.00 and rose to 2.38, 1.20 and 1.75. The average turbidity for the year ending July 31, 1898, was 0.17. For 62 per cent. of the year it did not exceed 0.10. To remove this mud from the water was one of the most important objects to be reached.

Sand filters have been operated to filter from 2,000,000 to 5,000,000 gallons per acre per day, and have been conspicuously successful in removing those bacteria from surface waters whose presence would otherwise cause disease, but they have not been used to filter water as muddy as that from the Allegheny River. Mechanical filtration has commonly been used at a rate of about 100,000,000 gallons per acre per day, but has not been used much for waters containing sewage. Consequently experiments were thought necessary, and there were installed and operated at the Brilliant pumping station one sedimentation basin, two sand filters, one Jewell mechanical filter, one Warren mechanical filter and a set of artificial tiles on the Fischer system. The object was to ascertain their ability to deal with water as muddy as the Allegheny, to ascertain what bacterial efficiency could be secured by mechanical filtration and to settle purely local problems. The following points were particularly covered: Whether the Allegheny water could be filtered without preliminary sedimentation and whether such sedimentation was desirable; whether it would be necessary or desirable to cover filters in the climate of Pittsburg; whether the mud, crude petroleum, mine drainage and other substances in the Allegheny would interfere with filtration and cause results different from those obtained elsewhere; to determine the frequency with which it would be necessary to clean filters both with and without preliminary sedimentation, this being required to determine the cost of operation.

Work was begun about the first of June, 1897, and the experiments were completed by September 1, 1898, since which time the work done has been upon the report. The sand filters were about 25 x 13 feet, and were filled with sand to a depth of 5 feet, which settled so that, at the time the experiments were begun, it was but 4.2 feet deep. The effective size of the sand was 0.30 millimeters, and the uniformity coefficient was 2.0. The average composition of the sand was as follows: 0.97 per cent. of iron and aluminum oxides, 1.33 per cent. of calcium carbonate, and 97.7 per cent. of silicates and insoluble matter. The filters were run at as low a rate as 2,000,000 gallons per acre per day, and as high as 5,000,000 gallons per acre per day, with no effect upon the bacterial efficiency. The loss of head was limited to 4 feet, and when it reached this amount the filters were scraped. After scraping they were filled with filtered water from below. For a day or two after scraping the number of bacteria in the effluent increased somewhat.

The sand filters were run for 13 months, and the average efficiency for this time was 99.21 per cent. for one and 98.92 per cent. for the other. The average number of bacteria in the raw water was 16,340, and the average number in the effluents from the beds was 129 and 177. One filter was used for raw water and the other for water after it had passed through the settling basin. The report says that with low turbidities the two filters gave equally good results. With greater turbidity a marked difference in behavior was noticed. The filter supplied with water from the settling basin was operated for longer periods before cleaning and gave a much more satisfactory effluent. At times of maximum turbidity the filter supplied with unsettled water became clogged so rapidly that grave difficulties would be experienced in

cleaning filters in a municipal plant operated in this manner. The bacterial efficiency was also materially less, although settling itself removed very few. The experiments thus demonstrated that for the Allegheny River water preliminary sedimentation, if not absolutely necessary, is certainly desirable, and either that or its equivalent must be considered as an essential part of a filtration plant.

Under the head of the necessity for covering filters the report says that the temperature of Pittsburg places it about on the dividing line between localities requiring and not requiring covering. The report does not regard covers as necessary, and does not recommend them.

No disturbing action was caused by the crude petroleum, mine drainage, etc., in the water. The filter receiving unsettled water was scraped 14 times between July 24, 1897, and August 19, 1898, and the average quantity of water filtered between scrapings was 77,000,000 gallons per acre. After the end of the experiments the layer of sand in the filters was about 3 feet thick.

The Warren filter had an area of 118 square feet of filtering surface and the settling basin had a capacity of 13,000 gallons. The sand layer was 2.3 feet deep, the sand having an effective size of 0.63 millimeters and a uniformity coefficient of 1.1. The filter was washed from below and the sand stirred during washing. The average of the analyses of the coagulant used during the test of the filter shows that it contained 17.18 per cent. of aluminum oxide soluble in water, no iron oxide, 38.66 per cent. of sulphuric acid, and 0.24 per cent. of matter insoluble in water. The main question to be determined in connection with the mechanical filters was their bacterial efficiency. Although negotiations had been carried on with the manufacturers of mechanical filters for some time, it was not until January, 1898, that they were put into operation. They were then run for seven months. Variations in the rates of filtration and in the application of the coagulant caused variations in the number of bacteria in the effluent. Special tests, called sensitive tests, were made with large quantities of aluminum sulphate and with none. On stopping the use of the sulphate the number of bacteria in the effluent increased rapidly. The filter was washed from one to five times per day. For the seven months while it was in use the average number of bacteria in the river water was 11,427, and the average number in the effluent was 262, giving an average efficiency of 97.7 per cent. The average number of grains of coagulant used was 1.36, and the average rate of filtration was 115,000,000 gallons per acre per day.

In the Jewell filter the sand area was 113 square feet. The effective size of the sand was 0.46 millimeters and the uniformity coefficient was 1.4. The same tests were made with variation in the rates of filtration and in application of the coagulant. The results showed less variation than in the Warren filter. In the sensitive tests the results were about the same with both filters. Twice during the time this filter was in use it was shut down, 100 pounds of soda ash were placed on top of it, a jet of steam applied beneath and the whole thoroughly boiled. This was followed with a long washing, and the effect was to cleanse the entire filter. This gave new life to it; it could run longer between washings and its quantitative efficiency was increased. The surface of the filter was occasionally raked into furrows instead of being washed. When the bed was new or when recently cleaned with soda ash this trailing, as it was called, increased the length of run between washings. For the seven months while the filter was in use the average number of bacteria in the effluent was 459, giving an efficiency of 95.99 per cent. The average number of grains of coagulant used was 1.00 and the average rate of filtration was 104,000,000 gallons per acre per day.

Just after washing the filters the effluent was of an inferior quality for about 20 minutes. The bacterial efficiency was increased by the use of a larger amount of sulphate of alumina. With the increase in quantity of the sulphate used the turbidity and number of bacteria in the effluent increased as well as the bacterial efficiency. It may be then that the increased efficiency with the increased quantities of sulphate of alumina are not due alone to the increased quantities of sulphate of alumina, but in part also to other conditions. To investigate this matter and eliminate the influence of turbidity and number of bacteria in the raw water the results were first classified with reference to turbidity. A comparison was made showing the bacterial efficiencies with turbid (0.10 or less), muddy (0.11 to 0.50) and thick (0.51 and over) waters with substantially equal quantities of sulphate. The results of this comparison showed that waters of various degrees of turbidity give substantially equal bacterial efficiencies with equal quantities of sulphate, the results varying as often in one direction as in the other. Within certain limits it may thus be said that turbidity is without influence upon the bacterial efficiency in mechanical filtration. This statement applies only in those cases where sufficient sulphate of alumina is used to adequately coagulate the water.

To investigate whether the number of bacteria in the raw water has an important influence upon the bacterial efficiencies, each of the two largest classes in the foregoing tests were divided into two parts, according to bacterial numbers in the raw water, namely, the results from the Jewell filter with turbid waters and with sulphate of alumina in quantities ranging from 0.75 to 1.00 grains per gallon, and the results from the Warren filter with turbid water and with sulphate of alumina in quantities of 1.25 grains per gallon and upwards. The results from this show that the bacterial efficiency is the same with the lower and the higher numbers of bacteria in the raw water. That is to say, other things being equal, as the number of bacteria increases in the water, the number of bacteria in the effluent increases in the same ratio.

The following table shows the amount of sulphate of alumina necessary to secure various efficiencies with different degrees of turbidity.

Required bacterial efficiency.	Coagulant required for this efficiency with least turbid waters.	This quantity is sufficient for treatment of waters with turbidities up to	Extra coagulant necessary for higher turbidities reckoned on all the water treated for one year.	Average quantity of coagulant required. Grains per gallon.
		Warren Filter.		
95	0.37	0.03	0.33	0.70
96	0.44	0.06	0.28	0.72
97	0 56	0.11	0.22	0.78
98	0.84	0.22	0.14	0.98
98.50	1.12	0.34	0.10	1.22
99	1.60	0.53	0 06	1.66
		Jewell Filter.		
95	0.42	0.07	0.18	0 60
.96	0 49	0.12	0.15	0.64
97	0.65	0.21	0.10	0.75
98	0.96	0.39	0.06	1.02
98.50	1.48	0.70	0.02	1.50

The quantitity of sulphate of alumina required to produce clear effluents and the bacterial efficiencies mentioned is given in the following table:

Bacterial Efficiency.	Coagalant required. Warren Filter.	Jewell Filter.	Used in computation of cost of operation.
95	0 70	0.60	0.65
96	0.72	0.64	0.68
97	0.78	0.75	0.76
98	0.98	1.02	1.00
98.50	1.22	1.50	1.35
99	1.66	....	1.70

The amount of sulphate of alumina which can be used depends upon the quantity of lime in the water. It is considered prudent to use only three-fourths of the quantity that the amount of lime will warrant. The report says it appears that at times the amount of sulphate of alumina which can safely be used with the Allegheny River water is not more than 1.2 to 1.5 grains per gallon.

The average bacterial efficiency developed by the tests were 99 per cent. for the sand filters and from 97 to 98 per cent. for the mechanical filters. With the sand filters the efficiency in the summer months, when the number of bacteria in the raw water was the highest, reached the remarkable figure of 99.96 per cent. The numbers of bacteria in the effluents vary less with changes in the numbers in the raw water in the sand filters than do those in the effluents from the mechanical filters. This has led to the theory that those bacteria result from growths in the under drains and lower part of the filters and do not represent bacteria that have come through the sand. With mechanical filters the action is so rapid that there is no chance for such growths and the numbers of bacteria found represent the numbers passing the filters. The importance of the difference is that bacteria capable of growing in the under drains are not injurious to health and the apparent efficiency of the filter is reduced below the true efficiency.

In the mechanical filters by using more sulphate of alumina the efficiency could be increased. The interruption of the introduction of this chemical increased the bacteria in the effluent in a short time to the number in the raw water, an important fact, as a temporary interruption would destroy the usefulness of the filter. On the whole, the bacterial efficiency of the sand filter is declared to be the best.

On the question of clearness the mechanical filters are pronounced the best. It is asserted, however, that either method will produce satisfactory water in this respect. The water after filtration is almost colorless. Occasionally it has a yellow tinge due to peaty matter. This the mechanical filters remove.

Tests were made with the Worms artificial-plate filter in two separate tanks, three plates being used in each. The coagulant used was chloride of iron. The water is treated with the coagulant and passes through a scrubber, which is a settling tank filled with stone and gravel. The tiles were washed with a reversed current under a head of about 20 feet, and resulted in their breaking. These tests extended over a number of months and gave unsatisfactory results.

In order to test the filtered water for increased hardness three 25-horse-power horizontal flue boilers were set up and were supplied with gas for fuel. One boiler was used with raw river water, one with water from the sand filter and one with water from the mechanical filters. Both the sand and mechanical filters increase the hardness of the water, but the former increase is what is known as temporary hardness while the latter is permanent. The hardness caused by the sand filters is temporary in another sense of the word, owing to the fact that it is formed by absorption of the lime from the sand of the filter. In the course of time the lime will all be absorbed and this source of hardness removed. The conclusions drawn from these tests are given in the following extract from the report of Mr. Knowles: "We have then, in conclusion, that filtration of the Allegheny River water removes the mud and insoluble matter, which would by depositing cause the boilers to be frequently cleaned and washed out. The incrusting properties which remain, while they may not make a scale as quickly or as thick as if greater amounts of other material were present, yet when the deposit is formed it is hard, of a character which gives it the name of 'porcelain scale' and difficult to remove except by tools."

The final comparison between the sand and mechanical filters is stated briefly in the report of Mr. Hazen in the following words: "With an amount of sulphate of alumina which makes the cost of the two processes substantially equal the mechanical filters yield effluents containing from two to three times as many bacteria as the sand filters, and are consequently two or three times as likely to transmit disease germs, while on the other hand the efflu-

ents are clearer and more nearly colorless. In the adaptability of the filtered water to mechanical purposes the differences between the two will not be very great, but such differences as there are will be in favor of sand filters. If the raw water were very much more muddy than it is and contained less sewage, the advantage would be on the side of mechanical filters, or at least the use of coagulants would be necessary. If, on the other hand, the water was less muddy and contained more sewage and sewage bacteria, the advantage would be decidedly with the sand filters. Considering the fact that mud is not likely to increase, while the amount of sewage entering the river is sure to increase, and at a rapid rate, I believe that sand filters will be more satisfactory to the city than mechanical filters."

Upon the question of the necessity of a storage reservoir for raw water, the report says that nearly all the difficulties in treating the Allegheny River water come at flood periods. It is only at these times that the sand filter refuses to give a practically clear effluent. These periods are of short duration. The worst water rarely lasts over 24 hours, and in no case over three or four days. There is a site for such a reservoir on the west side of the river, having a drainage area of five miles, and a population of 60 per square mile. This water is equal in quality to the Allegheny River water. The capacity of such a reservoir, if built, should be sufficient for 10 days' supply. The report says that it was thought best at present to construct a sedimentation basin having a capacity equal to one day's supply and let the storage reservoir wait.

The question of cost is discussed from a relative standpoint. The consumption of water in Pittsburg averages 50,000,000 gallons a day, and on some days is much greater than the average. To be safe the capacity should be 75,000,000 gallons daily. The estimates of the cost are as follows:

	Sand Filters with sedimentation Basins.	Sand Filters with Storage Reservoir.
Intake, pumping machinery and pump house	$315,000	$455,000
Sedimentation basin	200,000	......
Raw water basin	......	442,000
Filters	751,000	751,000
Pure water reservoir	133,000	133,000
Force main and conduits	78,600	210,300
Tunnel under river	60,000	60,000
Engineering and contingencies, 10 per cent	153,760	205,130
Total cost of construction	1,691,360	2,256,430
Land, with reserve area to double plant	420,000	312,500
Total estimated cost	$2,111,360	$2,568,930

	Mechanical Filters North of River.	Mech'l Filters South of River.
Intake, pumping machinery and pump house	$315,000	......
Filters	600,000	$660,000
Filter house, boilers, etc	258 800	400,000
Pure water reservoir	133,000	.....
Force main and conduits	57,500	467,200
Tunnel under river	60,000	......
Engineering and contingencies, 10 per cent	142,430	152,720
Total cost of construction	1,566,730	1,679,920
Land, with reserve area to double plant	75,000	50 000
Total estimated cost	$1,641,730	$1,729,920

The additional cost of covering the sand filters would be $375,000. The cost of maintenance per year is estimated as follows: Sand filters with sedimentation basins, $192,184, or $10.53 per 1,000,000 gallons; sand filters with storage reservoir, $208,492, or $11.42 per 1,000,000 gallons; mechanical filter north of river, $196,807, or $10.78 per 1,000,000 gallons; mechanical filter south of river, $186,201, or $10.20 per 1,000,000 gallons. The estimates are based on 20 years for the machinery and 40 years on the buildings. The buildings would be practically permanent, but it is not known that the Allegheny would be a suitable source of supply after 40 years.

The question of securing a supply from a gravity system was considered and Indian Creek, in which the Western Water Company has rights, was the only practicable source for such a supply. This would require a conduit 47 miles long, including 42 miles of pipe and 5 miles of tunnel. The dam required would be higher than any yet constructed. The quantity estimated as available from this source was 92,000,000 gallons daily, which could be increased to 130,000,000 gallons by adding Laurel Hill Creek. The dam would have to be large enough to hold a year's supply. The water from this source would be soft and colorless. The difficulties attending this scheme would be in crossing the coal fields with the pipe lines. Owing to the settling of the surface of the ground over the coal fields two pipe lines would be necessary, each having a capacity of 75,000,000 gallons per day. The cost of building this system is estimated to be $13,568,500, which includes the cost of the duplicate pipe line. After the consumption reached 65,000,000 gallons per day a third pipe line would be necessary. This portion of the investigation was reported upon in detail by Mr. Emil Kuichling, M. Am. Soc. C. E.

The following conclusions and recommendations are taken in full from Mr. Hazen's report:

"I have shown that your present water supply is seriously objectionable, because of the mud which it carries, and because of the polluting matters which enter the river. By filtration the mud and the effects of pollution can be effectively removed.

"It is feasible to introduce a gravity supply of excellent water from practically unpolluted sources, but the cost of doing it will be six times as great as the cost of installing filters. The operating expenses of filters are greater, but allowing for them, the cost of the gravity supply is much greater than the cost of your present supply with filtration. I therefore recommend that the present supply should be continued in use and that it should be filtered.

"Two methods of filtration have been examined, either of which is capable of furnishing at all times sufficient water free from mud or objectionable turbidity. Of these systems, one, namely, sand filtration, removes more completely the effects of pollution than does the other, namely, mechanical filtration. I therefore recommend the adoption of sand filtration.

"The city is now wasting several times as much water as it uses. The experience of other cities shows that the consumption can be greatly reduced by the adoption of the meter system for the sale of water, and the cost of filtration and pumping can be kept within reasonable limits. I recommend the adoption of the meter system.

"A filter plant suitable for supplying an annual average consumption of 50,000,000 gallons per day, and with a mximum capacity one-half greater, will supply the whole city, including those wards not now supplied from the city works, until the population of the city reaches half a million.

"The general arrangement of such a plant has been indicated in connection with the estimates for the various filter projects. It would consist of a pumping station on the north side of the river, pumping water to sedimentation basins holding 50,000,000 gallons, from which it would flow to open sand filters with an effective filtering area of 25 acres; thence to a covered pure-water reservoir, and thence through a tunnel under the river to the Brilliant pumping station. The cost of constructing such a plant with all accessories complete is estimated at $1,691,000. To this must be added the cost of the necessary land, which is estimated at $420,000, and an appropriation of $100,000 for commencing the work of installing meters. The total estimated cost of carrying out the works now recommended is $2,211,000.

"I believe that this is the best way for the city of Pittsburg to supply itself with good, wholesome and clear water, and I recommend its adoption, and that the necessary arrangements for carrying it into effect be adopted."

The report of Prof. William T. Sedgwick said that the vital statistics show that typhoid fever in the last ten years has been the cause of 2,245 deaths, an average of 224.5 per year. During this time and probably for much longer Pittsburg has never been free from the disease; at no time in the ten years has there been fewer than four deaths a month, while the average has been 18.7 deaths a month. There has been probably from 150 to 200 cases at any given time under treatment. The average annual number of deaths in Pittsburg in ten years—1888-1897—is 224.5. The estimated population in 1895 was 275,000. During the same period the average in Boston was much smaller—158.9—with a population of 496,920. In the same period in New York, with a population in 1895 of 1,669,801, the average number of deaths was 352.2. This means a death rate per 100,000 inhabitants of 21.0 in New York, 31.9 in Boston and 81.6 in Pittsburg. The disease is very general all over the city and is not confined to any one particular spot. In conclusion he says: "I am forced to conclude that the water supply is in all probability the principal source of the constant and excessive amount of typhoid fever in Pittsburg."

The report says that it has been suggested that the excessive amount of water used in Pittsburg is due to the manufactories. The fact is that these establishments do not use the amount of city water supposed, as nearly all have their own pumping plants. This is an argument against establishing an auxiliary system by which unfiltered water would be supplied to factories.

The quantity of water pumped in Pittsburg has doubled in the last twelve years and the amount used per inhabitant has also greatly increased. In 1883 the average daily use was 157 gallons per inhabitant; in 1897 it was 233 gallons. In 1883 the quantity pumped was 20,300,000 gallons a day; in 1897 it was 49,200,000 gallons. In 1900 it is estimated that the population within a 10-mile radius of city hall will be 700,000; in 1910, 980,000; in 1920, 1,370,000; in 1930, 1,920,000. If the consumption of water increases as it has in the past the amount required would be of enormous dimensions. This is not looked for. The experience of other cities shows that the waste ceases where rational measures are adopted. It is estimated that today 15,200,000 gallons are really required, being less than one-third the amount pumped. The remedy is the use of meters, and these are strongly advocated, and a system for their gradual introduction is suggested. With meters the proposed filtering plant will be sufficient for 15 years; without it the plant will be outgrown before it can be built.

The south side which now uses water from the Monongahela River is supplied by a private company whose charter has seven years yet to run. If meters are used the report of the commission provides for supplying this portion of the city with filtered water from the Allegheny River, provided satisfactory arrangements can be made with the company.

The conclusions of the commission are as follows:

"We conclude, as the result of careful investigations, that the city is now wasting more than twice as much water as it uses. We find that the experience of other cities reveals that the introduction of a system of sale by meter has the result of greatly reducing the waste, and we strongly recommend the adoption of the meter system for the sale of water. We believe that the introduction of the use of meters will prevent waste to such a material extent as to greatly lessen the cost, alike of the establishment of a system of filtration and its subsequent operation, and possibly to make it feasible, from a plant of the size suggested in the report of the consulting engineer, to supply, not only the portions of the city now using the water of the

Allegheny, but those also which are drawing their supply from the Monongahela.

"We recommend, in conclusion, that the city of Pittsburg adopt for its water supply the system of sand filtration upon the plan recommended herewith in the report of our consulting engineer, and that the system of selling water by meter be likewise adopted. For the erection of a filtration plant approximately $1,700,000 will be required; to provide the necessary site $500,000 should be amply sufficient; to establish the meter system will require an additional outlay of $600,000. We recommend that your honorable bodies make provision for an issue of bonds for these purposes to the amount of $3,000,000, the bonds to be issued by the proper authorities, as they may be required, and no more to be issued than are actually required to provide for the establishment of a system of filtering and metering the water supplied to the city. In recommending an issue of bonds to the amount of $3,000,000 we have allowed $200,000 for contingencies, which might but are unlikely to arise, and we believe that the sum above named will be quite sufficient to make it sure that all the water supplied the municipality will be wholesome, as it certainly will be clear and free from mud."

In concluding this review of the results of the Pittsburg investigations, "The Engineering Record" desires to express its appreciation of the courtesy of Mr. Knowles and Mr. E. J. Martin, city clerk of Pittsburg, through which it is able to give its readers all the important results of these painstaking studies long before their official publication.

ELECTROLYSIS IN JERSEY CITY.

Some time ago Mr. C. A. Van Keuren, chief engineer of the Board of Street and Water Commissioners of Jersey City, became convinced that electrolysis was injuring some of the water mains in that city. After making several investigations he secured authority to retain Mr. A. A. Knudson, whose studies of wandering electricity in New York were reviewed in these columns on November 5, 1898. The latter engineer recently submitted a report on the subject, which is reprinted through the courtesy of Mr. Van Keuren, as showing an unusual manifestation of this annoying phenomenon.

"Belleville Avenue is a street in the country over a portion of which the trolley cars of the Union Traction Company run on their way from Rutherford to Arlington, N. J. There are no fire hydrants on this road, as is the case in cities, in connection with the pipes, which are convenient for making electrical tests. Therefore excavations were necessary. Two of them were made, one at the intersection of Belleville and Kearney Avenues, near the reservoir, and the other at Elm Street. The distance between the two excavations were about 2,000 feet on the Belleville road, for which distance the pipes and tracks occupy the street. A test was also made at a gate on pipe No. 1, located about 300 feet from the Elm Street corner. After the mains had been uncovered and electrical connections made, voltmeter readings were taken to ascertain the difference of potential between the rails and pipes. For convenience of reference these are recorded in the following table. The cement covered main we designate as No. 1, and the others, to the right, facing the reservoir, as Nos. 2 and 3:

RECORDS OF TESTS MADE.

Jan. 5th, 1899. Time, 1 to 3 P. M. Weather mild.

No. of Main.	1.	2.	3.
Distance from nearest rail	2 ft. 6 ins.	4 ft. 6 ins.	8 ft. 2 ins.
Size of main.........	36 ins.	36 ins.	20 ins.
Year when laid......	1873	1862	1853
Max. d. of p. at Kearney ave., rails positive	5 volts.	10 volts.	10.2volts.
Max. d. of p. at Elm st.	2.5 volts.	2 volts.	4.1 volts.
Test Jan. 10, 12.30 p. m., Elm st..........	....	....	15 volts.
Max. d. of p. at gate, rails positive	6 volts.	....	....

"The table shows that stray currents of electricity are passing from the rails of this road into your mains at a voltage much too high, in view of other conditions of the case to be explained later, to consider them free from the destructive action of electrolysis. The range of maximum voltage is from 5 to 10.2 volts at Kearney Avenue, and from 2 to 15 volts at Elm Street, this latter high reading being discovered at a second test on the 10th instant on pipe No. 3. The rails, however, in all of these tests were positive to the mains; consequently no damage is anticipated from electrolysis to the pipes in this street, and no signs of same were found at these excavations on any of the mains. The rails, however, show evidence of electrolysis to a marked degree at both openings, but more so at Kearney Avenue, where their lower sides show considerable corrosion.

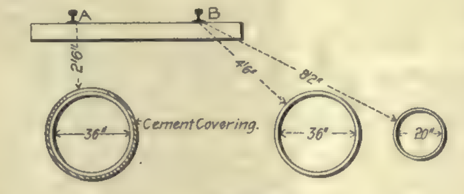


Fig. 1

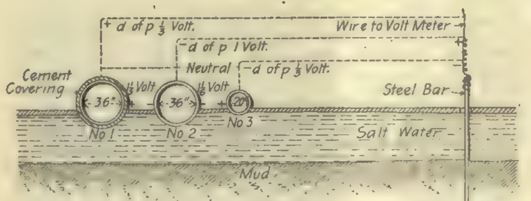


Fig. 2

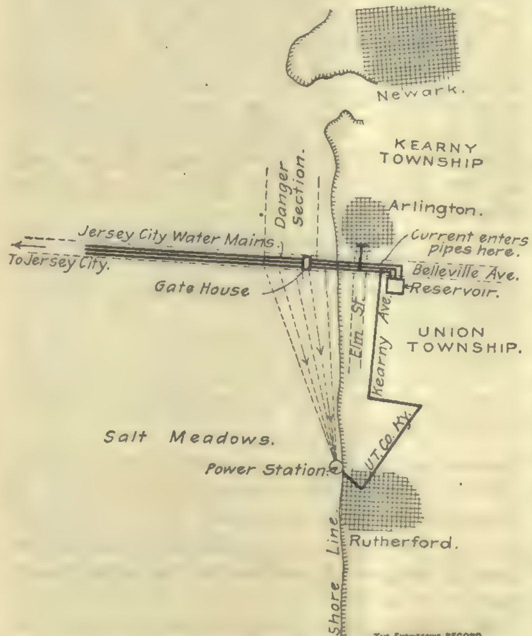


Fig. 3

ELECTROLYSIS DIAGRAMS, JERSEY CITY

"It will be understood that the point where damage is caused by electrolysis is where the current leaves the metal, or, in other words, tests positive to some other metal.

"For the purpose of easy reference as to position of tracks, with mains, distances from same, etc., we submit Figure 1, which shows the situation where the Kearney Avenue excavation was made. At the Elm Street corner the distances are about the same, with the exception that pipe No 1 comes under rail B, instead of rail A, Nos. 2 and 3 further to the right and keeping about the same distance throughout.

"In former experience it has been found that when a stray current passes from the rails of the road to water pipes it is very apt to find an exit at some other locality in the system in seeking another path of easy return to the dynamo. In our efforts to discover, if possible, such point of exit of the current in question we have consulted maps which show the line of the Union Traction Company's railway, the location of their power station, and the route of your water main. From a careful study of the same we came to the conclusion that the most probable point of exit in this case would be where the water mains cross the salt meadows on their way to Jersey City, for the following reasons:

"First. The power station of this road is located at Rutherford, on the border of the salt meadows.

"Second. The distance in a straight line from the water mains, which the current would take at a point near the shore of this station, is shorter by about two miles than the route of the railway over the various roads through which it runs. This is shown by the use of a scale of miles.

"Third. The salt water and mud of the marsh in which these mains are partly submerged offer a good conductor for the current to pass through them on to the aforesaid power station in a direct line. We therefore, with the assistance of your foreman, Mr. Carroll, made voltmeter tests at a point known as the gate house, about one-half mile from the shore proper, on the morning of the 10th instant, between the hours of 10 a. m. and noon, weather very cold.

"In our attempt to intercept any current which may be flowing from the pipes at this point toward Rutherford we drove a steel bar down through the ice and water and well into the mud of the marsh. From its upper end we connected a wire and attached the distant end to the voltmeter. Electrical contact was then made to each pipe without difficulty and the voltmeter readings taken.

"As the results of our tests at this point show features of scientific interest as well as information of importance, we give them in Figure 2, and also in Figure 3. It will be seen that the two outside mains, Nos. 1 and 3, are positive to the steel bar at a difference of potential of one-third volt in both cases, while the middle pipe, No. 2, tests 1 volt negative to the bar or marsh, the outside mains, 1 and 3, testing neutral to each other.

"Tests between the mains show that both Nos. 1 and 3 are positive to No. 2 with 1 1/5 and 1 1/6 volts, respectively, showing the current to be leaving the two outside mains and passing into No. 2.

"While these tests show a comparatively low voltage from the outside pipes to the marsh, under conditions such as being buried under soil free from alkaline solutions or salts such as would prevail on a country road, no particular danger from electrolysis would be feared; but as the case stands the presence of salt water, in which they lie continually is an electrolyte which materially assists the action of electrolysis even at low voltage. Again, the case is more serious under these conditions when the higher voltage of 1 1/5 is considered found passing between the mains. The brick and cement coverings on pipe No. 1 would offer but little, if any, protection against electrolysis under these conditions. From these tests, therefore, that were made on the meadows, the indications are that much of this escaping current passing into your mains on Belleville Avenue comes out from them on the meadows, but distributed for some distance along their length, probably for half a mile, as illustrated by Figure 3, the arrows pointing in the direction the current takes in returning to the power station at Rutherford.

"Mains Nos. 1 and 3, therefore, according to these tests and indications, would be the ones affected by electrolysis, while No. 2 would be practically free from same.

"The results of this investigation show a striking analogy to a condition of stray currents found by me in a recent investigation in the vicinity of the Brooklyn Bridge entrance, New York, where it was found that railway currents passed over the structure to New York, thence up the East Side, through underground pipes, etc., and recrossed through the river to the power station at Kent Avenue, the difference between this case and yours being

that your water mains represent the bridge and the salt meadows the iron piping and the East River.

"It is probable that if a number of tests were made along the sides of these mains in the meadows the voltage would be found to vary, higher or lower, as the case may be; but we believe sufficient data have been discovered to determine existing conditions. The danger section, therefore, of your water mains, as we have endeavored to locate in this investigation and set forth in this report, is on the salt meadows, where the current leaves the pipes about two miles from where it enters, at Belleville Avenue. Taking all things into consideration, therefore, the excessive escape of 10 volts maximum at Kearney Avenue, and of 15 volts maximum at Elm Street, and passing out of this current on the meadows through an electrolyte, such as salt earth and salt water, thereby facilitating the action of electrolysis, is a condition which, if allowed to continue, will, in my opinion, seriously shorten the life of these very important water mains.

"In regard to the remedy I have consulted with the officers of the Union Traction Company with reference to making such changes that will reduce this escape of current into your mains, and they express their willingness to do whatever is necessary to obviate the trouble.

"I do not think that this escape of current is due to any imperfect design of construction, as, generally speaking, the road is well built, much better than is found among the average trolley roads operating through and between small towns. It is provided with an insulated return conductor through its entire length, which many electric roads do not have. I have also seen the character of bond used for connecting electrically the ends of the rails, and they seem to be as good as any in the market, two being used, I am told, for each rail. Notwithstanding this, there is something wrong, and the railway people appear to be as anxious to discover and rectify it for their own interests as well as yours.

"The most effectual method for eliminating this current escape to your mains would be a removal of the rails from this portion of the street in which the mains are located. As this, however, may be impracticable, I would suggest that the company be allowed to make such changes to reduce the escape as they have in mind, such as putting in more frequent tap connections from their return wire to their rails (they now being over 1,000 feet apart), and examining and renewing such rail bonds, as well as cross bonds, as may be found imperfect. When this is done further tests should be made at Belleville Avenue, as well as at the danger section on the meadows, to determine if the escaping currents have been checked and danger from electrolysis removed.

"In referring to future tests on Belleville Avenue these can be made without further excavations, as before the holes were covered in we took the precaution to make a good connection with insulated wires to one of the mains (No. 3), which was led up to a known point on the surface. This was done at both of the excavations, and as tests have been made at both places since covering it, the readings of the voltmeter showed the wires to be intact and ready for future use.

"The instrument used in making these tests was a standard Weston high and low reading voltmeter, which had not been used since being recently standardized at the Weston factory, at Newark, and consequently was in perfect order."

THE PROPORTIONS OF CONCRETE.

About two years ago at a meeting of the Institution of Civil Engineers Mr. John Kyle stated that the proportions of material for concrete should be "if of hand-broken metal, say four parts to pass a 3½-inch ring, two to pass 1¼-inch, two of gritty sand and one of cement." Taking this statement as a text, Mr. Francis J. Preston has a paper in the last volume of the Institution's "Proceedings" which opposes the adoption of such proportions and advises others. As the subject is of considerable interest just now, Mr. Preston's discussion is reprinted in full after the introductory lines referring to Mr. Kyle's remark.

If it is admitted that in making good concrete it is essential that all the interstices of the aggregate should be filled with mortar, and that a small surplus of mortar should be allowed for surrounding the stones, such concrete cannot possibly be made with the proportions quoted, nor indeed with 6 parts of any ordinary-sized broken stone. Further, such concrete cannot be made if proportions of 1 of cement, 2 of sand and 7 or more of shingle are used, as they often are. Even 6 parts of shingle leave only a small margin of mortar in excess of interstices. One part of cement and 2 parts sand make ¾ (1 + 2) parts = 2.25 parts of mortar; or, if the quantity of mortar is given, then the quantity of cement and sand will be one-third greater. Slight variations, depending on the kind of sand employed, may occur.

The percentage of interstices of several samples of broken stone of the kind mentioned averaged 48 per cent. The percentage of interstices of several samples of shingle tested varied between 33 per cent. and 38 per cent. It is given by Mr. J. W. Sandeman, M. Inst. C. E., as 50.9 per cent. for broken stone and 33.6 per cent. for gravel. With a concrete composed of 1 part of cement, 2 parts of sand and 6 parts of broken stone, with 48 per cent. of interstices, the following results are obtained:

	Parts.
Mortar = (1 part cement + 2 parts sand) ¾	= 2.25
Interstices = 6 parts × 0.48	= 2.88

That is to say, the interstices are largely in excess of the mortar provided, and 10½ per cent. of the concrete will be made up of hollow spaces.

In the case of concrete composed of 1 part of cement, 2 parts of sand and 7 parts of shingle, taking the lowest percentage of interstices, viz., 33 per cent.:

	Parts.
Mortar (as before)	= 2.25
Interstices = 7 parts × 0.33	= 2.31

With 1 part of cement, 2 parts of sand and 6 parts of shingle:

	Parts.
Mortar (as before)	= 2.25
Interstices = 6 × 0.33	= 1.98
Mortar in excess of interstices	= 0.27

So that the mortar is 5 per cent. of the aggregate in excess of the interstices, which is barely sufficient.

Of broken-stone concrete, therefore, made according to the proportions quoted, 10½ per cent. would consist of hollow spaces. It is possible that such concrete may be good enough for the purposes for which it was intended, but it cannot be generally recommended.

In order to correctly determine the component parts of concrete it is necessary (1) To fix the proportion of cement to sand to be used; 1 to 2 will be found a useful proportion for most works. (2) To ascertain the quantity of mortar the selected proportion will make. (3) To know approximately the percentage of interstices of the aggregate. (4) To fix a certain percentage of mortar in excess of the interstices for surrounding the stones and to cover variations in the percentage of interstices of the same aggregate. Mortar equal to 10 per cent. of the aggregate is usually ample.

The percentage of interstices can be ascertained sufficiently approximately by filling a tank, the cubic contents of which are known, with samples of the aggregate. If the tank is then filled with water to the top, i. e., if all the interstices are filled and the quantity of water required is noted, the percentage of interstices can be calculated. If, as a check, the water is drawn off and measured again, the percentage of interstices must lie between the water filled in and that drawn off; or, if the materials used absorb much water they should be soaked before being placed in the tank.

The following examples are given to show how the ratios of cement, sand and aggregate per 100 parts of finished concrete can be correctly ascertained.

(1.) In this case the proportions selected are 1 part of cement, 2 parts of sand, and broken stone having 48 per cent. of interstices; the amount of mortar required in excess of interstices to be equal to 10 per cent. of aggregate.

Then if......... x = aggregate without excess of mortar.
x + $\frac{1}{10}$x = 100 parts of finished concrete,
and.............. x = 90.90 parts = aggregate.
Mortar in excess of interstices.... = 9.09 " (10 per cent. of aggregate).
99.99 "

	Parts.
Interstices (to be filled with mortar) = 90.9 × 0.48..	= 43.63
Mortar in excess of interstices = 90.9 × 0.10..	= 9.09
Total mortar required	= 52.72
To find cement and sand add ⅓	= 17.57
and divide by	3)70.29
Cement, 1 part	= 23.43
Sand, 2 parts	= 46.86
Aggregate	= 90.90
	161.19

It will be seen that with this class of stone barely 4 parts can be used to 1 of cement.

(2.) One part of cement, 2½ parts of sand, shingle having 30 per cent. interstices; mortar in excess of interstices to be equal to 15 per cent. of aggregate.

If x = aggregate.
x + 0.15 x = 100 parts.
and x = 86.95 parts = aggregate.
Mortar in excess of interstices = 13.04 parts = 15 per cent. of aggregate.
99.99 parts.

	Parts.
Interstices (to be filled with mortar) = 86.95 × 0.30	= 26.08
Mortar in excess of interstices = 86.95 × 0.15	= 13.04
Total mortar required	= 39.12
To find cement and sand, add ⅓	= 13.04
	7)52.16
	7.45
	2
Cement, 1 part	= 14.90
Sand, 2½ parts	= 37.25
Aggregate	= 86.95
	139.10

If, instead of fixing the quantity of mortar to be used certain ratios, such as 1 part of cement, 2 parts of sand and 6 of stone, are fixed, it is necessary to determine whether such ratios allow sufficient mortar, and if this were done such ratios as 1 part of cement, 2 of sand and 6 of broken stone would probably not be specified in connection with good work.

(3.) Suppose ratios of 1 part of cement, 2 parts of sand and 4 of broken stone, having 48 per cent. of interstices are selected, and it is required to know how much cement, sand and stone are used in making 100 parts of finished concrete.

If x = cement, 2x = sand, 4x = stone:

Mortar $= \frac{(x + 2x)\,3}{4}$	= 2.25x
Interstices = 4x × 0.48	= 1.92x
Mortar in excess of interstices	= 0.33x

Aggregate.		Mortar in excess of interstices.	
4x	+	0.33x	= 100 parts.
		4.33x	= 100 parts.
		x	= 23.09 parts cement.
		2x	= 46.18 parts sand.
		4x	= 92.36 parts stone.
			161.63 parts.

In this case the amount of mortar in excess of the interstices is 8¼ per cent. of the aggregate.

The various proportions of any kind of concrete may thus be derived from the necessary data.

DRAFTING RULES FOR STRUCTURAL IRON WORKS.—II.

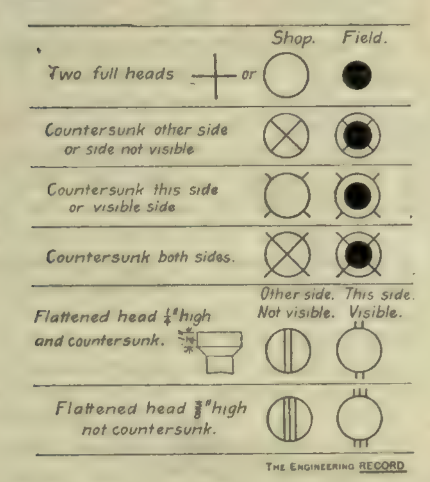
(Continued from Page 144.)

In the previous installment of this article, the rules of the Pittsburg Bridge Company were reproduced so far as they related to punching angles, channels and beams, rivet bearing and

shearing, pins, rollers, loop and fork eyes, standard upsets, eye-bars, turn-buckles, washers and similar details. The company also uses in its drafting room a number of sheets of diagrams of various purposes, which it is inexpedient to reproduce here. For example, diagrams are made of all the cross-sections of regular sizes of angles, showing the maximum diameter of the rivets allowed with such pieces, and the distance from the back at which the holes must be punched for one or two rows in one or both legs. Tables were also prepared for channels of all regular sizes, giving the index section, depth in inches, weight per foot, flange width, web thickness and increment of thickness of web and flange for each additional increase in weight per foot; these also give data concerning the rivets, and the distance from the center of the rivet holes to the back of the web. The table for I-beams is similarly arranged, and gives the distances between the centers of the holes through each side of a flange, at equal distances from the center of the web, that is to say, twice the distance between the center of the rivet holes and the center line of the web.

Another table gives the diameters of rivets up to 1 inch in fractions, and also in decimals, the areas in decimals of a square inch, the values for single shear at 6,000, 7,000, 7,500, 8,000, 10,000, 11,000 and 12,000 pounds per square inch, and the bearing values on plates from a ¼ inch to 1⅛ inches in thickness, showing by heavy lines the limits at which the bearing values exceed the values for single and double shear. Still another table gives the maximum bending moments to be allowed on pins for fiber strains of 15,000, 18,000, 20,000, 21,000 and 22,500 pounds per square inch, the pins varying by an eighth of an inch from 1 to 15 inches, and by half an inch from 15 to 20 inches. Other tables give the number of inches of rollers required for various loads, and for formulas varying from 500 $\sqrt{D}$ to 1,000 $\sqrt{D}$. In these diagrams the rollers are from 2 to 4 inches in diameter, varying by a quarter of an inch, and the loads run from 10,000 to 100,000 pounds.

The rules to be observed in order to facilitate the erection of work are as follows: The first consideration for ease and safety in erection should be to arrange all details, joints and connections so that a span may be connected, made self-sustaining and safe in the shortest time possible.



In bridge trusses having an even number of panels make a section of the top chord next the center with two pin holes; in trusses having an odd number of panels make the center section of the top chord with two pin holes; and in skew bridges the section of the top chord in each truss having two pin holes must be opposite, and in the same panel.

Top chord sections with half pin holes, having hinge plates on each section, are undesirable. When half pin holes are used, if possible only put hinge plates on one section, making it long enough to rivet or bolt to the adjoining section when in place. Hinge plates are to be arranged so as to give two full pin holes in the center of the chord section, and to be put on the ends farthest from the center on the other sections, except in special cases, when it is necessary to commence to raise spans from the end instead of the center.

Entering connections of any character should be avoided when possible, notably on top chord connections, floor beam and stringer connections, splices in girders, etc., when it can be done. Joints should be so arranged as to avoid having to put members together by moving them on end, as it is often impossible to do this.

It is not advisable to put two shoes on one bed plate, and if this is done the plates should be made longer and anchor bolt holes slotted to allow for variations in the masonry.

It is of the greatest importance to allow ample clearance where members pack in chords, posts, etc. Lack of proper clearance causes much trouble and expense, and greatly increases the risk of erection, by increasing the time for making a span safe.

When it can be done the trusses are connected first, before the floor system is put in, and floor connections should be arranged accordingly, unless in special cases local conditions make it desirable to put in the floor system first.

Adjoining spans should always be entirely independent. Two spans should never be connected on the same end pin or on the same shoe when the bridge is to replace an old structure. In the case of viaducts, the spans abutting on a bent should be so arranged that one span can be fixed in place entirely independent of the adjoining span.

Anchor bolt holes should be arranged so that the holes in the masonry can be drilled and bolts put in after the span is swung. Make the holes a quarter of an inch larger in diameter than the bolts.

In putting in the bars and diagonals, it is customary to connect them on the bottom chord pin first, and then swing them into the chords or posts around the lower pins as centers. All rivets coming in the path of the bars swung in this way should be cleared.

Where adjustable rods pack close together, the sleeve nuts should be staggered.

When girder spans of different depths abut on the same bent, they should be arranged so that either span can be set in place first, independent of the other.

All lateral bracing, hitch plates, rivets and laterals, etc., should be kept enough below the level of the top of the chords, girders and stringers so that the ties, when in place, will not foul them, it being very expensive to cut out ties to clear such obstructions.

Lateral hitch plates should either be shipped loose or riveted to the bracing. If shipped on the girders, they are usually broken off in unloading and handling. When slide plates project much beyond the flanges of girders, it is best to ship them loose.

Enough clear space should be allowed around all field rivets to admit of the button set (which is about 2 inches square) being held in the line of the axis of the rivet or at right angles to the plate through which the rivet is driven; otherwise the rivet heads cannot be set down.

Among the other tables and instructions given to the draftsmen is one showing the extra length of rod required to make a single plain loop eye on a round or square rod, increasing by an eighth of an inch from half an inch to 3⅛ inches in thickness, the diameters of the pins increasing by a quarter of an inch from one to 10 inches. The length to be added is 3.2 times the diameter of the pin plus 5.46 times the diameter of the rod. Another table shows the extra length of rod required to make a forked loop eye on a square rod from ⅝ to 1⅞ inches square for pins from 1 to 3½ inches in diameter. Another gives the diameter and length of standard upsets, and the extra length of the rod for each inch of upset. Still another table gives the lengths to be added to the center lengths of forged eye bars to allow for waste and forming two heads by upsetting or piling. Other tables give the dimensions of wrought-iron pin nuts, open turn-buckles, sleeve nuts for upsets, cast washers and flat washers. It will be seen that many of these special tables are amplifications of those in various handbooks, which have been modified to meet the needs of a large bridge manufacturing establishment.

RECENT MUNICIPAL WORK IN WASHINGTON.

The report of the operations of the Engineer Department of the District of Columbia for the year ending June 30, 1898, contains much useful information to engineers in other cities. Colonel William M. Black, M. Am. Soc. C. E., who was engineer commissioner for the greater part of the year, was assigned to other duties incident to the war with Spain and was succeeded by Captain Lansing H. Beach, who was previously the assistant in charge of streets, pavements, sewers, plumbing, etc. Captain Edward Burr, M. Am. Soc. C. E., was the assistant in charge of the departments of water, street lighting, buildings, etc., until relieved from duty in the District of Columbia and ordered to duties incident to the war.

In connection with the streets and pavements, of which department Mr. Conway B. Hunt, M. Am. Soc. C. E., is computing engineer, it is interesting to note that sheet asphalt and asphalt blocks were the only driveway pavements used upon the city streets during the year. The report corrects the statement made last year that asphalt laid over granite block had not given satisfaction. The only pavement of this kind which was unsatisfactory was an experimental one in which no binder was used and the wearing surface, with an extra amount of sand, was only 1½ inches thick, and laid directly on the blocks. A table is given showing the amount of asphalt pavement which has been laid over cobble, asphalt block, macadam and granite block. This gives the year when the pavement was laid, the square yards, cost, price and the present condition. Another table shows the cost, for a number of years, of repairs per square yard of sheet asphalt pavements on 6 and 4-inch bases.

Many complaints have been made during the past year against granite block pavement, owing to noise and its slippery condition in dry weather; and it is recommended that a certain amount of this pavement be replaced each year with asphalt. Of the suburban streets and county roads, those of macadam have suffered from lack of good surfacing material and from lack of maintenance. They are built by contract and are supposed to be kept in repair by the contractor for five years. None of the contractors in recent years have possessed road rollers and poor roads have resulted. It is recommended that Congress inaugurate the policy of taking the granite blocks from the streets within the city and using them on the county roads in 10-foot strips on either side, with a 10-foot strip of asphalt in the middle.

Cement sidewalks to the extent of 62,796 square yards have been laid during the year at a cost of $0.89 per square yard. This is laid 5 inches thick and without a frost base. More trouble has been caused by the expansion from heat in the summer than from frost in the winter. In one case a cement sidewalk around the Congressional Library building was subjected to such compression from expansion that a couple of blocks were thrown several feet into the air with a noise like the report of a gun.

In the report of the sewer department, Mr. D. E. McComb, M. Am. Soc. C. E., superintendent,

the necessity of sewage disposal works is again urged. A portion of the intercepting sewers leading to the future disposal works has been completed. The condition of the water department, Mr. W. A. McFarland, superintendent, is much the same as during the preceding year. The supply system still suffers greatly from waste and to detect this many tests have been made with a Deacon meter. The rate in gallons per hour passing through the meter is automatically recorded on a chart. When placed on a pipe supplying a residential district the amount of water passing the meter during certain hours of the night shows the amount wasted. By shutting off the pipes in different blocks the leakage is more closely located. A table is also given showing the results of a ten-day test of a new 8,000,000-gallon pumping engine.

In the report of the inspector of asphalt and cements, Mr. A. W. Dow, are tables showing the results of tests of over 6,000 samples of natural hydraulic cement and over 2,300 samples of Portland cement. Another table shows the results of some long-time tests of a number of natural and Portland cements, the time ranging from one day to four years. A number of analyses of crude and refined asphalts, residuum oil, etc., have been made during the year. An interesting description is also given of tests which have been carried on to determine, whether petroleum residuum is a good softening agent for asphalt. In this investigation only the residuum from the petroleum oils of the eastern portion of the United States have been tested and Trinidad asphalt is the only asphalt used so far. Mr. Dow has also designed a new apparatus for determining the relative viscosity of asphalt and allied bodies. The tests are all made in a water-jacketed copper box, in which any temperature can be obtained by running through the jacket, water cooled or heated as desired. The detailed description of this apparatus is given in full as follows:

"The penetrating needle, which is an ordinary No. 2 sewing needle, is rigidly fastened in the end of a small brass rod. This rod is inserted in the end of an aluminum tube, about 40 centimeters in length and 1 centimeter in diameter, where it is securely fastened by means of a binding screw. By filling or partially filling this tube with mercury it can be made of any desired weight from 30 to 300 grams, after which it is closed by a cap which screws on to the end opposite the needle. When this cap is screwed into place its surface, which is perfectly flat, is absolutely at right angles to the sides of the tube. The aluminum tube holding the needle passes down through a wooden framework in which it is held in a vertical position, with the needle end down, by means of a jaw clamp. When this clamp is released the tube can move freely up or down, while it is retained in its vertical position by two guides. These guides are each made of two metal plates a fraction of a centimeter in thickness. Each plate has a semi-circular piece cut out of one side, so that when the two are placed together it leaves a circular opening through which the aluminum tube passes freely, but yet not so freely as to get out of the vertical. To facilitate the removal of the needle tube from the framework, as it must be slightly inclined while withdrawing so as to clear the measuring device, the guides are constructed so that one plate in each can be pushed a short distance from the other, thus allowing the inclination of the tube. These plates are returned to their original position by springs.

"In the upper part of the framework directly over the tube is a spindle 3.17 millimeters in diameter, with a pointer on one end, which turns on a dial. A small plumb weight is suspended from the spindle by a fine platinum thread which winds on it. This weight is partly counterbalanced by a second weight suspended from the spindle by a linen thread. These weights are so that if they be allowed to move freely the former is just sufficiently heavy to cause it to fall gradually, and when the aluminum tube is in position this weight will fall until it just touches the surface of the cap on the top of the tube. The fall of 1 centimeter of this weight causes the spindle to make one revolution, thus making one revolution of the pointer on the dial equivalent to 1 centimeter. The above framework is fastened onto the cover of a copper chamber, the aluminum tube projecting through this cover into the chamber, needle end down. This cover, which is of wood, is made in two thicknesses, with an air chamber between, thus more perfectly insulating the interior of the chamber from the outside air. It is supplied with two large windows on each side of where the needle tube passes in, admitting light and allowing the operator to see the sample. The chamber to hold the samples, which is of thin sheet copper, is constructed with a rounded bottom like a kettle, and is fitted with a flat false bottom or flooring of sheet iron. Raised above the flooring about an inch, resting on three rollers, is a circular disk on which the samples to be tested are placed in a circle about half an inch from the edge. This disk can be rotated like a turntable by means of an iron rod which passes through its center into a bearing on the floor and out through the cover of the chamber, where it is fitted with a wheel. By turning this wheel, thus revolving the disk, each sample on it can be brought in turn under the penetrating needle. In this way twelve samples can be tested by this particular apparatus without opening the chamber. Two swinging mirrors are fastened—one on each side of the copper chamber—one mirror being so adjusted as to throw light on the sample to be tested, while the other reflects the image of the sample so that it can be seen by looking in through a window in the cover. This copper chamber is fastened into a lead-lined tank, which is filled with water of any degree, or a freezing mixture, as the case may be, to produce the desired temperature in the chamber. To keep this temperature constant the tank is supplied with one inlet, in the center of the bottom, and four outlet pipes, one on each side near the top. The temperature of the copper chamber is regulated by a simple electrical thermostat suspended in it, which will cut off or let on a supply of liquid or water entering the tank as the temperature requires.

"In making a test or tests the samples are placed in position on the disk in the copper chamber, the cover with the apparatus put in place, and the chamber secured in the lead-lined tank. The water or liquid of the desired temperature is run into the tank, which is allowed to fill and run off by the overflow pipes. The entire apparatus is then leveled by leveling screws in the feet of the tank until the needle tube is perfectly vertical. When asphalt is to be tested it is for convenience put into small round tins like small blacking boxes. By heating just sufficiently to melt it a smooth surface is obtained with quite a gloss. These boxes containing the samples are placed on the revolving disk, each sample resting on two raised points on the surface of the disk, this giving them a slight incline. The table is then revolved until the desired sample is directly under the needle tube, when it is lowered until the needle is very nearly in contact with the surface. The surface of the sample being slightly inclined, it can be brought just in contact with the needle by a slight revolution of the disk. By arranging the mirror on top of the cover so that it will reflect the light from a window down upon one of the mirrors in the chamber —which in turn reflects it on the surface of the sample—and then having the other mirror in the chamber in such a position as to reflect the image of the sample up, the needle can be set accurately to the surface by watching its reflection in the surface of the sample. To determine the penetration the reading of the dial is taken, and the clamp is released, which allows the needle to sink in the asphalt under the weight of the tube. The apparatus is so constructed that when the clamp is released from the tube another clamp closes on the thread of the counterbalance weight, thus preventing the plumb weight from falling and adding its weight to that of the tube. On clamping the tube again at the expiration of the desired time the thread of the counterweight is released, which allows the plumb weight to sink until it is checked by the top of the tube. The present reading of the dial, less that before taken, is the distance the needle penetrates into the sample. Readings can be made with accuracy to one-fiftieth millimeter."

Included in the report of Mr. W. C. Allen, inspector of electric lighting, is a report of a number of cases of electrolysis of pipes. Cases of destruction of 3-inch iron gas pipe carrying naphtha are mentioned and photographs are shown. In one case the leakage of naphtha was so great that it saturated the ground and became ignited from a match. The holes in the gas pipe were directly under two small water-service pipes crossing it at right angles. The water and gas pipes were afterwards tested for flow of electricity, which was found to be very distinct. A case of corrosion of a lead service-water pipe is also mentioned and illustrated. This pipe was laid in October, 1897, and was so corroded by electricity that it had to be replaced in March, 1898. It is said that this pipe, which was in a house on a street corner, carried the current from the main of an electric light company from one street to a manhole in the other. A case is mentioned where an electric railway company used the water pipe in a street as a return conduit, but this was discontinued by request of the Commissioners. A bill was prepared by the Commissioners for the protection of underground construction from electricity, but failed to pass Congress. A large amount of overhead wires have been removed and placed in conduits underground.

PLAIN TALK FROM A WATER-WORKS MANAGER.

A number of times within the past two years reference has been made in these columns to the astonishing unconcern with which the people of Philadelphia allow their Councilmen to let the water-works of the city fall into poor repair, the water itself be delivered in a filthy, disease-spreading state, and the quantity remain so inadequate, because of waste and inadequate facilities, that the fear of a water famine is always present with the hard-worked officials of the water bureau. Mr. John C. Trautwine, Jr., head of the bureau, has just filed, as an annual report, a strong arraignment of the foolish course of the local Councils, to call it nothing worse, in refusing practically all financial aid or relief to the bureau since the various schemes of private corporations to secure control of the works began to force their way into public attention. In 1897 Mr. Trautwine reported that although the water-works were earning about a million dollars annually above expenses, the bureau was handicapped by the refusal of all appropriations for extensions and a shortage of water was predicted. Continuing, his latest report reads:

"This prediction, foreshadowed in each of my preceding annual reports, was abundantly fulfilled. During the summer of 1898 the condition was well-nigh intolerable. During that of 1899 it must be much worse. Year after year I have warned Councils of the condition of our works and have appealed for the means necessary to avert disaster. Year after year my warnings and appeals have been disregarded. During my administration not one cent has

been appropriated for extensions of the works, until, within the past year, a few trifling amounts have been granted, barely sufficient to prevent absolute water famine in one or two cases, but leaving entirely untouched the great and urgent needs of our system as a whole. Every effort has been made to meet the conditions with the inadequate means provided. Our boilers and engines are strained to the utmost night and day, and in some cases disabled; there is no opportunity for thorough repairs; we dare not stop pumping during seasons of muddy water; in spite of all manner of pitiful expedients we are compelled to cut off our reservoirs from the distribution in order to keep them from being entirely emptied; and from all sides come loud and well-grounded complaints from citizens who pay for a water supply, but do not get it."

The estimated cost of the present works is about $35,000,000, and the average daily pumpage is now 275,000,000 gallons, a quantity Mr. Trautwine considers more than twice what it should be. He has several times said in his reports that if waste were stopped the question of an ample supply of good water would be easily settled. For some unexplained reason, however, a water meter excites a Philadelphian to an unreasoning frenzy, and it is therefore a bold step for an engineer holding a public office in the City of Brotherly Love to make such remarks as those in the next paragraph.

"It is of the first importance that our citizens should be encouraged to use water not only freely but lavishly, whatever the cost to the city. No system of waste-restriction that would restrict the lavish use of water should be considered for a moment. It is far better to have a gallon wasted than to discourage the proper use of a pint. For this reason and to avoid unnecessary expense, the water meter should not be applied to dwellings except where waste of water is found to be going on or where a meter is requested; and even there only the water wasted should be charged by meter, not the water used. Councils have wisely so arranged our schedule as to provide for this. Indeed, a consumer would draw all the water he could possibly use and enjoy, and would do a fair amount of wasting besides, long before his meter began to register against him. It is only against scandalous waste that the meter is aimed. A few of our people are wasting more water than the whole population uses. The water wasted by this small minority does no good whatever, even to those who waste it; and yet, for the privilege of having it wasted, our careful consumers, who are in a large majority, pay double what they should and get but a poor supply, and our whole system is being hurried into physical bankruptcy. Our preposterously enormous consumption is the sole excuse for propositions to deprive the city of the control of her water supply. * * * The water meter is unpopular only where it is unknown. It is most lamentable that, in spite of my efforts and of those of my predecessors, our citizens are deprived of the supplies they pay for, and the city's control of her works is jeopardized, solely through lack of general information as to the functions of the water meter and the results of its use."

The answer to a criticism that the Water Bureau is dilatory in preparing plans is met by the following statement, for which engineers everywhere should thank the author:

"The city of New York, before the recent consolidation, although furnishing considerably less water than Philadelphia furnishes to-day, employed, in the operation and ordinary extension of her water-works, a corps of 36 engineers and engineering assistants, with a total salary of about $75,000 per annum, besides a corps of 54 additional engineers and assistants engaged in completing the works in connection with the new Croton aqueduct. Philadelphia has a total engineering force of nine persons, including the chief, at a total salary of about $15,000 per annum. Our engineering force is weaker than in 1885, when only one-fourth of the present supply was being pumped, and is ill equipped even for the ordinary routine of the service; yet we have been required, in addition, to submit detailed reservoir plans within three weeks from notice; a plan for the filtration of the entire supply, with estimates of cost, within two summer months, and 'at the earliest possible time' a report on a gravity supply with estimates of cost, 'together with any other information bearing on the subject.' Some fifteen years ago, Mr. Rudolph Hering, with a force of about 20 assistants, very properly devoted three years of time, at an expenditure of about $80,000, to a problem of this nature, but of less magnitude. The proper development of a large water supply requires that it be placed in the hands of a sufficient force of intelligent, well-informed and skilled persons, capable of understanding the present and estimating the future conditions and needs of the service. This force must be given every possible facility for investigation and experiment, and must not only be unhampered by capricious legislative interference, but must be assured of intelligent, hearty and loyal legislative support. Under these auspices a harmonious plan for the development of the system, for many years in advance, should be mapped out, adopted and followed; and every proposition for extension or other change should be carefully studied in the light of this plan and made to conform to it."

It has long been recognized that the present water supply of Philadelphia should be filtered before use, but just how this should be done has never been thoroughly investigated. Moreover the problem is complicated by the enormous waste in the city, as Mr. Trautwine shows in the following portions of his report:

"In order that any system of filtration may be made effective, it must, of course, be supplied with water sufficient for the demand, and with that required for cleaning the filters. Our works are incapable of supplying even the present demand, more than half of which is for water wasted. To make them equal to the emergency, we must spend either $500,000 to $1,000,000 in restricting the present waste of water, or $5,000,000 for its perpetuation. In the latter case the filter plants will cost about $7,500,000, as against $2,500,000 in the former case.

"Uninformed persons are apt to suppose that it is a simple matter to design and construct a system of filtration plants sufficient for our needs. Nothing could be further from the fact. The problem is not only a most complex one in itself. It is intimately involved with that of the future expansion of the entire system, and the two must be deliberately studied in conjunction, by a sufficient force of competent persons properly equipped and in the interest of the city alone. Even though a hastily designed system of filtration, based upon our insufficient present knowledge, might, by a happy chance, result in something short of dismal failure (if we had the means for supplying it with water), it is practically certain that it would be very far indeed from being the best obtainable and still further from being the most economical. Still more certainly ruinous would it be, for the sake of some alleged economy in first cost, to rush blindly into a contract with outside interested parties for the construction of unknown or untried systems, designed often in appalling ignorance of the requirements of the problem."

In order to show the ridiculous result of failure to follow the advice of the Chief of the Bureau of Water in the matter of a reservoir, the following story of basin No. 3 of the Belmont reservoir is reprinted from the report, which, it should be mentioned, is addressed to the Director of Public Works:

"In my annual report for 1897, I stated that the construction of a new reservoir for West Philadelphia would involve merely an expenditure of money without adequate return, that the money required for a new reservoir would, if properly expended, give to West Philadelphia an ample supply of excellent water, while such a reservoir as could be built for any reasonable proportion of the funds available would make little or no appreciable improvement in the supply, and that it would be two or three years before a new reservoir could be put in service. In your report for 1897 you recommended the construction of this reservoir. An ordinance approved July 12, 1898, appropriates 'out of the loan authorized by ordinance of Councils, approved June 17, 1898,' $500,000 'for the purpose of constructing a reservoir, furnishing pumping machinery and mains for that portion of the city lying west of the Schuylkill River.'

"As pointed out in my letter to you of 6th December last, the new basin will probably consume the entire appropriation, leaving nothing for the pumping engine and the needed mains, which will cost nearly as much more; and the new basin will effect no material improvement until the engine and mains are provided. During the past summer, the demand exceeding our pumping facilities, we were obliged (as at Roxborough) to cut off the present Belmont reservoir from the distribution in order to keep it from being entirely emptied. The new basin, of course, would have been in the same plight. In obedience to resolutions of Councils, the preparation of the plans and specifications for the new basin has been given precedence over matters of real urgency, including the pumping engines and mains for the same district, and has been pushed diligently by our slender force. On October 13, having made every possible effort, I succeeded in handing you a set of plans of this basin, in anticipation of a joint resolution of Councils requiring the plans by October 20. On October 20 both branches of Councils passed preambles and resolutions requesting the submission of the plans not later than the first regular meeting of Councils in November (November 3). In obedience to this, a second set of plans was submitted to you on November 2. At your request, it was accompanied by a specification. The plans and the specification are now being perfected as rapidly as possible, consistent with proper care. The appropriation for this basin is not yet available."

The result of Council's failure to appropriate enough money for keeping up the pumping plants is shown by the result at the Roxborough station, for which $177,000 was stated to be urgently needed. The appropriation made was $100,000. Boilers, pumps and an intake exhausted this sum, and the expensive machinery must be housed in a frame building built by employees of the bureau. The new reservoir connected with this station, which was lined with asphalt two years ago, has never been filled because of the inability of the pumps to more than meet the enormous use and waste of water in the district, and it is doubtful if the situation will be much improved when the new engines are put in service because of the inadequate capacity of the force mains, which Councils have refused to enlarge. The condition at two other stations is best shown by the following quotations:

"The second Queen Lane pumping main will obviate a part of the extreme risk under which that system has been laboring, but no provision is made for relaying the suction mains. We have resorted to every conceivable expedient to avoid the resulting damage, but without avail, and the four pumping engines, costing $300,000, have all been fractured in consequence, and are daily suffering further and more serious damage.

"One of the largest engines at Spring Garden station has been crippled by the fracture of a pump chamber, which has thrown out of service one of its three pumps, reducing its capacity by

one-third; and the other two pump chambers of this engine and the three in its sister engine are also fractured and liable to give out at any moment. Such an accident would precipitate dire calamity upon our largest system. Yet our drafting force is so hard pressed with other matters, including the plans for the new West Philadelphia basin, that it cannot now undertake the preparation of the plans for the repairs of these pumps."

In view of all that has been written and said about the improvement of the Philadelphia supply, it is interesting to read the following outline of Mr. Trautwine's plans for such work:

"Out of the $3,700,000 set apart for the improvement of the water supply, from the proceeds of the loan bill, $500,000 will be consumed by the new basin for Belmont reservoir. If the remainder becomes available, I recommend and urge the following disposition of the amount:

"(1) The expenditure of from $500,000 to $1,000,000 in the application of water meters to properties where reckless waste of water is going on without benefit to anyone.

"(2) The expenditure of about $1,000,000 upon the existing works in order to remedy defects and develop the full efficiency of the works, in accordance with one of my two alternative estimates for the current year.

"The investment of these two sums, amounting, together, to probably less than $2,000,000, would insure an abundant supply of water from our present sources and with our present works, with a surplus capacity such as would obviate the necessity of further extensions for some years to come, and would at once enable us to effect a marked improvement in the quality of the water furnished, even without the installation of any special works for its purification.

"(3) The investment of the remainder (say $1,200,000) in the installation of filtration plants, in accordance with plans to be prepared by the Department of Public Works, which must be authorized to employ the expert assistance necessary for their preparation. This amount will install plants sufficient for the filtration of about one-half of the total supply by methods already well known and approved.

"The $3,200,000 expected from the loan bill will thus, if properly applied, not only put the works in excellent condition and insure an ample supply (and this must be done before filtration can be made efficient), but will provide an ample fund for the inauguration of measures for the purification of the supply. If the waste of water is allowed to proceed unchecked, the entire $3,200,000, with $1,800,000 additional, must be immediately expended solely for supplying the present enormous demand, without provision for the rapid growth of that demand, and without provision for the purification of the water."

THE CARE OF STEAM BOILERS.

Some interesting and valuable matter in regard to the care of steam boilers, the various precautions that are necessary to their satisfactory working and to prevent undue deterioration, are given in a pamphlet written by Mr. Edward G. Hiller, M. Inst. M. E., chief engineer and general manager of the National Boiler & General Insurance Company, of Manchester, England. The following extracts from the pamphlet, which is quite fully illustrated, give a fair idea of its importance to American steam users:

In getting up steam in all types of boilers, the operation should be as gradual as circumstances will allow. Forcing of the fires when starting work is liable to cause straining of the seams in parts of the boiler. In the case of large boilers generally, steam should not be got up in less than four to six hours.

Before getting up steam, the water level should be observed, to ensure that the water is at the proper height in the glass, the pressure gauge noted, and the safety valves tried to see that they are free. The blow-off cock should also be examined to see if quite shut and tight.

When steam is being generated at first, the safety valve should be eased a little, or a tap on top of the boiler opened so as to allow the air in the boiler to escape.

If the boiler be connected to an economizer, then if the whole of the flue gases were to be passed through the economizer before the engine were started, as the water would not be moving through the economizer it might become unduly hot, forming steam in the pipes and leading to dangerous overheating of them. To avoid this risk, the damper to the economizer chamber should only be partly open (just sufficient to heat the water to the usual temperature), and the main body of the gases should be sent along the by-pass flue until the engine is started and the feeding of the boiler begins, when the gases may be passed through the economizer chamber as usual.

It is desirable that when all the flue gases are passing through the economizer chamber, the feed water should also be continuously passing along the economizer pipes. If the feed water is allowed to be at rest in the economizer for some time, as when the boiler is fed intermittently, the water is liable to become overheated in the economizer, leading to the formation of steam, water hammer, and other dangers. This is an important reason for feeding boilers continuously, and to do this, of course, requires a feed pump of suitable capacity, and also a careful adjustment of the feed valve.

The best method of firing the boiler will depend very greatly on the type of boiler and the nature of the coal. Generally, the principle to be observed is to fire little and often, keeping an even thickness of coal on the grate. In order to obtain complete combustion, it is necessary that a suitable amount of air should enter the furnace, either by passing through the coal on the grate or by entering through the fire door over the grate. The amount of air which it is necessary to admit through the fire door depends greatly on the nature of the coal which is being used. Bituminous coals require more air through the fire door than do Welsh coals.

A good plan of firing Lancashire boilers with ordinary bituminous coals is by alternate side firing—that is, throwing it to one side of the fire only, say to the left-hand side at one firing, leaving the right-hand bright, and the right-hand side at the next firing, leaving the left-hand side bright, and so on. Be careful to keep the back ends of the bars covered. After firing open the air grids on the fire door.

The prevention of smoke depends on the complete combustion of the fuel, and in order to completely prevent smoke it is necessary to admit sufficient air to the furnace. The air which passes through the fuel on the bars and that which passes through the openings in the fire doors of Lancashire and Cornish boilers is usually ample for this purpose. In some cases a further supply of air is necessary, which may be obtained by making openings in the fire bridge so as to admit air from below the fire bars to the back end of the furnace. A cast-iron split bridge is very useful for this purpose. The objection to the admission of too much air is that, although it will generally prevent smoke, it also tends to waste fuel by lowering the temperature of the furnace. The best economy is often obtained when just a little smoke is being produced. It is difficult to prevent smoke if boilers are very heavily worked.

The practice of raising steam by the various forced draught systems now on the market appears to be steadily growing. It should be borne in mind by steam users that generally the temperature in the furnaces is increased by this system of burning fuel. The legitimate function of these furnaces is that of burning inferior classes of fuel, such as coke breeze and common dross. So long as the furnace is limited to burning these fuels not much damage need be apprehended, but if a good quality of fuel be used the materially increased temperature in the furnaces is liable to bring about overheating and distortion of the plates, or leaky seams, if the water be of a sedimentary or limy nature. Hence if the adoption of this type of furnace is contemplated careful consideration is necessary of the whole of the circumstances of the case, including the construction and condition of the boiler, the nature of the feed water, the internal cleaning periods, and the class of fuel to be used.

When the fires have been banked at meal times, or other stoppages, usually a considerable amount of unburned gas from the fuel accumulates in the flues. If, when the boiler is restarted, the fires be at once broken up, and the damper fully opened, there is great risk of a serious flue-gas explosion. The proper steps to take are, first open the damper a little, and also the air grid in the fire door, then open the damper fully for a short time so that the gases in the flues will be fully swept out by the air. The fire may then be broken up, and firing carried on as usual.

The feeding of the boiler should be done regularly and continuously. The water should not be pumped up to a high level and then the feeding left until the level becomes low, but the feed pump and the feed valves should be so adjusted as to be, if possible, continuously working, and just supplying sufficient water to the boiler to keep the water level steady.

The feed valve should be preferably of the combined type—that is, a valve arranged to act both as a back-pressure valve and shut-off valve. The back-pressure valve, or check valve, is necessary to prevent the water being forced back out of the boiler along the feed pipe. In order that the chances of this occurring may be reduced to a minimum, it is also desirable that an internal feed pipe should be connected to the feed outlet, with its discharging end a few inches above the furnace crown.

It is always objectionable to discharge the feed water near the bottom of the boiler, as this plan exposes it to the risk of the water being entirely forced out of the boiler along the feed pipe in case of accident to any of the connections outside, or if the feed valve should stick. Also the introduction of the water at a low level is liable to chill the bottom plates, and cause fracture and other damage. The internal feed pipe should be examined and cleaned out every time the boiler is cleaned internally. With some kinds of feed water, incrustation forms inside the internal feed pipe, and if this be not removed the pipe becomes choked up and may lead to a serious accident.

It is advisable that every internally-fired boiler should be provided with a good fusible plug. Fusible plugs which have not been properly cleaned on both the fire and the water side cannot be depended upon to act in case of shortness of water. The scale or incrustation which accumulates on the water side tends to cause overheating of the plug and fusion when there is plenty of water in the boiler. On the other hand, accumulation of deposit, such as takes place in the ordinary way in the cavity of the fusible plug on the fire side, if not cleared away, ultimately forms a very strong, hard mass of caked deposit on the fire side, which would prevent the cone falling in case of deficiency of water. It is essential, therefore, whenever a boiler is stopped for cleaning, that the cavity on the fire side of the fusible plug should be thoroughly cleaned out, and also that the plug on the water side should be kept clear from scale and incrustation.

Generally, if it is found that the boiler is short of water, the dampers ought to be at once closed, the safety valve eased, and if possible some damp ashes or other incombustible material (which would smother the fire) thrown

on the fire. This step is usually better than drawing the fires, as the latter might cause a sudden increase of temperature in the furnaces, which would tend to increase the overheating of the plates. If on opening the fire doors it is seen that the furnace crowns are already heated, no attempt to withdraw the fire should be made. The other steps before mentioned should, if possible, be taken, the feed also being turned on. Attempts to draw the fires when the furnace crowns are heated have often resulted in the attendant being killed.

If the attendant finds on opening the fire door that the furnace crowns are red hot, the best course is to withdraw from the front of the boiler at once, and to warn everyone in the neighborhood, as it is probable that an explosion or most serious accident is about to occur.

If the boiler is one of a range, the junction valve should be shut off, otherwise the steam from the other boilers may enter this one, causing increased damage in this boiler, and possibly dangerous priming in the others.

With some kinds of water, a scum is formed on the surface which may be blown from the boiler by the use of a suitable scum tap and scum troughs. Where these are in use, the tap should be regularly opened and blown through when the water is at the proper level. To obtain the best result the tap should be used often, but only for a short time.

Every boiler should be provided with a good blow-out tap. This tap should be of a type which can be easily opened and closed. The tap should be used once or twice a day at least, or oftener, according to the nature of the feed water. Care should be taken always to close the blow-out tap before removing the key. In most boilers, it is useful to have this tap provided with a guard, so that the handle cannot be removed, except when the blow-out tap is closed.

The end of the blow-out discharge pipe should be regularly observed, so that any leakage past the tap may be detected. At least once annually, when the boiler is at rest, the plug of the tap should be withdrawn for examination, and if found leaky or defective it should be overhauled.

It is, of course, desirable that the feed water should, if possible, be of good quality. If it be impure, the best possible method of dealing with it is by some apparatus outside the boiler, in which the water is purified of any deposit or scale-forming matters, and any acid tendency neutralized. If, however, this be impracticable, some of the worst effects of impure feed water may often be neutralized by the use of suitable reagents inside the boiler, also some of the scale-forming constituents of the feed water may be got rid of by passing the water through a suitable feed-water heater before it enters the boiler.

The treatment of feed water by reagents inside the boiler is the plan most commonly adopted, various chemical bodies being used for this purpose. There is no reagent or composition which is suitable to all feed waters. Each case should be treated on its own merits, and before deciding on the course of treatment for any feed water it should be analyzed, so that the proper treatment may be determined.

It is particularly important that an analysis should be made in the case of any proposed new feed water, such as that from wells or streams, so as to ascertain its suitability for boiler purposes, otherwise serious damage may be done to the plates. The appearance of the water is no guide as to its quality or suitability.

The indiscriminate use of boiler compositions often leads to serious damage to steam boilers, and, in the majority of cases, to needless expense. The reagent which is least harmful for general use is common washing soda, or the pure soda alkali. This is very useful for neutralizing the acid in feed water, and for preventing corrosion, and, in some kinds of water, also for preventing the formation of hard scale. Generally, where such reagents are being used, it is best to introduce them into the boiler gradually and continuously with the feed water, by mixing them in the feed-water tank. The use of composition inside a boiler, even if effective, does not render it unnecessary to clean the boiler.

Usually, all that takes place when a composition is doing what it is intended to do, is that the scale or deposit is rendered soft and comparatively easy to remove. The boiler requires regular cleaning and scaling just as if no composition were used.

When there is a large quantity of scale-forming matter in the feed water it will, unless removed by frequent cleaning out or in some other effective manner, rapidly accumulate in the boiler, and lead to dangerous overheating of the furnace plates or other parts of the boiler. Special attention should be paid in such cases to regular cleaning and the use of the blow-out.

Grease in feed water is always objectionable, as either by thickening the water, or by forming a film of grease on the plates, it prevents the free transmission of heat and leads to overheating, with the consequent cracking of plates, bulging, distortion, and increased wear and tear generally.

It is found that where the flour-like carbonate of lime or magnesia is deposited from the feed water the water is thickened, and overheating is particularly liable to occur. Even if there is only a small amount of this deposit, and there is grease in the feed water from the exhaust steam (which occurs when the exhaust steam is run into the feed tank) or some other source, this grease will mix with the floury deposit, rendering the water like milk, preventing the free evolution of the steam, and so resulting in overheating. It is much better not to allow grease of any kind to enter the boiler in any way, but to heat the feed by a suitable feed-water heater, jacketed pipe, or some similar arrangement, in which the feed water does not come into contact with the exhaust steam.

If the hot-well water from a surface condenser is used, it should invariably be filtered, so as to remove the grease or oil. The grease filters used for this purpose require the greatest care and close supervision, so as to ensure that they are doing their work properly and efficiently. In all such cases care should be taken to restrict the supply of oil to the engine cylinder to just what is necessary and no more.

It is necessary that boilers should be regularly opened for internal cleaning. The proper periods for this will depend upon the nature of the feed water, and the amount of work which has been done. With extremely good feed waters internal cleaning may sometimes be safely delayed until say 1,000 hours' work has been done, but with average feed waters it is generally better not to exceed 500 hours' working in large boilers. The exact period for cleaning a boiler should be determined by careful consideration and observation of the working of the boiler. Generally, the cleaning should not be delayed any longer than will suffice for the formation of a scale 1/16 inch on the plates. It must be remembered that the use of composition or soda will not entirely prevent scale. When such compositions are used in a boiler it is necessary to clean it regularly, and this should be done and the plates kept clear of any accumulation of scale. Accumulation of scale is not only objectionable because it prevents the proper transmission of heat through the plates, but it may be very dangerous, as it conceals any wasting or corrosion of the plates which may be going on beneath it, and many serious explosions have arisen from this cause.

The cooling and emptying of the boiler should be done as gradually as possible. The best course to adopt when it is intended to stop a boiler is: Close the damper, draw the fires and shut off the junction valve. Then allow the boiler to stand one, two or three days, as found necessary, until it and the surrounding brickwork are cooled. Then run the water off and open the flues.

By doing this the straining of the seams and liability to fracture, which rapid cooling would result in, are avoided. The deposit internally is also kept in a soft condition, and thus it can be more easily removed. In order that the removal of the scale may be as easily done as possible, a course which is often successfully adopted is not to empty the water out of the boiler until cleaning is commenced, and then only to lower it as the plates above the level of the water are cleaned. By this plan many descriptions of deposit remain in the form of mud, and may be washed off, and thus avoid the trouble and expense of scaling with a hammer. The process is, however, open to the objection that the boiler cleaners get wet.

There are other more rapid methods of cooling and emptying boilers, as indicated in the following. None of these, however, is to be recommended.

Of the more rapid methods of cooling boilers, and probably the least objectionable, is the plan of introducing cold water at the same time as the hot water is run out.

In many cases the boilers are blown off under pressure, the junction valve being closed, fires drawn, and blow-out tap simply opened, and the hot water being blown out by the steam. This plan is open to many objections. Amongst the most serious of these is the fact that the sudden and rapid change of temperature is liable to seriously strain the boiler seams; also the scale and deposit being left on the hot plates is generally baked hard and rendered very difficult to remove.

The most objectionable of all methods of emptying and cooling a boiler is to blow it out under pressure, and afterwards run cold water in, in order to cool the shell still more rapidly. This arrangement really consists of emptying the boiler as described in the preceding paragraph and then cooling the plates by running cold water in. This plan should never be adopted; it is always likely to seriously injure the boiler. The sudden strains which are set up by the cold water running on to the hot plates may set up concealed fractures through the line of rivet holes forming the seams, which cannot be detected in the ordinary way, and which may lead to explosion and loss of life when the boiler is again worked.

(To be Continued.)

THEATER SANITATION.

Of all semi-public buildings it is probably safe to say that theaters are as a class the worst from a hygienic point of view. Outside of a few in the leading cities there is practically no intelligent attempt made to provide proper ventilation, the toilet rooms are disgusting, and the employees and players are forced to put up with accommodations more like those of Southern Europe a couple of centuries ago than the progress of American materialism would lead one to expect in edifices of such imposing general appearance. Mr. William Paul Gerhard did a good work for sanitary science in calling the attention of the American Public Health Association to this subject during its Ottawa convention. The public uses a theater for so few hours at a time that the evil possibilities of its unsanitary condition are liable to be overlooked, although a schoolhouse of like foulness would be at once condemned. Mr. Gerhard's paper is too long for reprinting in these columns, but some extracts of particular value to architects have been made.

Drainage.—In arranging for the drainage and sewerage of a theater building the general rules as to size and material for the sewer lines, the grade to be given, etc., should be followed. As

a rule, the area covered by a theater is so large as to require at least two 6-inch sewer connections. Proper attention should be paid to proportioning the sizes of the rain-water conductors which drain the roof surfaces over the stage and the auditorium, which latter are at times very extensive. All areas and courts should be properly paved and drained. A difficulty in the way of drainage often arises from the considerable depth to which that portion of the stage house known as the under stage has to be carried. Owing to the requirements of stage traps and stage machinery, the level of the under stage is frequently located below the level of the sewer in the street. Any subsoil water accumulating in the sump must be removed by lifting same by means of either automatic cellar drainers worked by water pressure, or steam ejectors, or electric centrifugal pumps. Often the entire subcellar is constructed perfectly watertight, like the cellar of a warehouse situated below tide or subsoil water level. This not only keeps out the subsoil water, and prevents dampness, which is undesirable for the stage house, as it would tend to ruin the stage flooring, the stage properties and the actors' and supers' costumes, but it also prevents ground air from rising upwards, and tends to keep the air of the stage pure and wholesome.

Plumbing.—In recently built theaters of cities where plumbing rules and regulations are enforced, the soil pipes and waste lines are carried full size up to the roof and the fixtures are separately trapped. Generally, however, the plumbing is of the plainest kind, and without any attempt at elaboration. On the other hand, the plumbing of theaters in smaller towns exhibits often the worst defects imaginable, the entire work being carried out in a slipshod manner, the water-closets of dressing rooms being generally set on dead ends of drain lines, having no soil pipe extension to the roof and often being a part of the dressing rooms, partitioned off only by thin board partitions. Basins and sinks are often in direct connection with the sewer, traps being considered a superfluous and altogether too expensive refinement for such a building. In dark corners disused closets or sinks are at times discovered. Drains are laid in a haphazard manner, often sloping the wrong way. Tile drains and cement pipes are used where extra heavy cast-iron sewer pipes should be run; all manner of faulty joints are discovered, and in many cases the sewage drips on to the floor and becomes the cause of the annoying odors which so often greet the audience when the curtain rises. Pan-closets and ill-flushed hopper-closets are used, and the apartments in which they are arranged are found to be in an indescribably filthy condition.

It goes without saying that the plumbing of theaters should be planned and arranged with the same care as that of other public buildings. There should be toilet rooms for each tier in the auditorium, entirely separate retiring rooms being provided for men and women. Sufficient accommodations should be provided in that part of the stage house which contains the dressing rooms for actors and actresses. In addition there should be in the basement well arranged and ventilated toilet rooms for the stage hands, employees and the supers. The office of the theater manager often has a separate toilet room, and there is, in larger houses, a toilet room adjoining the star's dressing room. Near the engine and pump room a toilet room for the engineer and his help should be provided, and if there is in the front part of the house a smoking room or refreshment room, a men's toilet room is arranged with urinals and lavatories.

Handsome, nickel-plated work and fittings do not seem called for in a theater, except possibly in the toilet rooms of the parquet and dress circle, or for the occupiers of the boxes, in large opera houses; but, nevertheless, the entire arrangement should be in every way sanitary, and the best workmanship is required. Woodwork should be avoided for well-known reasons. The floors and walls should be rendered waterproof and non-absorbent, partitions between water-closets and urinal stalls should consist of marble, slate or soapstone. Every toilet room should have a window to the outer air, and in addition artificial ventilation by exhaust flues should be provided.

The closets should be of glazed earthen or vitreous ware, which will not craze. The type known as washdown closet is particularly adapted for a theater, and the flush for the same should always come from a special copper-lined flushing cistern with pull-flush, though an automatic seat-flush may often be preferable, owing to the careless manner in which the public, as well as stage hands, use such places.

For the same reason it may be preferable to have porcelain urinal bowls with self-acting intermittent flush tanks. In theaters in which spectacular plays or ballets are performed, requiring a large number of female supers and dancers, self-flushing urinettes or pedestal urinals for women may with advantage be provided, as the same require for connection to the sewer a 2-inch waste line, whereas the water-closet requires a 4-inch soil pipe.

All stage dressing rooms should be fitted with small corner or wall lavatories, which must have both hot and cold water faucets, and each of which should be safely trapped, while the waste line should be extended to the roof for ventilation.

There should be a few slop sinks, both near the stage and in the public toilet rooms, as they are required by the women scrubbing the floors for the emptying of wash water and to draw clean water.

Water Supply.—Theater buildings require a very ample and large supply of water. There should be two entirely distinct systems of supply, one for fire protection while the second system provides water for the plumbing fixtures, flushing, washing and general cleanliness.

The water supply for fire-extinguishing purposes embraces large suction tanks in the basement, roof tanks to supply the automatic sprinkler system, a powerful fire pump in the engine room supplying the fire standpipes and fire valves, etc. This system has been elaborately described by Mr. Gerhard in his book on "Theater Fires and Panics," to which those interested are referred for further details.

The house supply should be entirely separate, and where the street pressure is insufficient to supply the plumbing fixtures in the upper parts of the theater, special house tanks should be provided on the roof over the stage. It will readily be seen that it would be inadvisable to use the sprinkler tank for such purpose, as it might be found empty when water is wanted for fire extinguishing purposes. The rules of the National Board of Fire Underwriters wisely specify that no branch for sinks or for drawing water for any purpose whatsoever should be taken from the sprinkler tanks. Sometimes house tanks placed above the highest plumbing fixtures, for instance, on one of the upper flies or in the rigging loft, fill at night by pressure from the street mains; in the majority of cases, however, it is necessary to pump the water to the tank, which is accomplished by means of direct-acting steam pumps, or by electric pumps, or hot-air engines, or even windmills placed on the roof.

The house water service comprises, further, a hot-water tank, because the players and supers require in their dressing rooms hot water in abundance at the basins and wash sinks to remove face paint, etc. Hot water is likewise required at the slop sinks for the use of the scrubwomen.

Ventilation.—When new theater buildings are to be erected architects should always associate with them an expert in heating and ventilation, which two problems always go together. It is necessary that every part of a theater should be ventilated—not only the auditorium, but likewise the stage, the dressing rooms, the under stage, the engine room, the vault where the gas meters stand, and finally the numerous toilet and retiring rooms in both parts of a theater.

In designing a system it should be borne in mind that ventilation means not merely the removal of foul air, but simultaneously the introduction of a sufficient quantity of pure air, drawn from a suitable source out-of-doors, suitably filtered and warmed in winter time, suitably sprayed or cooled with ice in summer time, and introduced at all times without any unpleasant air currents or draughts. It is manifestly insufficient, then, to merely provide in the auditorium a few outlet flues and ventilating registers of restricted size for the removal of foul air, and to rely upon fresh air being drawn in through accidental openings or cracks or crevices, or from the level of the stage. In all cases both inlet and outlet flues of generous size should be arranged, and care should be taken that the same are in no way obstructed. There should be a supply of fresh air to each and every person in the audience equal to at least 30 cubic feet per minute, or 1,800 cubic feet per hour.

The fresh air may be introduced at the top of the house, through the ceiling, and made to move downward in a steady and uniform current, until it reaches the lungs of the spectators, and then removed at or near the floor line; or else air may be introduced at or near the bottom and exhausted at the ceiling of the hall. To a certain extent, either one of the systems may be successfully planned and arranged; the plan and subdivision of the theater building, the details of construction and local conditions will generally decide the question. Where a theater is lighted with electric lights the downward system of ventilation will show better results than where gas lights are used.

A good system of ventilation should effect a complete change of air three or four times an hour, and this change of air is required not only in the auditorium, but also for the foyers, the stage, the dressing rooms and toilets.

The question of ventilation should always be treated in connection with the question of safety from fire. To depend, for example, for the ventilation of the stage upon a strong current of air from the stage toward the auditorium would be a grave mistake. For, with such an arrangement, in case of a fire on the stage—and it is proved by statistics that the majority of theater fires have their origin on the stage—the smoke from the burning scene decorations, etc., would be drawn into the upper part of the auditorium and suffocate numberless persons in the gallery before they could make their escape from the burning building. On the contrary, the aim should be to create, in such cases, a strong current from the auditorium in the direction toward the stage. Doubtless this can be efficiently accomplished, and one way of doing it is to provide large ventilators in the roof over the stage.

There should be adequate actors' dressing room accommodation, and these likewise require to be efficiently ventilated, preferably by windows to the outer air, or by special vent shafts where windows are out of the question. Finally, all toilet rooms require a constant change of air and an abundant supply of fresh air to keep them sweet and wholesome. Special stress should be laid upon the necessity of arranging for a current of air from the halls into the toilet rooms, and not vice versa; for otherwise, however good the system of ventilation may work, unpleasant odors from the water-closets and urinals will penetrate other parts of the theater.

The boiler and engine rooms should also have plenty of fresh air, and all building regulations provide that the vaults where gas meters are set must have suitable ventilation, to prevent explosions of gas.

A DISCUSSION ON FILTRATION.

At the regular monthly meeting of the New England Water-Works Association, which was held on Wednesday of this week, the topic under discussion was the filtration of public water supplies. The first speaker was Mr. George W. Fuller, chief chemist and bacteriologist of the new water commission of Cincinnati, Ohio, who has recently completed a series of experiments at Louisville, Ky., to determine the comparative merits of several systems of mechanical filtration. He divided the methods of filtration or systems of purification, as he prefers to call them, into two classes—the English method, whose distinguishing feature is the well-known filter bed composed of layers of sand overlying gravel, and the American or mechanical method.

The English system was originated in 1829, and numerous plants have been in successful operation for many years. From England the system was introduced into Western Europe, and its use spread eastward as far as central Germany and Russia. This system was first studied in this country by the late James P. Kirkwood at St. Louis. Several plants have been established in the Atlantic States, and have given good results. The comparatively clear waters of the streams of England, western Europe and our North Atlantic states have been most successfully treated by the English method, or a modification of it, introducing subsidence and coagulation where necessitated by the amount and character of suspended matter. The sand filter has achieved very great efficiency in the removal of bacteria, but has proved less adapted to the treatment of turbid waters, such as are found in eastern Europe and in the middle and western states of this country, especially those carrying clay. Many of the streams west of the Alleghenies carry large quantities of very finely divided clay in suspension. Some of these particles are about one-tenth the size of the bacteria, or 0.00001 of an inch in diameter, and penetrate into the sand to considerable depths, necessitating more frequent and deeper scrapings and complete renewals of the sand at comparatively brief intervals. This difficulty with the clay is caused largely by the scarcity of nitrifying organisms which form the gelatinous coating on the surface of the sand beds. These organisms are most lacking when most needed—at times of greatest turbidity. For the clarification of the clay-bearing waters, subsidence and coagulation have been found advantageous and the American or mechanical system of filtration has given the most satisfactory results; but the bacterial efficiency of the mechanical filters has not been well determined. Local conditions vary widely, and before recommending a system of purification for a given water supply the engineer must acquaint himself with these conditions and study them carefully. The American system is generally more easily managed and more economical of operation. But whatever system be adopted, skillful, intelligent management is imperative.

Mr. Allen Hazen, Assoc. M. Am. Soc. C. E., of New York city, continued the discussion. He said that mechanical filters clarified turbid waters usually satisfactorily, but that sand filters were more effective in removing disease germs. New England streams, like the Merrimac River, contain on an average 1 part in 100,000, by weight, of suspended matter. The Allegheny River at Pittsburg contains 4 or 5 parts to 100,000, the Ohio River at Cincinnati 20 to 25 and at Louisville 30 to 35. Bacteria tend to aggregate naturally, but the clay particles do not, and must therefore be gathered into larger masses by alum or some other coagulant. The turbidity of a stream frequently varies widely from day to day and from hour to hour. Hence it is desirable to make frequent determinations of turbidity and vary treatment accordingly. The turbidity of a stream draining a clay formation may rise in an hour from 0.02 to 2.0 on account of storms. If the supply system contains a storage reservoir for raw water, no water need be drawn from the stream during short periods of extreme turbidity. The turbidity is caused almost entirely by the action of rain on the cultivated land on the water shed, and very little by erosion of the river banks. A stream having become turbid continues to its mouth with very little change unless the river passes through a lake. But the very finely divided matter in suspension constituting turbidity must not be confused with the coarser materials picked up and dropped by the stream as its velocity varies. The period of turbidity of a stream is a function of the time required for the water from the remotest feeder to reach the main stream. These periods are shortest and the variations of turbidity greatest, generally speaking, on the smallest streams. In connection with his talk Mr. Hazen exhibited a large number of stereopticon views of filtration plants in Europe and America, including several photographs of the Albany filtration works now under construction in accordance with designs prepared in Mr. Hazen's office.

TESTS OF GASOLINE ENGINES IN PUMPING PLANTS.

Some interesting figures have been received from Mr. J. W. Ledoux, M. Am. Soc. C. E., regarding the performance of gasoline engines in pumping stations under his supervision. The tests were made on the water-works machinery at Westville, N. J., and Opelika, Ala. The plant at Westville consists of two 13½ horse-power Otto gasoline engines driving by belt two 7x8-inch Deming triplex pumps. The Opelika works are similar in both type and size of machinery, except that there is but one engine and pump.

The first test at Westville was made to determine the efficiency and gasoline consumption of the engine under conditions of a measurable engine output. For this purpose a pony brake was used and indicator cards were taken on the engine cylinder. The duration of the test was 16 minutes, and the results showed a consumption of 0.1222 gallon of gasoline per brake horse-power and an efficiency of 80.4 per cent., while developing 15.3 horse-power at the brake.

Three tests were then made, two with what is known as the west engine belted to its pump, and one with the east engine and pump. The first two tests were made under different pumping heads. The results of all three tests may be seen in the accompanying table:

Engine and pump	West.	West.	East.
Time, min.	31¾	19¾	21⅓
Revs. per min., engine	252	265	233
" " " pump	38.65	46.7	40.4
Total head, ft.	292.5	200.2	199.3
Water per min., gals., by displacement	154.6	187	161
Water per min., gals., by standpipe measure	144.6	174.7	155
Slip, approx., per cent.	6.5	6.5	3.7
Gasoline used, gals.	1	0.5	0.5
Water H.-P., by standpipe	10.74	8.85	7.82
Engine H.-P., with 65 per cent. pump effic.	16.5	13.62	12.01
Gasoline per eng. H.-P. hour, gals.	0.1145	0.1116	......
Gasoline per eng. H.-P. hour, gals., guaranteed	0.125	0.125	......
Gasoline per water H.-P. hour, gals.	0.1763	0.1717	0.18
Gasoline per water H.-P. hour, gals., guaranteed	0.1954	0.1954	0.1954
Excess over guaranty	10	12.2	8

It will be noticed in this table that the efficiency of the pumps was assumed as 65 per cent. It is considered, however, to be nearer 70 per cent., and was calculated approximately by the ratio of the gasoline consumed per horse-power of the engine as determined by the first test to that consumed per water-horse-power of the pumps. This gave for the three cases 69.3 per cent., 71.2 per cent. and 67.8 per cent.

The data from the Opelika plant are of special interest as giving a record of the performance of a gasoline engine pumping station for a year. During this time 37,645,130 gallons were pumped against a head of 217 feet, requiring 5,858 gallons of gasoline. This shows 11,638,000 foot-pounds of work done per gallon of gasoline, or 0.17014 gallon of gasoline per water-horse-power per hour. Assuming an efficiency of 70 for the pump, as determined by the Westville experiments, 0.1191 gallon of gasoline is consumed per hour per engine horse-power, which is equivalent to 0.9528 pint per engine horse-power hour on the basis of one year's run. From these figures it has been calculated that to pump 100,000 gallons 100 feet high about 7.182 gallons of gasoline are required. For a year it is estimated that the necessary gasoline at 10 cents per gallon would cost $262. Mr. Ledoux says: "This engine was put in to replace a direct-acting simple duplex pump, which gave an approximate duty when in good condition of 20,000,000 foot-pounds. To afford the same economy coal would have to be $3.85 per ton, but the gasoline engine enabled the plant to be run with less attendance."

NOTES.

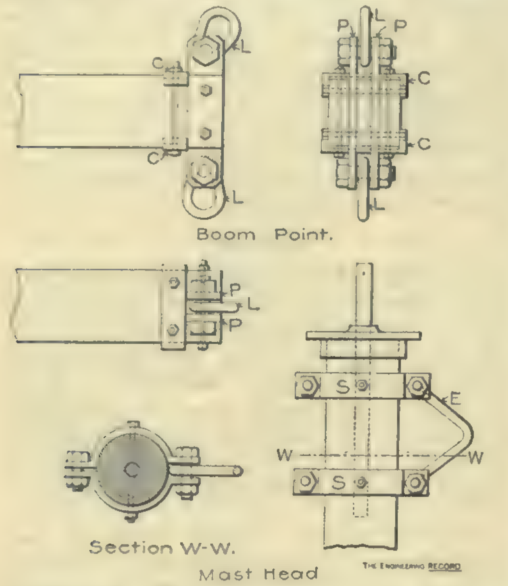
The Wreck of the Lattice Bridge described in these columns on January 21, was stated to have occurred on the Chicago, Milwaukee & St. Paul Railway, whereas it was on the Chicago & Northwestern Railway. Moreover, as if this mistake was not enough, Messrs. Blunt and Finley, respectively chief and bridge engineers of the latter road, were similarly shifted to the former without their consent or knowledge.

A New Form of Electric Pump has been patented by Mr. Carl Eickemeyer, of Yonkers, N. Y. It is a double-acting power pump driven by means of a gear wheel, like a large proportion of these machines. Instead, however, of the wheel having the usual face teeth, these are cut to engage a worm on a shaft running under the pump parallel with bore of the cylinders. This shaft is fitted with an armature revolving within field magnets, which form the base of the water-end. The shaft is held in position longitudinally by powerful springs, which permit it to move somewhat as the load varies; this motion is communicated by levers to the electric regulating apparatus, which is adjusted in this manner much as a governor regulates the action of a steam engine.

The Money Value of Good Water was referred to by Professor J. B. Johnson in a recent interesting address before the Engineers' Club of St. Louis on the civil engineer as a guardian of the public health. In referring to the death rate at Chicago from typhoid fever, he said that it "dropped from 83, 160 and 104 per 100,000 in 1890, 1891 and 1892 to 31, 32 and 46 in 1894, 1895 and 1896 respectively. This was traceable directly to bringing into service the water inlet four miles from shore in place of two miles out, which change was made in 1893. That is to say, this change in the intake of the water supply reduced the deaths from typhoid fever in that city during the three years, 1894, 1895 and 1896, from 1,856 to 576, or a saving of 1,280 lives annually. If a life is worth $5,000, as the laws of many States, including Misouri, have determined, then the money value of the lives saved in these years and since has been over $6,000,000 annually. If to this we add the value of the loss of time by sickness on the part of those attacked by this disease and who recovered, which is usually about six times as many as die, we have a saving of 7,680 cases of typhoid sickness. If we estimate a loss of six weeks' time to each patient, and a combined money loss of time and expense of $200 for each case, we have $1,500,000 more to be credited annually to the improvement caused by taking the water from a point two miles further out in the lake."

Some Derrick Fittings which differ from the usual standard patterns are indicated in a general way in the accompanying diagram. The

boom point has a center mortise in the end of the stick, in which are set two pin plates, P P, secured by two through bolts. The plates bear on the edges of a pair of clamp plates, C C, which are tightly bolted together so as to grip the sides of the timber and develop a large frictional resistance. Links L L for the hoisting and topping tackle are pin-connected to the end plates. There can be no jamming or cross strains; everything is tight; there are no splitting or shearing strains in the timber, and any required strength can be secured without clumsiness. The timber is not weakened by cutting away and no difficult forgings or any castings



Boom Point.

Section W-W.

Mast Head

are required. The whole set of irons can be made in slack time by a blacksmith. A masthead connection is also shown which is intended to avoid cutting the timber and to distribute the strain from the topping lift. The upper block of the tackle is hooked into the loop of the double eye, E, each end of which is secured by the bolt through one pair of flanges of a split collar. Special care is taken that these collars do not quite engage around the mast, so as to allow their bolts to be drawn up tight and clamp the timbers securely. In this sketch the top of the mast is shown with a Carlin cast-iron cap set on the end of the timber with a driving jib. It affords a reinforced bearing for the gudgeon pin, which fits it closely and is fastened by two cross bolts through the collars. These bolts may be arranged to take single sheaves for lead lines, etc., if necessary.

TRADE PUBLICATIONS.

The Lundell electric motor is fully described and illustrated in an attractive catalogue issued by the Sprague Electric Company, New York. This pamphlet gives a number of valuable tables and some excellent cuts showing the motor attached to machinery of various sorts.

Steam and electric hoisting engines are described in a new catalogue issued by the C. W. Hunt Company, Allan Street, West New Brighton, N. Y. The hoists are intended for all kinds of work. Cable drivers and coal handling machinery are also described and illustrated.

The Bostwick Steel Lath Company, Niles, Ohio, have sent for notice a beautifully printed account of the new high school building at Springfield, Mass., one of the latest structures of the kind in New England. All who enjoy studying the construction of this class of buildings will find much of interest in this pamphlet.

The H. Mueller Manufacturing Company, Decatur, Ill., has had a new catalogue printed describing and illustrating fully the well-known line of supplies for gas and water-works and plumbers, which it manufactures and carries. The book is attractively bound in cloth, and gives a large amount of information in concise form.

Since the last notice concerning calendars was inserted in these columns two more specimens have been received, both of the large, wall type. The Ashton Valve Company, 271 Franklin Street, Boston, has issued one with a steel engraving of two prospective users of its gauges and valves for a headpiece, and the Bostwick Steel Lath Company, Niles, Ohio, has one with a well-executed piece of half-tone printing in color as a decoration.

The Ingersoll-Sergeant Drill Company, Havemeyer Building, New York, has issued a new catalogue of mining, tunneling and quarrying machinery. Like all the trade literature distributed by the company, it is full of important information for the classes to which it is addressed. While much of it is familiar to people who are acquainted with the products of the company, other portions are new, and the whole is presented in a very attractive form.

The B. F. Sturtevant Company, of Boston, Mass., has just issued Bulletin I. This is an illustrated description of its 8-pole electric motors and generators, which, it states, are designed to meet extreme variations of load without sparking or the necessity of brush adjustment. The commutators are of large diameter, and for high voltages or small output at low speeds, fiber-graphite brushes are used. Half-tones with accompanying tables are given showing different types of direct-connected motors and fans, and direct-connected engines and generators.

The Westinghouse Standard engine has now a history of something like 18 years behind it, in which time nearly 5,000 engines of this type have been built. Those who recall the criticism with which its appearance was greeted will take much interest in the pamphlet just issued by the makers, the Westinghouse Machine Company, of Pittsburg, describing this unique mechanism, which has survived so easily the early attacks upon it from a large portion of the engine-using public of that time. The little book is as attractively printed as the preceding publications of this company, which is the same as saying it is a model of typography.

PERSONAL AND OBITUARY NOTES.

Mr. C. M. Slocum has been re-elected city engineer of Springfield, Mass.

Dr. Louis Duncan and Mr. M. K. Eyre have opened offices as consulting engineers at 71 Broadway, New York.

Mr. Arthur J. Rockwood, of Guthrie & Rockwood, Buffalo, has been appointed division engineer of the western division of the Erie Canal.

Messrs. Waddell & Hedrick, Kansas City, Mo., have been retained to design a number of bridges for the Tennessee Central Railway Company and superintend their manufacture.

Mr. F. W. Cappelen, M. Am. Soc. C. E., until recently city engineer of Minneapolis, has decided to open an office as consulting engineer. His successor as city engineer is Mr. G. W. Sublett.

Mr. J. N. Hazlehurst has resigned his office of engineer to the Board of Public Works of Tampa, Fla., to become connected with the water-works of Mobile, and has been succeeded by Mr. Fred. Warren.

Mr. Nicholas S. Hill, Jr., who needs no introduction to the readers of "The Engineering Record," has been appointed chief engineer and general manager of the Charleston, S. C., Consolidated Railway, Gas & Electric Company. This corporation controls the street railway and lighting business in Charleston.

Mr. John W. Payne has been elected city engineer of Akron, O., for a term of two years. He was graduated from the engineering department of the University of Michigan in 1883, and was an assistant engineer on the Government work on the Missisipi for several years. Since 1892 he has been first assistant engineer in the Akron office.

Mr. James L. Tighe has been appointed city engineer of Holyoke, Mass., succeeding Mr. John J. Kirkpatrick. He served a three-years' apprenticeship with an engineering firm in Ireland. In 1891 he was graduated at the head of his class in engineering at McGill University, and the following year was engaged by the water commissioners of Holyoke, in whose service he has remained ever since.

Members of the American Institute of Architects will learn with regret of the death of Colonel William C. Smith, of the First Tennessee Volunteers, during the battle with the insurgents at Manila recently. He was a Virginian by birth, and served with distinction in the Confederate army. For many years he was a regular attendant at the conventions of the Institution, of which he was a highly esteemed member.

Mr. W. W. Churchill, for nine years associated with Westinghouse, Church, Kerr & Company, has been appointed its mechanical engineer. He was graduated in 1889 from Cornell University, but remained there a year longer as Sibley Fellow in mechanical engineering. Another promotion by the same firm is that of Mr. Henry J. Conant, manager of its Boston office. He was graduated from the Massachusetts Institute of Technology in 1887.

The following transfers have been announced in the Corps of Engineers, U. S. Army: Major William D. Beach to Augusta, Ga., as acting inspector, first division, second corps. Captain Harry F. Hodges to the office of chief mustering officer for New York State. Captain Chester Harding to Grand Rapids, Mich. Lieutenant Jay J. Morrow to New York to assist Major Henry M. Adams. Lieutenant Robert McGregor to Little Rock, Ark. Major Robert B. C. Bement, M. Am. Soc. C. E., has been honorably discharged, to take effect March 20.

Mr. George Lewis Heins has been appointed State Capitol Commissioner of New York, to succeed Mr. Isaac G. Perry. The position is an onerous one, calling for supervision of all the hospitals, armories, reformatories and other State buildings, and the fact that Governor Roosevelt has persuaded an architect having so large a practice as Mr. Heins to accept it is noteworthy. The new appointee was born in Philadelphia, and studied at the University of Pennsylvania and the Massachusetts Institute of Technology. After graduating from the latter school in 1882, he was engaged in architectural offices in St. Paul and Minneapolis. In St. Paul he joined Mr. C. Grant Le Farge, but in a short time the firm removed its offices to New York. Its best known professional achievement is the Cathedral of St. John the Divine, now in course of construction in New York.

Dr. Elon Huntington Hooker, who has just been appointed assistant superintendent of public works of New York State, is an unusually young man for such a responsible position. But although he is only about thirty years old, he has had the best of training, theoretical and practical, for an office which has to do largely with the management of canals. He was graduated from the University of Rochester, and engaged in field engineering for a time. Then he took post-graduated studies in civil engineering at Cornell, and in the polytechnic schools of Paris and Zurich, making a specialty of hydraulic branches. His thesis for his degree of doctor of philosophy was the elaborate study of the suspension of solids in flowing water, which was printed in the "Transactions" of the American Society of Civil Engineers, an unprecedented honor for a college paper. He was engaged for a time on the construction of the new hydraulic laboratory at Cornell, then on a large contract for excavating and dredging, and lately on work on the Grace Nicaragua Canal project as an assistant to Mr. F. W. Washburn, M. Am. Soc. C. E.

CONTRACTING NEWS

OF SPECIAL INTEREST TO

CONTRACTORS, BUILDERS, ENGINEERS, AND MANUFACTURERS

OF ENGINEERING AND BUILDING SUPPLIES.

For Proposals see pages 248, xi and xii.

WATER.

Newark, O.—The State Board of Public Works has asked the Emergency Board for the sum of $14,000 to make contemplated improvements to the aqueducts near Newark.

Washington, D. C.—Bids are wanted March 11 for building a reservoir, as advertised in "The Engineering Record."

Perris, Cal.—The construction of a system of water-works is under consideration.

San Luis Obispo, Cal.—Local press reports state that the city has purchased the property of the San Luis Water Co. for $50,000.

Mauch Chunk, Pa.—An application is about to be made by J. Price Wetherell, Geo. G. Converse, Wm. S. Cortright and others, for a charter for the intended corporation to be called Palmer Water Co., having for its object the supplying of water to the Township of Lower Towamensing.

Whitehall, Ill.—Bids are wanted Feb. 25 for pumping machinery for the water system. T. A. Chapin, Engr.

Everett, Mass.—Bids are wanted March 7 for cast-iron water pipe, specials, cocks, etc., as advertised in "The Engineering Record."

Cincinnati, O.—Bids are wanted Feb. 13 for laying water pipe on West Sixth St. A. B. Rattermann, Pres. Bd. City Affairs.

Chicago, Ill.—Bids are wanted Feb. 15 for water supply and water service pipes in several streets. L. E. McGann, Pres. Bd. Local Improvements.

Mt. Pleasant, Mich.—Bids are wanted March 1 for a water and sewer system in the Indian Industrial School. W. A. Jones, Commr. Indian Affairs, Washington, D. C.

Topeka, Kan.—The Senate has passed a bill appropriating $3,500 to rebuild the asylum pumping station, recently destroyed by fire.

Jackson, Mich.—A special committee has under consideration plans for increasing the water supply from 7,000,000 gal. to 10,000,000 gal. in 24 hours.

Danville, Ill.—It is stated that the South Danville Electric Light & Power Co. proposes to install a water plant for the village.

Cedar Rapids, Ia.—Reports state that several new filters will be added to the local plant this year. Chas. J. Fox, Supt.

St. Petersburg, Fla.—It is stated that an election will probably soon be called to vote on the issue of bonds for water-works.

Alameda, Cal.—B. Lamborn, City Clk., writes that the municipal ownership of the water plant is being considered.

McCune, Kan.—Frank Miller, City Clk., writes that it was voted Feb. 1 to issue $2,000 bonds to sink a well, preparatory to constructing water-works.

Carbondale, Pa.—Press reports state that capitalists, headed by John Jermyn, of Scranton, have bought the plant of the Crystal Lake Water Co.

Lockhart, Tex.—According to press reports Dr. W. F. Blunt, Lockhart, proposes to build a system of water-works.

Jamaica (L. I.), N. Y.—The Board of Public Improvements has taken favorable action on the petition from the residents of Richmond Hill to allow the Jamaica Water Supply Co. to extend its mains through several streets of that place. The Citizens' Water Supply Co. was also authorized to extend its mains in various parts of Newtown, to an extent aggregating upward of 10,000 ft.

St. Joseph, Mo.—The Common Council has passed an ordinance authorizing Judge Romulus E. Culver, of St. Joseph, and others to construct, maintain and operate a system of water-works, and making a contract for a supply for the city for a period of 20 years. A special election has been ordered for Feb. 25 for the purpose of ratifying the action of the Council in granting the franchise and contracting with The Sechner Contracting Co., of Chicago, for the construction of works at a probable cost of $800,000.

Sandusky, O.—The Water-Works Trustees are contemplating an extensive improvement at the water-works by installing a system of filtration. Total estimated cost, according to local press reports, about $85,000.

Tarboro, N. C.—Local press reports state that the Town Commissioners and Board of Trade have voted in favor of the municipal ownership of water-works, sewerage and light plant; also it was voted to ask the present Legislature for authority to issue bonds to the amount of $50,000 to accomplish the same.

Memphis, Tenn.—The bill has been passed by the Legislature granting the city authority to issue $2,000,000 bonds to purchase or build water-works.

Ottawa, Ont.—City Engineer Galt has submitted a report to the Water-Works Committee in which he states that it is absolutely necessary that an additional plant be installed at once.

Osawatomie, Kan.—The city will issue $30,000 bonds for water-works and $5,000 for an electric light plant, according to reports.

Orange, N. J.—Local press reports state that on account of a change in plans for the pumping station, dam, etc., at Campbell's Pond, bids will probably be readvertised.

Laurel, Del.—A bill is before the Legislature granting the city authority to issue $20,000 bonds for water-works.

Worcester, Mass.—An order has been adopted authorizing the Water Commissioners to secure proposals for furnishing water pipe, etc.; estimated expense $50,000.

Lafayette, Ala.—A bill has passed the House authorizing the issue of $20,000 bonds for water-works and electric lights.

Highgrove, Cal.—Articles of incorporation have been filed by the Riverside Highland Water Co., with a capital of $200,000. Board of Directors: E. A. Chase, Charles R. Gray and K. Sanborn, of Riverside, and others.

Victoria, B. C.—It is stated that bids are wanted Feb. 20 for furnishing valves, main cocks, elbows, etc. W. W. Northcott, Purchasing Agent.

Baltimore, Md.—The contract for supplying the Water Board with brass castings has been awarded to the Curtis Bay Brass & Metal Wks. for $4,500.

Cincinnati, O.—Bids are wanted March 4 for $15,000 Mitchell Ave. aqueduct bonds, series No. 3. Geo. C. Zimmerman, Clk. Co. Commrs.

Moorhead, Minn.—Bids are wanted Feb. 20 for furnishing water-works and electric lighting. Jacob Kiefer, Mayor.

Jamesburg, N. J.—Bids are wanted March 6 for a system of water-works, as advertised in "The Engineering Record."

Fayetteville, Tenn.—Bids are wanted March 15 for 1,154 tons of 4 to 10-in. cast-iron pipe, constructing masonry distributing reservoir, hydrants, valves, etc. B. A. Lewis, Mayor.

McConnellsville, O.—It is stated that bids are wanted March 8 for $10,000 bonds for proposed works. Geo. Birch, City Clk.

Buffalo, N. Y.—The Board of Public Works has been authorized to order a new brick chimney at the pumping station, to cost $13,800.

Girard, Kan.—It is stated that a new reservoir is to be built.

Keshena, Wis.—See "Government Work."

Oregon City, Ore.—We are informed that it is proposed to construct a system of water-works to cost about $50,000. H. H. Johnson, Engr. in Charge, Oregon City.

Oakwood, O.—The Oakwood Water & Light Co. has filed an application for a franchise to lay water mains and erect poles and wires on the highways.

Washington, D. C.—The House Committee on Public Buildings and Grounds has ordered a favorable report on the bill providing that the architect of the United States Capitol building be directed to have erected a complete filtration plant, having a capacity to deliver not less than 300,000 gals. of pure water every 24 hours at the Senate end of the Capitol building, and a like amount at the House end.

Corsicana, Tex.—J. S. Thatcher, C. E., of Dallas, writes that plans and specifications have been completed for the new reservoir; also for the earth dam work, 1,980 ft. long and 29 ft. high; about 95,000 cu. yds. of earth work. Bids will be asked at once. C. B. Lewis, Supt. of Water-Works.

Bay City, Mich.—The Water Commissioners have authorized Superintendent Dunbar to advertise for bids for cast-iron water pipe.

Pueblo, Colo.—The City Council has passed an ordinance authorizing the issue of $118,000 water-works improvement bonds.

Montreal, Que.—The Water Committee has under consideration the purchase of a new boiler for the upper level pumping station.

Delaware, O.—The Water-Works Committee has secured the services of Col. John W. Hill, Consulting Civil Engineer, of Cincinnati, to make an expert examination of the water-works system of this city, with the view of the city purchasing the same.

Neosho, Mo.—It is stated that the city has purchased the system of the Neosho Water Co. for $46,000.

Elmwood, N. Y.—The Board of Village Trustees has rescinded its action of Jan. 24 granting franchises to the water and electric light companies.

Elkton, Ky.—Press reports state that the town is considering the establishment of a water-works plant.

Houston, Tex.—It is stated that the water-works company has contracted with Gus. Warnecke for the sinking of a sufficient number of artesian wells to secure an additional flow of 2,000,000 gallons of water.

Tucson, Ariz.—Articles of incorporation have been filed by the International Irrigation & Improvement Co., of Los Angeles, with a capital of $1,000,000. The object of the incorporation is to transact a general irrigating business outside of the Territory of Arizona. The directors are: R. H. Stuart, L. Miller, R. H. Lacy and others.

Pittsburg, Pa.—The Filtration Commission, in their report to the Councils, recommend the adoption of the sand filtration system; total estimated cost of construction, $2,111,000, and $192,184 for maintenance. The Commission also recommends the adoption of the meter system.

Manchester, N. H.—Local press reports state that the following bids were opened Feb. 3 for furnishing 450 to 500 tons of iron water pipe: H. J. Drummond & Co., New York City, $20.40 (all sizes); Warren Foundry & Machine Co., New York City, $20.40 (all sizes); McNeal Pipe & Foundry Co., Philadelphia, $19.80 for 14 and 12-in. pipe and $20.45 for 6-in. pipe.

Pittsburg, Pa.—The following bids for a 48-in. riveted steel force main to the reservoir in Highland Park were opened Dec. 30 by Edw. M. Bigelow, Dir. of Pub. Wks.: Stratton, Lewis & Co., $83,471; James McNeil & Bro., $82,000; James H. McQuade, $84,663; W. E. Howley & Co., $73,697; Riter & Conley Mfg. Co., $81,943; T. A. Gillespie & Co., *$74,940; Thos. McNally, $106,202; Keeling & Ridge, $68,775; Cronin & O'Herron, $74,000. Bidders all of Pittsburg.

*Contract awarded.

SEWERAGE AND SEWAGE DISPOSAL.

Cleveland, O.—Bids are wanted Feb. 17 for sewers in several streets and alleys. George R. Warden, Dir. Pub. Wks.

Demopolis, Ala.—A bill has been introduced in the Legislature authorizing the issue of $25,000 bonds for the construction of sewers.

New Orleans, La.—Local press reports state that the election to vote on the sewerage tax, ordered for March 2, has been postponed, probably until April 15.

Cambridge, O.—The City Council has passed resolutions directing O. M. Hoge, City Engr., to prepare plans for the extension of outfall sewer from Fourth to Ninth Sts., also laterals in 12 streets, and the completion of Stubenville Ave. sewer. Approximate amount, 25,000 ft.; sizes, 18 in. to 8 in., and 10,000 ft. 6-in. house connections.

Mt. Pleasant, Mich.—See "Water."

New York, N. Y.—Bids are wanted Feb. 15 for sewers. Jas. Kane, Commr. Sewers.

Chicago, Ill.—Bids are wanted Feb. 15 for vitrified tile pipe and brick, and vitrified tile pipe sewers in several streets. L. E. McGann, Pres. Bd. Local Improvements.

Dayton, O.—Bids are wanted Feb. 14 for sanitary sewers on Grafton and Rockwood Aves. J. L. Baker, Pres. Bd. City Affairs.

Cincinnati, O.—Bids are wanted March 3 for sewers. A. B. Rattermann, Pres. Bd. City Affairs.

Waseca, Minn.—We are informed that bids will probably be asked in April for the construction of a sewerage system. C. F. Loweth, Engr. in Charge, St. Paul, Minn.

Niles, O.—Bids are wanted March 7 for sewers on Robbins Ave. W. Y. Sayers, Clk. Bd. Sewer Commrs.

St. Paul, Minn.—The contract for extending Custer St. sewer has been awarded to Charles Stone, of St. Paul, for $3,384.

Atchison, Kan.—The City Engineer, Fred Giddings, has been directed to prepare estimates for constructing the South Atchison sewer system. Estimated cost, $37,000.

Norfolk, Va.—Bids are wanted March 9 for sewers in the Fifth Ward, as advertised in "The Engineering Record."

Cedar Rapids, Ia.—G. H. Merridith, City Engr., is preparing plans for a system of sanitary sewerage for the southwest district of the city. R. M. Buck, Chmn. Com. on Public Improvements.

Pasadena, Cal.—Press reports state that City Engineer Clapp estimated the cost of sewering the city to be $180,000, and recommends that the city be bonded for this amount.

Youngstown, O.—Vetter & Heasley have secured the contract for constructing the sewer outlet on the Powers & Bissell plat for about $2,000.

Folsom City, Cal.—The bill appropriating $75,000 for a sewerage system at the Folsom State Prison has passed the Assembly.

Steelton, Pa.—Bids are wanted Feb. 28 (re-advertisement) for the construction of a system of sewers for the Borough, as advertised in "The Engineering Record."

Wakefield, Mass.—The construction of a sewage disposal system is under consideration.

Cleveland, O.—Bids are wanted March 3 for sewers in Clark Ave., Franklin Ave. and Wilhelm St. George R. Wardin, Dir. Pub. Wks.

Baltimore, Md.—Assistant City Commissioner Brosius recommends the reconstruction of sewers as follows: Central Ave. sewer, probable cost $182,000; Schroeder St. sewer, probable cost, $100,000; Center St., $30,000, and Canton Ave., $15,000.

Keshena, Wis.—See "Government Work."

Indianapolis, Ind.—Bids are wanted Feb. 13 for a sewer. M. A. Downing, Chmn. Bd. Pub. Wks.

Coldwater, Mich.—Riggs & Sherman, of Toledo, O., have been retained as consulting engineers for sewerage.

Niagara Falls, N. Y.—The Common Council has decided to recommend the construction of sewers at an estimated cost of $44,776.

Westport, Mo.—City Engineer Wise, of Kansas City, according to local press reports, has stated that a main sewer is to be built, with an outlet, possibly, into Brush Creek.

Albany, N. Y.—Bids are wanted Feb. 20 for 2,730 ft. of 12 to 20-in. vitrified pipe sewers. Thomas J. Lanahan, Clk. Bd. Contract and Apportionment.

Wellsville, O.—Sewer bonds to the amount of $75,000 have been voted, and plans are to be prepared at once. Riggs & Sherman, Consulting Engineers, Toledo. D. L. Davidson, City Clk.

Seattle, Wash.—Local press reports state that bids are wanted for 1½ miles of sewer extension, estimated to cost $12,000.
The contract for building the Republican St. sewer system has been awarded to Erickson & Roseleaf of Seattle for $25,930.40.

Spokane, Wash.—The Committee on Sewers has submitted a report favoring the construction of sewers in certain streets at an estimated cost of $15,000.

Toledo, O.—Bids are wanted Feb. 20 for a 12-in. cylindrical pipe sewer. Lem. P. Harris, City Clk.

Spartanburg, S. C.—The following bids for 17 miles of 8 to 24-in. pipe sewers, 202 manholes and 26 flush tanks were opened Feb. 3 by the Mayor and Aldermen, J. L. Ludlow, Engr., Winston, N. C. Geo. O. Tenny, Spartanburg, S. C., *$45,407.10; Guild & Co., Chattanooga, Tenn., $48,301.90; Chas. T. Hookway, Syracuse, N. Y., $50,433.10; P. H. Harrison & Sons, New York City, $55,811.50; Joseph Perna, Philadelphia, $59,417.94; Sweeney & Houston, Pittsburg, Pa., $60,824.40; Moore & Willard, Spartanburg, S. C., $55,032. (Bid did not include pipe.)
*Contract awarded.

Toledo, O.—Local press reports state that James Sheahan was the lowest bidder for sewers in two alleys at the following prices: $1.45 per ft. for 24-in. pipe laid, $1.25 for 20-in., $1.15 for 18-in., $1.05 for 15-in. and $14.50 each for manholes. For the 12-in. pipe sewer, 89 cts. per ft. for pipe and $15 each for manholes.

BRIDGES.

Joplin, Mo.—The City Council has instructed the engineer to readvertise for bids for a bridge over Willow branch, on 6th St.

Somerville, O.—L. H. Dillon, City Engr., Hamilton, O., has prepared plans for the high truss bridge to be constructed across Seven Mile Creek. Estimated cost $15,800.

New Kensington, Pa.—The construction of a bridge across the Allegheny River between New Kensington and Boquet is under consideration.

Boston, Mass.—City Engineer Jackson is having plans prepared for a steel plate girder deck bridge (83 ft. wide at one end and 104 ft. at the other) at the Back Bay Fens entrance on Charles-gate, over the new Ipswich St. It will have a buckle plate and asphalt floor and 9 girders, of which 7 will be 55 ft. 4 in. long and two 58 ft. and 6 in. long.

St. Joseph, Mo.—Bids are wanted Feb. 17 for building several bridges. Theo. Steinacker, Co. Surveyor.

Saginaw, Mich.—H. E. Warren, Engr. of the Saginaw Valley Traction Co., writes that bids are about to be asked for a bridge at Bristol St., which will cost between $5,000 and $10,000.

New York, N. Y.—Bids are wanted Feb. 18 for the steel towers and end spans of the new East River bridge, as advertised in "The Engineering Record."

Cedar Rapids, Ia.—City Engineer G. H. Merridith has recommended the construction of two steel bridges over the Cedar River.

Savannah, Ga.—See "Railroads."

Northampton, Mass.—Engineer Thacher estimated the cost of repairing the Hadley bridge at about $3,000; he estimates the cost of a new bridge (which will replace the present structure), to accommodate a street railway, at about $120,000.

Reading, Pa.—The Common Council accepted the report made by City Engineer Hoff estimating the cost of bridges over the Philadelphia & Reading R. R. tracks at Spring and Pike Sts. at $84,100.

Lexington, Okla.—It is stated that the Lexington & Purcell Bridge Co. filed articles of incorporation with Secretary Jenkins, Guthrie, Okla., to construct a bridge over the South Canadian River. Capital, $15,000. Directors, B. Weitzeneffer, Frank P. Cease, Nathan Turk, Lexington; C. G. Jones, Oklahoma City, and others.

Tacoma, Wash.—A bill was passed in Congress authorizing the British Columbia, Seattle & Pacific Coast Railroad Co. to construct a bridge across the Columbia River.

Grand Rapids, Mich.—The construction of a viaduct over the railroad tracks at Bartlette St. is stated to be under consideration.

Bedford City, Va.—Press reports state that a proposition from the Virginia Bridge & Iron Co., Roanoke, Va., to construct an iron bridge across Big Otter River at Wilkes' Mill for $2,100 was accepted in the session of the County Court.

Cleveland, O.—Local press reports state that the lowest bid for constructing the superstructure of Center St. bridge was submitted by the King Bridge Co., Cleveland, at $36,999.

Waverly, Ia.—The Toledo Bridge Co., Toledo, O., is stated to have received the contract for a steel girder bridge across Cedar River at Bremer Ave. for $15,990. For list of bids received see our issue of Feb. 4.

Elkhart, Ind.—Press reports state that the bids opened Feb. 1 by the County Commissioners for a bridge on Sherman St. have been rejected.

Boston, Mass.—Bids are wanted Feb. 20 for two masonry abutments of a bridge on Swett St. over N. Y., N. H. & H. R. R., South Boston. William Jackson, City Engr.

Binghamton, N. Y.—A special election will be held March 2 to vote on the issue of $40,000 bonds for the erection of a bridge at Tompkins St. B. W. Mosher, City Clk.

Macon, Ga.—The Mayor has been authorized to advertise for plans and specifications for a two span iron bridge about 400 ft. long across Ocmulgee River at 5th St. The Central of Ga. Ry. will be required to build plate girder bridge over 4th St.; length of span 72 ft.

Painesville, O.—The Commissioners of Lake Co. have decided to have the taxpayers vote on the question of constructing a bridge over Grand River. B. F. Morse, of Cleveland, has been engaged to estimate the cost of the structure.

Shreveporft, La.—It is stated that bids are wanted March 9 for a bridge over Cowhide Bayou. A. L. Duringer, Clk. of Parish.

Marietta, O.—Charles Tinkler, of the Canton Bridge Co., has prepared plans and specifications for the proposed Putnam St. bridge.

Boston Mass.—The following bids for building trucks for the draws of Summer St. bridge were opened at the office of the City Engineer Jan. 20: Coffin Valve Co., *$3,705; Atlantic Wks., $4,230; Whittier Machine Co., $4,243; George T. McLaughlin & Co., $4,300; Lockwood Mfg. Co., $4,895; Bertelsen & Petersen, $4,990.
*Contract awarded. Bidders all of Boston.

Helena, Mont.—The following bids for 75 ft. span steel bridge across south fork of Dearborn River were opened Feb. 1 by Charles J. Clark, Clk. Co. Commrs.: Missouri Valley Bridge & Iron Wks., Leavenworth, Kan., *$2,900 and $2,775; Gillette-Herzog Mfg. Co., Minneapolis, Minn., $2,850 and $2,750; San Francisco Bridge Co., San Francisco, Cal., $3,250; O. E. Peppard, Missoula, Mont., $3,225; Wisconsin Bridge & Iron Wks., Milwaukee, Wis., $3,250; King Bridge Co., Cleveland, O., $3,599.
*Contract awarded.

PAVING AND ROADMAKING.

Toronto, Ont.—Bids are wanted Feb. 15 for paving several streets with asphalt, brick and macadam. John Shaw (Mayor), Chmn. Bd. Control.

Cleveland, O.—Bids are wanted March 4 for paving several streets with brick. George R. Warden, Dir. Pub. Wks.

Atchison, Kan.—City Engineer Fred Giddings writes that contracts will be let in February for 16,555 sq. yds. of brick paving, 724 lin. ft. of cement curb, 490 lin. ft. curb reset on 4th ave.; also for 6,100 sq. yds. of brick paving and 3,100 lin. ft. of cement curb on Division St.

Appleton, Wis.—Street improvement and building bonds to the amount of $50,000 have been sold to the First National Bank of Appleton.

Petersburg, Va.—G. B. Gill, City Auditor, writes that the report of Samuel M. Gray, E. C., of Providence, R. I., with specifications for both vitrified brick and sheet asphalt paving, will be considered at the Common Council meeting to be held March 1. Estimated cost of work, $50,000. Thos. R. Dunn, Engr. in Charge, Petersburg.

Fulton, N. Y.—Bids are wanted Feb. 23 for 22,000 sq. yds. of brick paving, 5,000 lin. ft. of stone curbing, 1,500 lin. ft. 15x18-in. sewer with connections, and 1,200 cub. yds. embankment and grading, as advertised in "The Engineering Record."

Batavia, O.—It is stated that bids are wanted March 1 for constructing portions of 6 turnpikes a distance of about 5 miles. John W. Davis, Co. Aud.

Baltimore, Md.—The Board of Estimates has agreed to report favorably ordinances for paving several streets with macadam.

Atlantic City, N. J.—It is stated that bids are wanted Feb. 21 by County Road Engineer Albertson for the construction of Longport drive.

Detroit, Mich.—According to local press reports the Public Works Commissinoers' estimate of cost for repaving this year will be about $600,000. H. D. Ludden, City Engr., estimates that there are 2,000,000 sq. yds. of cedar block pavement that will have to be replaced during the next three years.

Toledo, O.—The special committee of the City Council has decided to pave Summit Ave. on either side of a 15 ft. grass plat for a distance of 32 ft.

Jersey City, N. J.—Bids are wanted Feb. 14 for paving about 1,850 sq. yds. on Stegman St. with Belgian block. Geo. T. Bouton, Clk. Bd. Street and Water Commrs.

Albany, N. Y.—Local press reports state that paving contracts have been awarded as follows: To T. Henry Dumary of Albany for Dove St. and Hamilton St. with brick for $3,951.79 and $15,004.90 respectively; to Mulderry Bros. of Albany for paving Elizabeth St. with brick for $14,461.70.

Scranton, Pa.—Bids are wanted Feb. 16 for paving East Market St. with brick. M. S. Lavelle, City Clk.

Pawtucket, R. I.—An act has been introduced in the Legislature authorizing the city to issue $250,000 bonds for street and school purposes.

Rochester, N. Y.—It is stated that Whitmore, Rauber & Vicinus of Rochester have secured contracts for asphalt paving on Bartlett St. for $7,262 and for macadam on Alexander St. for $5,149.

Boone, Ia.—City Engineer Finley has completed plans and specifications for 9,039 yds. of paving and 2,684 ft. of cement curbing, to cost about $17,000.

Alma, Mich.—An ordinance is before the Council authorizing the issue of $4,000 street improvement bonds. W. W. Kinch, Village Clk.

New York, N. Y.—The Board of Estimate and Apportionment on Feb. 2 authorized the issue of $2,000,000 bonds, to be used in repaving streets. Of this sum $1,000,000 is to be spent in the Borough of Manhattan, $700,000 in Brooklyn, $200,000 in the Bronx, $75,000 in Queens and $25,000 in Richmond.

Woodbury, N. J.—Bids are wanted March 11 for macadamizing about 4,204 ft. on Broad St. C. W. Starr, Dir. Bd. Chosen Freeholders.

Zanesville, O.—Bids are wanted March 1 for $17,400 paving bonds. Charles N. Bainter, City Clk.

Philadelphia, Pa.—Bids are wanted Feb. 17 for paving and repairing Broad St. with asphalt. Thomas M. Thompson, Dir. Dept. Pub. Wks.

Lebanon, Ind.—Bids are wanted Feb. 18 for brick paving on West Pearl St. Herbert S. Freeman, Eng. in Charge.

Baltimore, Md.—Engineer Frank H. Sloan estimates the cost of building the boulevard speedway on Park Heights Ave. at $27,336 a mile for a width of 104 ft., or $29,218 a mile for a width of 114 ft.

Houston, Tex.—According to local press reports, the contract for paving Main St. has been awarded to Hipp & Key for rock asphalt on a 6-in. gravel and cement foundation, with a 5-year guarantee.

Peoria, Ill.—The Board of Local Improvement has passed estimates on paving the following streets: University Ave. with brick, to cost $13,382; Malvern and Cutler Sts. with asphalt, cost $8,124 and $11,535 respectively.

Rockford, Ill.—It is stated that ordinances are being prepared for improving certain streets. Estimated cost, $20,000.

Lower Saucon, Pa.—A vote will be taken at the coming election on the question of purchasing a stone crushing plant.

Bethlehem, Pa.—Superintendent of Highways Neumeyer, in his recent report, shows that $40,000 was expended last year on street improvements, and that $35,000 more is to be spent on macadamizing this year.

Bedford, Ind.—It is stated that bids are wanted March 3 for constructing portions of 10 roads. John M. Gainey, Aud.

Atlantic City, N. J.—An ordinance is about to be introduced in the City Council for the paving of Arctic Ave.

Cleveland, O.—Bids are wanted Feb. 18 for improving three streets. Geo. R. Warden, Dir. Pub. Wks.

Minneapolis, Minn.—The City Clerk has been directed to advertise at once for bids for paving several streets with brick on a 6-in. concrete foundation.

Cleveland, O.—Bids are wanted March 7 for paving several streets with brick. George R. Warden, Dir. Pub. Wks.

Flushing, N. Y.—Press reports state that Thomas F. Tuohey & Co. have been granted a contract by the City of New York to lay flag sidewalks in the Third Ward of Queens Borough to the amount of $49,000.

Jamestown, N. Y.—The following bids for about 5,374 sq. yds. of brick paving, 3,240 lin. ft. of curbing and 272 ft. curved curbing were opened Feb. 1 by the Board of Public Works: Gust. Burland, $8,817.55; Jamestown Construction Co., $8,326.50; L. E. Fenton Co., $9,722.60; Mullen & Doyle, $8,855.75. Bidders all of Jamestown.

New Orleans, La.—The following bids were opened Jan. 30 by the Finance Committee for asphalt pavement on 6-in. concrete foundation: For Berlin st., 800 sq. yds., Louisiana Improvement Co., $2.17 per sq. yd.; Barber Asphalt Paving Co., N. Y. City, $1.97 per sq. yd. For Ursulines st., 11,600 sq. yds., General Asphalt Co., $2.98 per sq. yd.

Winnipeg, Man.—The following bids were opened Oct. 19 for paving Portage Ave.: *a*, 16,800 sq. yds. asphalt; *b*, 1,230 sq. yds. of brick or block pavement between railway tracks and trackwork; *c*, 2,960 lin. ft. natural stone curb; *d*, 180 lin. ft. of curved curb. Kelly Bros. & Co., Winnipeg, *a*, $2.71½; *b*, $2.25; *c*, $1.30; *d*, $1.50; total, $52,497.50. Warren Scharf Asphalt Paving Co., N. Y. City, *a*, $2.73¼; *b*, $2.31; *c*, $1.28; *d*, $1.50; total, $52,806.10. Estimate of H. N. Ruttan, City Engr., Winnipeg, *a*, $2.21; *b*, $2.27; *c*, $1.20; *d*, $1.30; total, $43,806.10.

The work was ordered to be done by day labor under the supervision of the City Engineer at the estimated cost as shown above.

Eau Claire, Wis.—C. A. Alderman, City Engr., writes that the following bids for about 9,394 sq. yds. of brick paving, 200 lin. ft. of new curbing and relining 3,416 ft. old curbing were opened Jan. 30 by the Committee on Pavements as advertised in "The Engineering Record."

The reference letter indicates the kind of brick to be used: *a*, Galesburg brick of Purington Brick Co. *b*, Des Moines Brick Mfg. Co. *c*, Iowa Brick Co. *d*, Capital City Brick Co. *e*, Flint Brick Co. *A. R. Rutledge & Co., Rockford, Ill., *a*, $1.30. Fielding & Shepley, St. Paul, *b*, $1.41; *c*, $1.41. Wm. Horrabin, Iowa City, Ia., *a*, $1.40; *c*, $1.31, $1.33 and $1.38; *d*, $1.31. J. B. Canney, Minneapolis, *a*, $1.31; *b*, $1.29; *c*, $1.29. Winona Construction Co., Winona, Minn., *a*, $1.32. Smith, Moss & Brown, Chicago, *a*, $1.43; *b*, $1.36; *c*, $1.36; *e*, $1.36. Charles Stone, St. Paul, *a*, $1.85; *b*, $1.80.

* Contract awarded at $1.30 for paving, 60 cts. for setting new curb and 6 cts. for relining old curbing.

POWER PLANTS, GAS AND ELECTRICITY.

Vincennes, Ind.—Bids are wanted Feb. 27 for lighting the streets, alleys, parks and public buildings with electricity for a period of 10 years, as advertised in "The Engineering Record."

Clayton, N. J.—The Gloucester County Electric Light Co. is stated to have received a franchise to light this place by electricity.

Woodstown, N. J.—The Borough Council is stated to have decided to issue $10,000 bonds for an electric light plant.

Osawatomie, Kan.—See "Water."

Ashland, O.—A company composed of Andrew Jackson, W. E. Johnson and others, is stated to have applied for a franchise for an electric light plant.

Red Bluff, Cal.—See "Fires."

Savannah, Ga.—Bids are wanted Feb. 17 for combination gas and electric light fixtures in the U. S. Courthouse and Postoffice. W. B. Howell, Asst. Secy., Treas. Dept., Washington, D. C.

Defiance, O.—There is a movement on foot to build an incandescent electric light plant. B. F. Enos and T. Mahoney are said to be interested.

Iowa City, Ia.—See "Fires."

Highland, Ill.—The Highland Electric Co. has been incorporated; capital $15,000. Incorporators; Willis M. Rickert and Godfrey H. Atkins.

Madison, Wis.—B. B. Clarke is said to have applied for a franchise to establish an electric plant.

Westfield, N. J.—The construction of a municipal electric light plant is under consideration. Township Committee: G. H. Embree, Chmn.; C. W. Harden and J. A. Dennis; town clerk, Irving I. Ross.

Pulaski, Ia.—There is some talk of putting in electric lights here.

Lafayette, Ala.—See "Water."

Greenville, Ala.—A bill is stated to have been passed by the House authorizing the town to negotiate a loan for the purpose of establishing a system of electric lights.

Jefferson, Ia.—The Jefferson Heat, Power, Water & Light Co. is stated to have applied for a franchise to construct and maintain a system of heating for the city.

Joplin, Mo.—The Committee on Lighting is stated to have decided to recommend to the Council that an election be called at once to vote on issuing $30,000 bonds for an electric light plant.

Newark, N. J.—The Economic Light & Power Co. has been incorporated; capital $100,000. Incorporators; Horace M. Decker, Richmond C. Coventry and Frederic M. Payne, all of this city.

Bedford, Pa.—The Welsbach St. Lighting Co. is stated to have received the contract for lighting the streets for 1899.

Phoenixville, Pa.—The question of establishing a municipal light plant is being agitated here, according to reports.

Eastport, Me.—Chas. E. Capen has purchased the plant of the Eastport Electric Light Co. It is stated that improvements will be made and additional machinery put in.

Bremen, Ind.—W. W. Watson, A. W. Ritchey and Harry Allmein are stated to have been appointed a committee to secure estimates for an electric light plant.

Berea, O.—The Council is said to be investigating the cost of putting in an electric light plant in connection with the water plant.

Roswell, N. M.—John J. Cooper, of Trinidad, Colo., has secured a franchise for the construction of an electric light plant.

Watertown, Wis.—F. C. Hartwig, Chairman of the Street Lighting Committee, informs us that the city has under consideration a municipal lighting plant and has instructed the committee to obtain estimates of the cost of a 100 arc light plant.

Wilmerding, Pa.—The North Versailles Township Light & Power Co., of North Braddock and Turtle Creek, is stated to have received a charter and will build a plant at this place and supply Turtle Creek, Wilmerding, Pitcairn and East McKeesport with light and power; capital, $15,000. E. W. Boyd, Pres.; Anthony Lewis, Secy.

Orillia, Ont.—The Central Construction Co., of Buffalo, is stated to have received the contract for an electric light plant here, to cost about $67,000.

Cincinnati, O.—See "Government Work."

Winona, Minn.—Geo. Z. Heuston, City Engr., writes that the project of installing a municipal electric light plant is in the hands of a Council committee.

Coshocton, O.—It is stated that plans and specifications are being prepared for an electric light plant; estimated cost, $15,000.

St. Regis Falls, N. Y.—The St. Regis Falls Electric Light Co. has been incorporated; capital, $2,000. Directors: H. E. O'Neill, Wm. T. O'Neill and Wm. B. Babcock.

Marshfield, Wis.—The Marshfield Water, Electric Light & Power Co. is stated to have received the contract for lighting the city for five years at $90 per lamp per year.

Tampa, Fla.—See "Electric Railways."

Massena, N. Y.—The Massena Electric Light & Power Co. has been incorporated; capital, $10,000. Directors: Thos. H. Gillespie, of New York City; Robt. Swan, of Massena, and others.

Hoboken, N. J.—Articles of incorporation were filed with County Clerk John Fisher, at Jersey City, Feb. 7, by the North River Light, Heat & Power Co.; capital, $300,000. The plant will be in Hoboken, and will furnish electricity to that city as well as to the towns of North Hudson. Incorporators: Arthur Seitz, W. C. Anderson and A. K. Bonta.

Grand Rapids, Mich.—Hauser, Hayden & Owen, of Grand Rapids, are stated to have received the contract for constructing the electric lighting station at $35,992.

Oakland City, Ind.—The Council is said to be considering the purchase of the electric light plant.

Richmond, Va.—H. L. Rice, Supt. Norfolk Gas Works, a gas expert, has examined the gas plant of this city and reports a recommendation to overhaul the plant at a cost of $12,000.

West Union, O.—H. S. Erimes, of Portsmouth, is stated to have petitioned for a franchise for an electric light plant.

Moorhead, Minn.—See "Water."

Halifax, N. S.—Bids are wanted March 8 for an electric light plant for the city, as advertised in "The Engineering Record."

Syracuse, N. Y.—Mayor McGuire, in his annual message, recommends the municipal ownership of the lighting plant.

Chicago, Ill.—The following bids are stated to have been received for installing electric light plants in the (a) Springfield Ave. and (b) Central Park Ave. pumping stations: Arthur Frantzen & Co., Chicago, a, $3,085; b, $3,000; Henry Newgard, a, $2,440; b, $2,200; Western Electric Co., New York, a, $2,381; b, $2,218; Roonheld & Gallery, a, $2,498; b, $2,388.

ELECTRIC RAILWAYS.

Sylvania, O.—Lester P. French is stated to have received a franchise.

Detroit, Mich.—It is reported that the Detroit Ypsilanti & Ann Arbor Electric Ry. Co. will expend about $400,000 on improvements.

Kalamazoo, Mich.—The Grand Rapids & Kalamazoo Electric Co. is stated to have applied for a franchise.

Huntington, W. Va.—A charter has been granted to the Huntington Connecting Ry. Co. to construct and operate a street railway in Huntington; capital $50,000. Incorporators: E. E. Canda, of New York; Ely Ensign and F. B. Enslow, of Huntington, and others.

Cambridge City, Ind.—The Cambridge City Interurban Traction Co. is stated to have been formed to construct an electric railway from this city to Milton, Dublin and East Germantown.

Indianapolis, Ind.—The County Commissioners are stated to have granted a franchise for an electric railway on the National road, east from Irvington to the county limits, to the Indianapolis, Greenfield & Eastern R. R. Co.

Easton, Pa.—A charter has been granted to the Nazareth Transit Co. to build and operate a street railway between Easton and Nazareth, a distance of about 8 miles; capital $48,000. Wm. J. Daub, Pres., Steelton.

Bethlehem, Pa.—Geo. H. Wolle, of Bethlehem; M. T. Swartz, of Nazareth; Andrew S. Keck, of Allentown, and others are stated to have received a charter for a trolley line from Bethlehem to Nazareth; capital, $60,000.

Neenah, Wis.—The Fox River Interurban Ry. will in all probability extend its line from Neenah to Oshkosh, Wis.

Massena, N. Y.—The Massena St. Ry. Co. has been incorporated to construct an electric railway 8 miles long; capital, $100,000. Directors: Thos. H. Gillespie, New York City; Robt. Swan, of Massena, and others.

Uniontown, Pa.—It is reported that surveys are being made for an electric line to connect Uniontown and Scottdale. Frank Hicks, of Pittsburg, is interested.

Washington, D. C.—The Capital Traction Co. is stated to have received permission to reconstruct its present U St. line and establish an underground electric system.

Tampa, Fla.—It is stated that Chester W. Chapin, Receiver of the Consumers' Electric Light & St. Ry. Co., will probably expend about $50,000 on improving the plant.

Sayreville, N. J.—The Township Committee is stated to have received a petition from the Sayreville Electric Light & Power Co. for a franchise for a trolley line from Sayreville to South Amboy. Sayre & Fisher, who conduct brick yards at the place, are said to be interested.

Dayton, O.—It is stated that Dr. J. E. Lowes, Pres. Western Traction Co., of Dayton, will shortly inspect the proposed route for an electric road from this city to Greenville, to be built this summer.

RAILROADS.

Erie, Pa.—Wellington Downing, Pres. of the Erie Traction Co., writes that bids will be asked in March for the construction of a line from Erie to Cambridge Springs. Probable cost, $300,000.

Pineapple, Ala.—The Southern Alabama R. R. Co. has been incorporated to construct a railroad in Wilcox, Monroe and Connecuh counties. Capital $50,000. Incorporators: J. M. Falkner, Montgomery; E. L. Moore, Nashville, Tenn.; H. Smith, Louisville, Ky., and others.

Savannah, Ga.—See "Miscellaneous."

Ft. Smith, Ark.—The Fort Smith & Western Railroad Co. has been incorporated to construct a line from Fort Smith to Kingfisher, I. T.; capital $5,000,000. Directors: Edgar E. Bryant and Geo. T. Sparks, Fort Smith, Ark.; George Hayden, Ishpeming, Mich.; Solomon S. Curry, Ironwood, Mich., and others.

Fairmont, W. Va.—A charter has been granted to the Riverside & Fairmont R. R. Co. to construct a railroad from Rivesville to Fairmont; capital $500,000. Incorporators: J. M. Guffey, Pittsburg; C. E. Reed and Frank Hayden, of Fairmont, and others.

Columbus, O.—The Columbus, Wellston & Southern R. R. Co. has been incorporated with a capital of $2,000,000. The line will run through Franklin, Fairfield, Pickaway, Hocking, Vinton and Jackson counties. Incorporators: M. W. H. Stevenson, J. O. Curry and others.

Chicago, Ill.—A charter has been granted to the Eastern Illinois & Missouri R. R. Co., with its principal office at Chicago, to build and operate a railroad to connect with the Chicago & Eastern Illinois Railroad; capital $50,000. Incorporators: Edw. H. Seneff, Don R. Patterson, Geo. H. Trenary and others.

Boundbrook, N. J.—The Middle Brook R. R. Co. has been incorporated to construct and operate a railroad about 1½ miles long in Somerset County; capital, $50,000. Incorporators: Stephens M. Williams, of Roselle; Saml. Knox, of Elizabeth; Geo. O. Waterman, of Red Bank, and others.

NEW DEPOTS.

Greensburg, Ind.—It is stated that the Southern Indiana R. R. Co. will erect new passenger and freight depots at this place.

Peoria, Ill.—It is stated that the Chicago, Rock Island & Pacific Ry. Co. will erect new freight houses and a new depot at this place in the spring.

PUBLIC BUILDINGS.

Newport, R. I.—Separate bids are wanted Feb. 21 for building a city hall, ventilating, heating, plumbing, electric wiring and gas piping for the same. Louis Shanteler, Chmn. pro. tem. City Hall Com.

Chicago, Ill.—The Falkenau Construction Co., 110 La Salle St., is stated to have received the contract for additions to the plant of the Western Electric Co. The buildings will all be fireproof and cost about $250,000.

Scranton, Pa.—A $200,000 Y. M. C. A. building is to be erected. No architect selected.

Philadelphia, Pa.—The plans of Edgar V. Seeler, 328 Chestnut St., are stated to have been accepted for a new church for the United First Baptist and Beth Eden congregations. Wm. A. Levering, Chmn. Bldg. Com.

Battle Creek, Mich.—It is reported that a $50,000 addition will be erected to the M. E. Church.

Ephraim, Utah.—R. C. Watkins, of Provo, is stated to have prepared plans for a $25,000 building to be erected for the Sanpete State Academy.

Brockton, Mass.—It is stated that a $50,000 Y. M. C. A. building is to be erected here.

Brooklyn, N. Y.—Geo. L. Morse, 303 Washington St., is stated to be completing plans for a 14-story office building for David G. Leggitt; estimated cost, $200,000.

Philadelphia, Pa.—The Select Council on Feb. 2 concurred in the ordinance to authorize a temporary loan of $200,000 for the equipment and building of the Philadelphia Museums.

Albany, N. Y.—It is stated that plans are being prepared for a $20,000 addition to St. Vincent's Male Orphan Asylum.

Austin, Ill.—The congregation of the First Methodist Church is stated to have decided to erect a $45,000 edifice.

Rutland, Vt.—It is stated that the city hall will be enlarged and improved at a cost of about $20,000.

Indianapolis, Ind.—The Joint Committee on Reformatories of the House and Senate is stated to have decided to recommend an appropriation of $200,000 for a 600 room cell house at the reformatory.

Chicago, Ill.—It is stated that the Merchants' Loan & Trust Co. will erect a new bank building; it will probably be 11 stories high. Orson Smith, Pres.

Boston, Mass.—Stephen Codman, 6 Beacon St., is preparing plans for an 8-story fire proof steel frame mercantile building, to be erected at 81 and 83 Essex St. Harry J. Carlson, 70 Kilby St., is drawing working plans for an entire interior reconstruction of Hotel Haymarket. The George A. Fuller Co. has secured the contract for the 11-story fire proof hotel on Atlantic Ave. Arthur H. Bowditch, Archt.; also the contract for the 5-story addition to R. H. White & Co.'s store Shepley, Rutan & Coolidge, Ames Bldg., are preparing plans for a 10-story mercantile building, to be erected on Chauncey and Essex Sts. by a syndicate, with Francis C. Welch and C. E. Cotting, Trustees.

Chicago, Ill.—Egan & Prindeville, 85 Dearborn St., are stated to have prepared plans for a $250,000 academy for the Sisters of Mercy.

Detroit, Mich.—Bids are wanted Feb. 23 for marble and scagliola work, iron work, etc., in the new Wayne County Building. Lou Burt, Chmn. Bd. County Auditors.

West Union, W. Va.—It is stated that an election will be held Feb. 28 to vote on issuing $25,000 bonds for a court house.

Sandersville, Ga.—J. H. McKenzie & Co. of Augusta are stated to have received the contract for enlarging the court house at $20,000.

Lestershire, N. Y.—Bids are wanted Feb. 13 for a fire station and municipal building. J. Lewis Weir, Archt.

Albany, N. Y.—The plans of Egerton Swartwout, 160 5th Ave., N. Y. City, are stated to have been accepted for a public bath house; probable cost, $21,500.

Syracuse, N. Y.—The First M. E. Society is stated to have decided to build a $60,000 church. Rev. C. H. Sims, Pastor.

Owatonna, Minn.—Hammell Bros., of Owatonna, are stated to have received the contract for the public library at $18,157.

Boone, Ia.—The plans of the Champion Iron Works of Canton, O., are stated to have been accepted for the jail; probable cost, $10,000.

Chicago, Ill.—The Chicago Telephone Co. is said to be considering the matter of erecting a $100,000 addition.

Des Moines, Ia.—The Foster & Liebbe Co. of Des Moines is stated to have been selected to prepare plans for the new Home for the Aged, to be erected on 28th St., to cost about $35,000.

Nacogdoches, Tex.—Bids are wanted March 1 for a church. June C. Harris, Secy. Bldg. Com.

Buffalo, Minn.—Bids are wanted Feb. 21 (readvertisement) for putting a steam-heating plant in the court house. H. S. Swanberg, Co. Aud.

Baltimore, Md.—The following bids were opened Feb. 1 by the Court House Commission for elevators for the court house; a, hydraulic; b, electric: Morse, Williams & Co., Baltimore, a, $33,500. Sprague Electric Co., New York, a, $32,625; b, $25,895. Bartlett, Hayward & Co., Baltimore, a, $32,900; b, $26,580.

Janesville, Wis.—The following bids are stated to have been opened Feb. 2 for the county jail: The Pauley Jail Building & Mfg. Co., St. Louis, Mo., *$20,950; R. G. Kirsch & Co., Milwaukee, $22,300; J. G. Wagner & Co., Milwaukee, $24,911; Philip Dean Appleton, Wis., $23,515; Champion Iron Wks., Canton, O., $21,688; Portsmouth Steel & Iron Co., Portsmouth, O., $22,408.

*Contract awarded.

FIRES.

Red Bluff, Cal.—The plant of the Tehama Electric Co., owned and operated by Jas. Cross of San Francisco, was burned Jan. 27. The plant was recently completed at a cost of about $30,000.

Philadelphia, Pa.—The carpet mills of Thos. Caves & Sons at Manayunk were burned Jan. 31; loss about $150,000.

Detroit, Mich.—The piano and organ factory of the Clough & Warren Co. is stated to have been damaged by fire Feb. 2 to the extent of about $100,000.

Iowa City, Ia.—The electric light plant at Coralville that supplied light to this place is stated to have been burned Jan. 31; loss about $15,000. D. F. Sawyer, Pres.

Dunkirk, Ind.—The Ohio Flint Glass Co.'s plant at this place was burned Jan. 30; loss, $50,000.

NEW INDUSTRIAL PLANTS.

T. R. Morse, New Iberia, La., will put up a 91x40-ft. ice factory, having a daily capacity of 10 tons.

J. F. Standley, Trinity, Tex., is in the market for a cotton gin outfit of 3 gins and a grist mill outfit.

W. T. Parham & Sons, Marysville, Tenn., will put up a 3-story 60x200-ft. woolen mill at South Knoxville, Tenn., and will want an engine of 150 to 200 H.-P., a pump, dynamo, heating system and sprinkler system.

The West Bay City Sugar Co., West Bay City, Mich., proposes putting up a plant for making 400 tons of beet sugar per day.

The Maryland Cement Co., Baltimore, Md., is to double the capacity of its plant at Sparrows Point, Md., and will install a new battery of boilers.

The La Grange Mills, La Grange, Ga., is to double the capacity of its cotton mill plant by the addition of a building 80x167 ft., at an approximate cost of $125,000, including machinery and engines.

The New Castle Shovel Co., New Castle, Pa., will put up a 275x80-ft. building and one 87x30 feet. The power plant will comprise two 100-H.-P. and one 50-H.-P. engines and two 150-H.-P. boilers.

The Brightman Mfg. Co., of Millersburg, O., is erecting a 60x124-ft. building which will increase its shafting output to 500 tons per month.

F. S. Hunt, Rutland, Mass., will put up a 4-story 30x102-ft. factory and will want a 35-H.-P. engine.

The Odell Manufacturing Co., Concord, N. C., is building a 126x215-ft. weave shed for 500 looms and will install a 150 H.-P. steam plant.

The Bristoe Company, of Waterbury, Conn., manufacturers of belt lacing and recording gauges, is about to double the capacity of its plant. The Berlin Iron Bridge Company has the contract for the building.

BUSINESS NOTES.

The Pawtucket Mfg. Co., Pawtucket, R. I., is erecting a 168 x 40-ft. addition to its bolt and nut works.

The General Electric Co. has received an order from the St. Anthony Falls Power Co., Minneapolis, for three 700 K.W. three-phase, revolving-armature generators with accessory machinery needed to bring the station up to the capacity of 10,000 H.P. originally contemplated. The present plant has been in operation nearly a year, furnishing current for the electric railways of St. Paul and Minneapolis.

On January 24, the city of Columbia, S. C., placed a contract with the Pittsburg Meter Co. for 1,293 disc water meters from ⅝ to 6 inches in size. The order is stated to be the largest ever given at one time in the South.

Mr. E. D. Johnston, of the P. H. & F. M. Roots Co., has closed a contract for a pumping plant at New Orleans, amounting to nearly $100,000. It will be filled with the company's well-known rotary positive pressure pumps.

The Prest Heating Co., 917 Walnut St., Kansas City, Mo., has decided to build a 160 x 42-ft. addition to its plant.

BUILDING INTELLIGENCE.

NEW YORK, N. Y.

S s Bond st, 576 e Broadway, br store and lofts; cost, $60,000; o, Catherine Taylor; a, Ralph S Townsend.

15-17 Water st, 110-122 Broad st, 16-18 Front st, br office and factory; cost, $164,994; o, Eldridge T Gerry; a, Ralph S Townsend; br, List & Lennon.

137 Goerck st, br stores and tenements; cost, $18,000; o, Abraham Perelman; a, Horenburger & Straub.

128-130 Allen st, br stores and flats; cost, $50,000; o, Jacob Fischel; a, Horenburger & Straub.

5-7 Maiden Lane, br and steel store and offices; cost, $30,000; o, Louisa M Gerry; a, John B Snook & Sons.

82 Chrystie st, br stores and flats; cost, $28,000; o, Julius Dreyfus; a, G. F. Pelham.

N e cor 54th st and 10th ave, br stores and flats; cost, $45,000; o, George A Fisher; a, G F Pelham.

S s 74th st, 40 w Park ave, 3 br dwell'gs; cost, $75,000 all; o and b, G C & C J Weber; a, Buchman & Deisler.

S s 95th st, 117 w Madison ave, 6 br dwellg's; cost, $104,000 all; o, P J Quirk; a, Henry Andersen.

S s 114th st, 100 e 8th ave, 10 br tenem'ts; cost, $160,000 all; o, Daniel D Lawson; a, Jno P Leo.

W s 5th ave, 100 s 116th st, 2 br stores and flats; cost, $50,000 all; o, John V Signell; a, Neville & Baggs.

S s 122d st, 150 e 8th ave, 3 br flats; cost, $32,000 all; o, Marcus Hoffberg; a, G F Pelham.

S s 137th st, 274 w 7th ave, 3 br dwell'gs; cost, $60,000 all; o, Jas C Picken; a, John Hauser.

W s Rider ave, 330 n 138th st, br laundry; cost, $20,000; o, Patrick Donahue; a, W C Dickerson.

W s Eagle ave, 100 s Westchester ave, br flat; cost, $20,000; o and a, A Rothermel.

E s St Ann's ave, 554 s 156th st, 4 br flats; cost, $48,000 all; o, E Seiber; a, John H. Knubel.

ALTERATIONS.

7 E 80th st, extensions and alterations; cost, $12,000; o, Isabella B Satterthwait; a, Wm Strom.

1514 Broadway, interior alterations; cost, $25,000; o, The Fifth Ave Real Estate Co.; a, Farnsworth & Miller.

E s 6th ave, 18th and 19th sts, extension; cost, $100,000; o, Siegel-Cooper Co.; a, De Lemos & Cordes.

141-143 5th ave, interior alterations; cost, $20,000; o, N L McCready; a, H Edwards Ficken.

MISCELLANEOUS.

Carbondale, Pa.—Trinity Church; cost, $30,000; a, not selected.

Newport News, Va.—27th and Washington av, 6-story br and stone offices; cost, $30,000; a, M J Dimmock, Richmond, Va. LaFayet av, br and stone synagogue; cost, $11,000; o, Jewish congregation; a, W D Hill.

Pueblo, Colo.—Union av, stone bldg; cost, $20,000; o, Atchison, Topeka & Santa Fe Railroad Co.

Worcester, Mass.—Tumbull Sq, 2 apart. blks; cost, $35,000; o, Dis, J H Kelley & W J Delehanty; a, Barker & Nourse. Millbury st, 6-rm school H; cost $20,000; o, City of Worcester; a, Barker & Nourse. Union st, factory ad; cost, $18,000; o, Wire Goods Co.; a, Barker & Nourse.

PROPOSALS OPEN.

Bids Close. — See Eng. Record.

WATER-WORKS.

Feb. 13. Bonds, Reno, Nev ... Dec. 24
Feb. 13. Pipe, etc., Hastings, Neb. ... Jan. 28
Feb. 13. Pipe, Cincinnati, O ... Feb. 11
Feb. 15. Pipe, Chicago, Ill ... Feb. 11
Feb. 15. Tuskegee, Ala ... Feb. 4
Adv., Eng. Record, Feb. 4, 11.
Feb. 16. New York, N. Y ... Feb. 4
Feb. 18. Fort Meade, S. Dak ... Jan. 28
Feb. 18. Spring Lake, N. J ... Jan. 28
Adv., Eng. Record, Jan. 28, Feb. 4.
Feb. 20. Elhart Lake, Wis ... Jan. 28
Feb. 20. Valves, etc., Victoria, B. C ... Feb. 11
Feb. 20. Moorhead, Minn ... Feb. 11
Feb. 21. Honolulu, Hawaiian Is ... Jan. 14
Adv., Eng. Record, Jan. 14 to 28.
Feb. 24. Valves, etc., Cleveland, O ... Feb. 4
Feb. 25. Whitehall, Ill ... Feb. 11
Mar. 1. Oto, Ia ... Jan. 21
Mar. 1. Amsterdam, N. Y ... Feb. 4
Adv., Eng. Record, Feb. 4, 11.
Mar. 1. Mt. Pleasant, Mich ... Feb. 11
Mar. 3. Keshena, Wis ... Feb. 11
Mar. 4. Bonds, Cincinnati, O ... Feb. 11
Mar. 6. Jamesburg, N. J ... Feb. 11
Adv., Eng. Record, Feb. 11.
Mar. 7. Pipe, etc., Everett, Mass ... Feb. 11
Adv., Eng. Record, Feb. 11.
Mar. 8. Bonds, McConnellsville, O ... Feb. 11
Mar. 11. Washington, D. C ... Feb. 11
Adv., Eng. Record, Feb 11.
Mar. 15. Belem, Para, Brazil ... Nov. 26
Mar. 15. Pipe, etc., Fayetteville, Ten ... Feb. 11
Apr. 3. Winnepeg, Man ... Feb. 4
Adv., Eng. Record, Feb. 4, 11.

SEWERAGE AND SEWAGE DISPOSAL.

Feb. 13. Indianapolis, Ind ... Feb. 11
Feb. 14. Dayton, O ... Feb. 11
Feb. 14. Bonds, Grass Valley, Cal ... Feb. 4
Feb. 15. Buffalo, N. Y ... Feb. 4
Feb. 15. Chicago, Ill ... Feb. 11
Feb. 15. New York, N. Y ... Feb. 11
Feb. 17. Cleveland, O ... Feb. 11
Feb. 20. Bonds, Cleveland, O ... Jan. 14
Feb. 20. Toledo, O ... Feb. 11
Feb. 20. Albany, N. Y ... Feb. 11
Feb. 21. Bonds, Mt. Vernon, N. Y ... Feb. 4
Feb. 28. Steelton, Pa ... Feb. 11
Adv., Eng. Record, Feb. 11.
Mar. 1. Mt. Pleasant, Mich ... Feb. 11
Mar. 3. Keshena, Wis ... Feb. 11
Mar. 3. Cincinnati, O ... Feb. 11
Mar. 3. Cleveland, O ... Feb. 11
Mar. 6. Woonsocket, R. I ... Feb. 4
Adv., Eng. Record, Feb. 4, 11.
Mar. 7. Niles, O ... Feb. 11
Mar. 9. Norfolk, Va ... Feb. 11
Adv., Eng. Record, Feb. 11.

BRIDGES.

Feb. 15. Seneca, Kan ... Jan. 28
Feb. 15. Adrian, N. Dak ... Jan. 28
Feb. 15. Helena, Ark ... Jan. 28
Feb. 16. New York, N. Y ... Feb. 4
Feb. 17. St. Joseph, Mo ... Feb. 11
Feb. 18. New York City ... Feb. 11
Adv., Eng. Record, Feb. 11.
Feb. 20. Abutments, Boston, Mass ... Feb. 11
Feb. 20. Rockford, Ill ... Jan. 28
Adv., Eng. Record, Jan. 28.
Feb. 20. Chicago, Ill ... Dec. 31
Adv., Eng. Record, Dec. 31.
Feb. 24. Hamilton, O ... Feb. 4
Feb. 27. Monticello, Mo ... Feb. 4
Mar. 1. Quebec, Que ... Jan. 7
Mar. 2. Shreveport, La ... Jan. 21
Mar. 9. Shreveport, La ... Feb. 11
Mar. 15. Chicago, Ill ... Jan. 21
Adv., Eng. Record, Jan. 21.
Apr. 1. Substructure, St. Joseph, Mo ... Jan. 7
—— Spring Lake, N. J ... Jan. 7

PAVING AND ROADMAKING.

Feb. 13. Lebanon, Ind ... Feb. 11
Feb. 14. Jersey City, N. J ... Feb. 11
Feb. 14. St. Louis, Mo ... Jan. 21
Feb. 15. Cleveland, O ... Jan. 21
Feb. 15. Toronto, Ont ... Feb. 11
Feb. 16. Decatur, Ind ... Jan. 14
Feb. 16. Cleveland, O ... Feb. 4
Feb. 16. Scranton, Pa ... Feb. 11
Feb. 17. Philadelphia, Pa ... Feb. 11
Feb. 17. Cleveland, O ... Jan. 28
Feb. 18. Cleveland, O ... Feb. 11
Feb. 20. Geneva, N. Y ... Jan. 28
Adv., Eng. Record, Jan. 28 to Feb. 11.
Feb. 20. Anderson, Ind ... Feb. 4
Feb. 21. Atlantic City, N. J ... Feb. 11
Feb. 22. Bedford, Ind ... Jan. 28
Feb. 23. Fulton, N. Y ... Feb. 11
Adv., Eng. Record, Feb. 11.
Feb. 27. Yonkers, N. Y ... Dec. 3
Feb. 27. Portsmouth, Pa ... Feb. 4
Mar. 1. Bonds, Bridgeport, O ... Feb. 4
Mar. 1. Batavia, O ... Feb. 11
Mar. 1. Bonds, Zanesville, O ... Feb. 11
Mar. 2. Cleveland, O ... Feb. 4
Mar. 3. Bedford, Ind ... Feb. 11
Mar. 4. Washington, D. C ... Feb. 4
Adv., Eng. Record, Feb 4.
Mar. 4. Cleveland, O ... Feb. 11
Mar. 7. Joplin, Mo ... Feb. 4
Mar. 7. Cleveland, O ... Feb. 11
Mar. 11. Woodbury, N. J ... Feb. 11

POWER, GAS AND ELECTRICITY.

Feb. 13. Gas plant, Pawhuska, O. T ... Jan. 21
Feb. 14. Wiring, etc, St. Albans, Vt ... Feb. 4
Feb. 14. Conduits, etc., Akron, O ... Feb. 4
Feb. 14. Conduits, etc., Pottsville, Pa ... Feb. 4
Feb. 15. Tuskegee, Ala ... Feb. 4
Adv., Eng. Record, Feb. 4.
Feb. 15. Baltimore, Md ... Feb. 4
Adv., Eng. Record, Feb. 4, 11.
Feb. 17. Fixtures, Savannah, Ga ... Feb. 11
Feb. 20. Moorehead, Minn ... Feb. 11
Feb. 20. New York, N. Y ... Feb. 4
Feb. 27. Vincennes, Ind ... Feb. 11
Adv., Eng. Record, Feb. 11.
Feb. 28. Darlington, O. T ... Feb. 4
Mar. 1. Sault Ste. Marie, Mich ... Dec. 24
Mar. 1. Spartanburg, S. C ... Jan. 14
Adv., Eng. Record, Jan. 14 to Feb. 11.
Mar. 6. Portland, Me ... Feb. 4
Adv., Eng. Record, Feb. 4.
Mar. 8. Halifax, N. S ... Feb. 11
Adv., Eng. Record, Feb. 11.
Mar. 31. Telephone, Shanghai, China ... Nov. 19
—— Pleasantville, O ... Dec. 24

GOVERNMENT WORK.

Feb. 13. New Orleans, La ... Jan. 14
Adv., Eng. Record, Jan. 14 to 28.
Feb. 14. Wiring, etc., St. Albans, Vt ... Feb. 4
Feb. 14. Conduits, etc., Pottsville, Pa ... Feb. 4
Feb. 14. Conduits, etc, Akron, O ... Feb. 4
Feb. 16. Buildings, Annapolis, Md ... Jan. 28
Feb. 16. Duluth, Minn ... Jan. 21
Adv., Eng. Record, Jan. 21 to Feb. 11.
Feb. 18. Philadelphia, Pa ... Feb. 4
Feb. 21. Wreck, Boston, Mass ... Jan. 21
Feb. 21. Savannah, Ga ... Jan. 28
Adv., Eng. Record, Jan. 28, Feb. 4.
Feb. 23. Kansas City, Mo ... Jan. 28
Adv., Eng. Record, Jan. 28, Feb. 4.
Mar. 1. New York City ... Feb 4
Adv., Eng. Record, Feb. 4, 11.
Mar. 3. Water, etc., Keshena, Wis ... Feb. 11
Mar. 4. San Francisco, Cal ... Feb. 11
Mar. 6. Portland, Me ... Feb. 4
Adv., Eng. Record, Feb. 4, 11.
Mar. 7. Camden, N. J ... Feb. 11
Adv., Eng. Record, Feb. 11.
Mar. 8. Wharf, Rockpoint, Md ... Feb. 11
Mar. 8. New York, N. Y ... Feb. 11
Adv., Eng. Record, Feb. 11.
Mar. 10. New York City ... Feb. 11
Adv. Eng. Record, Feb. 11.
Mar. 10. Baltimore, Md ... Feb. 11
Adv., Eng. Record, Feb. 11.
Mar. 15. San Francisco, Cal ... Feb. 11
Apr 6. New Orleans, La ... Feb. 11
Adv., Eng. Record, Feb. 11.
Apr. 6. Dredgeboat, Sabine Pass, Tex ... Feb. 11

BUILDINGS.

Feb. 13. Rock Springs, Tex ....Jan. 14
Feb. 13. Birmingham, Ala..........................Feb. 4
Feb. 13. Lestershire, N. Y..........................Feb. 11
Feb. 14. School, New York, N. Y..............Feb. 4
Feb. 14. Plans, White Plains, N. Y ....Feb. 4
Feb. 15. School, Foxhome, Minn...............Feb. 11
Feb. 15. School, Ironton, Mich...................Feb. 4
Feb. 16. School, Ellendale, N. D..................Jan. 7
Feb. 16. Buckhannon, W. Va......................Jan. 21
Feb. 16. School, Piermont, N. Y.................Feb. 4
Feb. 17. Chicago, Ill ....Feb. 11
Feb. 20. School bonds, Freemont, Neb.......Feb. 11
Feb. 21. School, New York, N. Y...............Feb. 11
Feb. 21. Heating, Buffalo, Minn................Feb. 11
Feb. 21. School, Columbus, O....................Feb. 11
Feb. 21. School bonds, Columbus, O ....Feb. 11
Feb. 21. Newport, R. I...............................Feb. 11
Feb. 22. Plans, etc., Alexandria, La ....Feb. 4
Feb. 23. Detroit, Mich ....Feb. 11
Feb. 23. School, Flandreau, S. D.................Feb. 4
Feb. 25. School, Cleveland, O.....................Feb. 4
Feb. 25. Douglass, Ga.................................Dec. 31
Mar. 1. Arkadelphia, Ark...........................Jan. 14
Mar. 1. Macogdoches, Tex...........................Feb. 11
Mar. 6. School, Eau Claire, Wis.................Jan. 28
Mar. 8. Aberdeen, S. Dak...........................Jan. 28
Mar. 15. Plans, Wilkesbarre, Pa..................Jan. 28
Apr. 3. Many, La...Jan. 21
Apr. 14. Plans, Bradford, England..............Jan. 21

MISCELLANEOUS.

Feb. 13. Ditches, New Madrid, Mo..............Feb. 4
Feb. 15. Canal, Albuquerque, N. Mex ....Jan. 21
Feb. 15. Shaft, Centralia, Pa.......................Feb. 4
Feb. 14. Dredging, etc., Savannah, Ga.........Feb. 11
Feb. 16. Garbage, Meriden, Conn ....Feb. 11
Feb. 16. Columbus, O ....Feb. 4
Adv., Eng. RECORD, Feb. 4, 11.
Feb. 17. Garbage disposal, Atlanta, Ga........Feb. 11
Feb. 20. Newark, N. J ....Jan. 21
Adv., Eng. RECORD, Jan. 21 to Feb. 4.
Feb. 20. Boston, Mass ....Feb. 4
Feb. 21. Boston, Mass.......................................Feb. 4
Adv., Eng. RECORD, Feb. 4, 11.
Feb. 21. Cement, etc., New York, N. Y.........Feb. 11
Feb. 25. Garbage disposal, Allenton, Pa......Feb. 11
Mar. 4. Washington, D. C ....Feb. 11
Adv., Eng. RECORD, Feb. 11.
Mar. 7. Street cleaning, Cleveland O..........Feb. 4
Mar. 15. El. Ry., Shanghai, China..............Nov. 19

NEW SCHOOLS.

Ft. Madison, Ia.—Martin Heer, Archt., of Dubuque, has about completed plans for a brick school. Estimated cost, $25,000.

New Wilmington, Pa.—The plans of C. C. Thayer, New Castle, Pa., are stated to have been accepted for a $30,000 school.

Foxhome, Minn.—Bids are wanted Feb. 15 for a school. Peter D. Reed, clk.

Milton, Ore.—The citizens are stated to have voted to issue $12,000 bonds for a school.

Columbus, O.—Bids are wanted Feb. 21 for $65,000 school bonds. G. T. Chamberlain, Chmn. Finance Com.

North Baltimore, O.—It is stated that an election will be held Feb. 13 to vote on erecting a $15,000 school.

West Hoboken, N. J.—School bonds amounting to $45,000 have been sold.

Rochester, N. Y.—The School Board is stated to have asked for an appropriation of $40,000 to build School No. 12 and for an appropriation to build additions to 12 schools.

Chicago, Ill.—Bids are wanted Feb. 17 by the Business Manager of the Board of Education for alterations in the Darwin School; also for ventilating, heating, plumbing, etc., in the Darwin School and Cooper Kindergarten.

Wells, Minn.—The citizens are stated to have voted to erect a 14-room school, to cost about $23,000.

New York, N. Y.—Bids are wanted Feb. 21 for school No. 170, in Manhattan Borough, and for alterations, repairs, etc., to school No. 20 in Richmond Borough. John E. Eustis, Chmn. Com. on Bldgs.

Fremont, Neb.—It is stated that bids are wanted Feb. 20 for $250,000 school bonds.

Meriden, Conn.—Bids are wanted Feb. 16 for the removal of garbage twice each week for one year. E. S. Smith, Chmn. Bd. Health Com.

Allentown, Pa.—It is stated that bids are wanted by the Mayor Feb. 25 for the removal of garbage.

Louisville, Ky.—The Board of Public Works will at an early date advertise for bids for the construction of a garbage incinerator capable of burning not less than 250 tons of garbage and waste per day. Thos. P. Craig, Secy. Bd. of Pub. Wks.

GOVERNMENT WORK.

Rockpoint, Md.—Bids are wanted March 8 for a wharf. Col. Peter C. Hains, Corps Engrs., U. S. A., Baltimore, Md.

Keshena, Wis.—Bids are wanted March 3 for water and sewer systems in the Menomonee Boarding School, Green Bay Agency. W. A. Jones, Commr. of Indian Affairs, Dept. of the Interior, Washington, D. C.

Sabine Pass, Tex.—Bids are wanted April 6 for building a dredge-boat for improving the harbor. Maj. James B. Quinn, Corps Engrs., U. S. A., New Orleans, La.

Cincinnati, O.—Collector Voight, Custodian of the Federal Building, is stated to have forwarded to Washington a formal request for a new electric light plant; estimated cost, $35,000.

Chicago, Ill.—The track elevation ordinance of the Fort Wayne and Western Indiana railroads has been recommended for passage by the track elevation committee of the Council.

New York, N. Y.—Bids are wanted Feb. 21 for furnishing 100,000 gals. No. 6 paving cement, 20,000 cu. yds. sand and 2,000 cu. yds. washed gravel. James P. Keating, Commr. of Highways.

Duluth, Minn.—The following bids were opened Feb. 3 by Major Clinton B. Sears, Corps of Engrs., U. S. A., for dredging in Portage Lake Ship Canals, Mich., as advertised in "The Engineering Record":

Name and address of bidder.	Per cu.yd.scow meas. Section 1. 476,081 cu yds. Cts	Section 2. 1,256,751 cu. yds. Cts.	Use of Dredging plant. Hr.	Total.
Duluth Dredge & Dock Co., Duluth, Minn	.27	.15	$12 00	$317,054.5
James Pryor, Houghton, Mich	.24	.12	10.00	265,069.5
S. O. Dixon, Racine, Wis	.26	.12½	12.50	280,874.9
Hingston & Woods, Buffalo, N Y	.11	.09	{12.00 / 30 00}	165,476.5
Carlin, Stickney & Cram, Detroit, Mich	15	.11	14.00	209,651.7
Lydon & Drews Co., Chicago, Ill	11.90	.10	15.00	182,328.7
John H. Gillett, Marquette, Mich	17½	.12½	15 00	240 408.
Arthur H. Vogel, Milwaukee, Wis	.27	.13½	15 00	298,203.2
Adolph F. Bues, Milwaukee, Wis	.26	.13	12.00	287,158.6

Duluth, Minn.—The following bids were opened Feb. 1 by Major Clinton B. Sears, Corps of Engrs., U. S. A., for the substructure for north pier, Duluth Ship Canal, as advertised in "The Engineering Record":

The reference letters indicate the amount of work to be done, etc., as follows: A, price per cu. yd., scow measurement, for 20,000 cu. yds. of dredging; B, price per 1,000 ft. B. M., for 25,000 ft. pine or fir timber, in place; C, price per lin. ft for 15,000 lin. ft. round pile, in place; D, price per pound for 8,400 lbs. machine bolts, in plac ; E, price per pound for 1,800 lbs. cast or wrought iron washers, in place; F, price per lin. ft. for 1,800 ft. wire rope; G, price per ton of 2,000 lbs. for 32,000 tons rock, in place; H, price per cu. yd. for 7,000 cu. yds. gravel, in place; I, price per hour for use of dipper dredge plant; J, price per hour for use of pile driver plant; K, total cost of 1,722 lin. ft. of canal pier cribs, in place; L, reduction in cost of 1,722 lin. ft. of cribs if patch bolting under water is omitted:

	A Cts.	B	C Cts.	D Cts.	E Cts.	F Cts.	G	H Cts.	I	J	K	L	Totals— With under water patch bolting.	Without under water patch bolting.
Engle, Osman & Schleunes, Duluth, Minn	27	$20.00	.15	.02	.02	.25	$0.85	.70	$16.50	$6.00	$184,792.46	$182,552.46	$228,146.46	$225,906.46
Butler-Ryan Co., St. Paul, Minn	.20	20.00	.11	.02¼	.01¼	.18	.83	.60	15.00	5.00	121,250 00	5.0 00	160,833.00	16 ,333.00
The Barnett & Record Co., Minneapolis, Minn	.26	18 00	.10$\frac{3}{10}$	.02	.01¾	.15	.90	.95	15.00	6.00	147 000 00	1 000.00	192,114.50	191,414.50
King & Steele, Duluth, Minn	.15	22 60	.11	03¼	.02	.10	1.00	.70	15.00	7.25	167 844 00	165,000.00	212,858 0	20 ,014.00
Lang & Stone, St. Paul, Minn	.25	19.25	.12	.03	.01¾	.12	.90	.51	15.00	6.00	186,619.00	18 ,523.00	229,049.75	223,92 .75
Hugo & Tims, Duluth, Minn	.25	20.00	15	.03	.02	.10	.70	.40	15 00	5.00	134,422.00	132,630.00	169,940.00	163,148.00
P. McDonnell, Duluth, Minn	.11	20.00	.12	.01¾	.01½	.10	.70	.30	20.00	8.00	116,500.00	116,000.00	148,965.5	148,465.50

Amount proposed to be expended on this work, about $175,000.

New York, N. Y.—Bids are wanted March 8 for rip-rap wall at Fort Hancock, N. J., as advertised in "The Engineering Record."

San Francisco, Cal.—Bids are wanted March 4 for officers' quarters at the Navy Yard, Mare Island. Mordecai T. Endicott, Ch. Bureau of Yards and Docks, Navy Dept., Washington, D. C.

New York, N. Y.—Bids are wanted March 10 for furnishing American Portland cement at Forts Schuyler and Totten, N. Y., as advertised in "The Engineering Record."

San Francisco, Cal.—Bids are wanted March 15 for constructing a barracks and boiler house for the U. S. naval training station on Yerba Buena Island. A. S. Crowninshield, Ch. Bureau of Navigation, Navy Dept., Washington, D. C.

Camden, N. J.—Bids are wanted March 7 by the Superv. Archt., Treas. Dept., Washington, D. C., for ventilating and heating apparatus for the U. S. Post Office and Custom House, etc., as advertised in "The Engineering Record."

Baltimore, Md.—Bids are wanted March 10 for furnishing and delivering at Hawkins Point, North Point, Rock Point and Fort Carroll cement, stone, brick, iron beams and lumber, as advertised in "The Engineering Record."

Philadelphia, Pa.—The following bids were opened Feb. 7 by the Board of Public Education: A, according to plans and specifications; B, substituting brick for granite; C, omitting cement yard and pavement;

Bidders. Addresses.	New 15 Division School Bldg., 16th & Porter Sts. A	B	C Deduct	New 15 Division School Bldg., Ontario & G Sts. A	B	C Deduct	Additions to Jas. G. Blain School.
H. C. Nichols Co., 2030 Market St	$85 000	$79 870	$1,375	....	.	....	$32,533
Doyle & Doak, 1509 Sansom St	76,250	72,600	6,900	$75,860	$71,700	$5,840	....
J. E. & A. L. Pennock, 305 Walnut St.	87,480	87,900	6,000	84,840	85.300	4,600	....
Chas. McCaul, 10 W. 11th St	83,750	82,735	7,501	80,700	79,685	5,500	..
Wm. R. Dougherty, 1604 Sansom St.	79.846	78,846	7,000	77,899	76,899	5,000	32,668
Thos. Gamon, 1629 Christian St	73,000	72,500	2,600	....	......	......	....
Geo. W. Pierson, Lippincott Bldg	79.999	78,600	5,475	79 292	77,492	5 500	....
R. C. Ballinger, 218 N. 13th St	83,338	80,938	7,250	74,700	73,400	3,500	.
Sam'l Gourley, Jr, 21st St. & Ridge Av.	..	....	....		.....	....	32,987
Hiram Miller, 307 Fidelity Bldg	77,765	76,565	5,250	74,480	73,380	4,700	34,290
Wm. Christy, 1606 Wharton St	79.566	71,166	......	......	......	......	......
H. Brocklehurst, 514 Norris St	82,178	......	5,200	78,341	......	......	3 .133
Chas. O'Neill, 12 6 S. Broad St	79,500	......	7,800	.....	......	.....	29 871
Thos. M. Seeds, Jr., 1216 Race St	......	......	......	78,780	78,777	4.800	....
Michael O'Rourke, Fidelity Bldg	......	.....	......	87,000	86,500	5,000	......
Philip Ames Co., Bourse Bldg	.....	......	......	......	......	......	31,600
Thos. C. Trafford, 2335 N. 15th St.	......	......	......	......	......	......	32,245

Montevallo, Ala.—The House is stated to have passed a bill appropriating $15,000 for additional buildings for the Girls' Industrial School.

Columbus, O.—Bids are wanted Feb. 21 for erecting the South High School. C. E. Morris, Chmn. Com. on Bldgs.

STREET CLEANING AND GARBAGE DISPOSAL.

Aurora, Ill.—The Board of Health is considering the proposition to build an incinerator.

Houston, Tex.—The Special Committee has recommended the purchase of a crematory of 100 tons capacity to dispose of sewage and garbage.

Atlanta, Ga.—Bids are wanted Feb. 17 by the Board of Health for garbage disposal.

Boston, Mass.—The contract for a dry dock at the Boston Navy Yard has been awarded to O'Brien & Sheehan, of New York City, for $857,200. For list of bids received see our issue of Feb. 4.

The contract for the electrical appliances will be awarded to the lowest bidder, the Thresher Electric Co., Dayton, O.

Algiers, La.—Press reports state that the contract for a combined floating and graving steel dry dock has been awarded to the Maryland Steel Co., Sparrows Point, Md., for $810,000. For list of bids received see our issue of Dec. 3, 1898.

New Orleans, La.—Bids are wanted at the U. S. Engineer Office until April 6 for building dredge-boat for improving harbor at Sabine Pass, Tex., as advertised in "The Engineering Record."

MISCELLANEOUS.

Washington, D. C.—Bids are wanted March 4 for quarrying and crushing stone, as advertised in "The Engineering Record."

Brooklyn, N. Y.—The Sinking Fund Commission has authorized an issue of $2,000,000 bonds for the use of the Department of Docks and Ferries.

Savannah, Ga.—Bids are wanted Feb. 14 for dredging, pile driving and bulkhead work on Hutchinson's Island. A. H. Johnson, Ch. Engr. of the Georgia and Alabama Terminal Co.

Cleveland, O.—The Park Board is about to advertise for bids for the issue of $500,000 park bonds, half of the proceeds of which will be devoted to the West Side boulevard and half to new park work in the remainder of the city.

New York City, N. Y.—The Park Commissioner for the Bronx has been empowered to spend $30,000 in improving Crotona Park.

Winona, Minn.—Press reports state that the Jaeger Land Co., of Dubuque, Ia., has received the contract for river work between Winona and La Crosse amounting to $60,000. J. Luxem, of Winona, will have charge of the work.

Proposals continued on pages xi and xii.

THE ENGINEERING RECORD.
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TABLE OF LEADING ARTICLES.

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POOR TREATMENT FOR A CITY ENGINEER.

It is with surprise and regret that "The Engineering Record" learns of a particularly mean piece of peanut politics concerning the City Engineer's office in Altoona, Pa. For a number of years this office has been filled with credit to the city and himself by Mr. Harvey Linton, M. Am. Soc. C. E. His work has been described in the columns of this paper on a number of occasions. Some years ago this gentleman had the misfortune to arouse the ill feeling of a councilman by objecting to the illegal purchase of cement by the city from a firm in which this official was interested. Apparently this action has resulted in chronic ill-will toward Mr. Linton, for, in spite of the protest of the daily papers of the city, steps have been taken to force him out of office, which can be designated by no other term than contemptible. His professional work has been so high that it was impossible to bring any charges of incompetence against him which could be successfully maintained, so they have adopted plans of driving him out by reducing his salary from $2,000 to $1,200.

It is difficult to understand how councilmen posing as representatives of the people can take a step which is so directly inimical to the interests of the city. No good city engineer regards public office as a private snap. He has little or nothing to do with politics. He does not expect to be paid more than a fair salary for the work he does and the responsibility he bears. If any one believes, however, that the City Engineer of Altoona does not more than earn the $2,000 formerly paid him it will be well for him to examine the duties of this officer.

In the first place, the city engineer has designed and built a sewage disposal system of considerable magnitude, illustrated in these columns on August 7, 1897. These works are under his supervision and their proper care requires careful attention and engineering knowledge which are themselves worth a comparatively large sum to the city. The sewerage system, moreover, is designed, constructed and maintained under his care, and the problem of storm-water drainage soon to be taken up in that city will demand a thorough familiarity with local conditions and engineering methods. The paving of the city is also in his charge. All the surveys for determining street lines and grades are made by him. Building materials are tested under his direction. Maps of the city and the legal records of final results in all questions concerning street lines and grades are made by him. A man with the training and experience to enable him to look after these subjects satisfactorily is certainly worth more to the city than $2,000 a year.

It is easy to show this. Assume that a political incompetent succeeds Mr. Linton and designs a system of storm-water sewers. Any lawyer in Altoona will say that the city is putting in the hands of this man the possibility of involving it in law suits causing an expenditure of many thousands of dollars, owing to flooded property, caused by poor designs and construction. Anyone who knows the difficulties arising from faulty surveys of streets and property lines, poor grades and defective official records of surveys can tell the people of this Pennsylvania city what they may expect from parsimony in dealing with the salary of the city engineering force. If the councilmen of Altoona, who are so anxious to save $800 for the good of the city by reducing the salary of its city engineer, will take the trouble to investigate the possible results of bad management of the sewage farms they will probably be convinced that their plan is a penny-wise pound-foolish scheme. In this connection the words of the Altoona Evening Gazette are certainly commendable: "Councils can ill afford to trifle with the city engineer's department. No branch of the municipal government is of more importance to the welfare of the community, and in no office is there need for so high a degree of technical skill. Incompetent administration is the logical outcome of excessive cheese paring, and a cheap engineering service is calculated to be a source of great expense."

THE CONNECTICUT SEWAGE COMMISSION.

Two years ago the General Assembly of Connecticut passed a bill authorizing the Governor to appoint a commission of five persons, to serve without pay other than their expenses, to investigate the sewage disposal of the cities, boroughs and towns of the State. The commission was given power to summon witnesses, and its expenses to be paid by the State were restricted to $1,000 in any one year. Any town, city or borough was given the authority to consult the commission and obtain its advice concerning sewerage and sewage disposal systems. The Governor appointed as members of this commission, Dr. Edward H. Jenkins, of New Haven; Robert A. Cairns, of Waterbury; John S. Cheney, of South Manchester; Dr. John N. Woodruff, of Sherman, and Fayette L. Wright, of Pomfret Center, making it a representative body of the professional and business interests directly concerned in such subjects.

There are eighteen cities (in Connecticut) which have a population of about 481,000, more than half the total population of the State. All have water supplies and all but one have sewerage systems. Meriden and Danbury purify their sewage by land filtration; the others discharge their sewage into waterways. Of the twenty-two boroughs in Connecticut, seventeen have water supplies and eight have more or less of a sewerage system. Of these Bristol and Litchfield purify their sewage by land filtration; in the other places the sewage is discharged either into swamps or waterways. In addition to these communities, seven towns have water supplies and some sanitary sewers. There are twenty-one other towns with water supplies but no sewers. In addition to these public works there are also many private drains conducting factory wastes into the water courses, the amount of these wastes from a single manufacturing plant frequently being as great as the sewage of a village of considerable population and containing much more organic matter than the same volume of town sewage. Waste liquors from tanneries, wool-scouring establishments and paper mills are notoriously difficult to treat. The commission find that all the large streams in the State are so polluted as to be non-potable and their waters can never be used for domestic supplies unless filtered through sand. While some of these rivers have not yet become so clogged with sewage as to be public nuisances, others have either reached the limit of permissible pollution or have so far passed it that suits are being brought with increasing frequency for relief from nuisance. The commission states that in every case in their knowledge the courts have found for the plaintiff against such pollution, and have rendered decisions strongly upholding the rights of a single riparian owner against the convenience and financial interest of a large community.

The commission has recently printed a preliminary report, a document of great value which should be published in some form so that it can be bought by people of other States interested in this important subject. The conclusions reached by its studies, and it should be said in passing that the reasons for these conclusions are stated with great clearness and at some length in the report, are:

The disposal of sewage without nuisance is a duty which each community owes to the public. It is a problem to be settled by each community for itself, under such state supervision and control as is necessary in the public interest. In some cases, however, several communities lying in the same topographical district may profitably unite in the construction and operation of a common outfall sewer or disposal works.

No city, borough or town which has not now a sewerage system should be allowed hereafter to build one which will discharge the sewage or polluted waters into any stream, whether such stream at the time is used by others for sewage disposal or not; nor should private corporations or individuals be allowed to discharge house sewage into any streams or rivers.

To insure sewerage construction and methods of sewage disposal which will be permanently satisfactory, the general assembly should not grant to any corporation authority to issue bonds for buildings or to condemn lands for building, or to build any sewers or systems of sewers until an accurate topographical survey of the region to be sewered has been made, and, together with plans for effective sewerage purification, before discharging the effluent into any stream has been submitted to and approved by some competent State authority.

Provision should also be made by which cities and boroughs now having sewage disposal works, or which may hereafter build them, may be compelled by the State to so manage them that the sewage shall at all times be effectively purified before its discharge into rivers.

One of the features which aroused considerable discussion at the time of the passage of the act instituting the Commission was the provision authorizing communities in the State to obtain advice on sewerage and sewage disposal from this body without other payment than its necessary expenses. Such a course would naturally interfere considerably with the work of private engineers, and it is therefore interesting to notice that the Commission's advice to these communities has so far been limited to broadly general statements and a recommendation to engage some competent engineer to plan and build the necessary works.

THE INTERCONTINENTAL RAILWAY.

The columns of this journal are not open to discussions of railway topics as a rule, but occasionally there is a subject of this nature which, on account of its general interest, well demands attention from every journal of an engineering nature. The receipt of a report in which are given the results of the work of the Intercontinental Railway Commission calls for

such mention. This commission, it will be remembered, was the result of the International American Conference authorized by Congress in May, 1888, and held its first session in December, 1890, in Washington.

The principal object before the commission was the determination of the question as to whether a practicable line of railroad, at a reasonable outlay of money, could be constructed to connect the systems of the United States and Mexico with the existing systems of the southern portions of South America. For this purpose three parties were organized and sent into the field. Corps No. 1, composed almost entirely of officers of the U. S. Army, under the command of Captain E. Z. Steever, proceeded to Central America and surveyed a line from the western boundary of Mexico through Guatemala, Salvador, Honduras, Nicaragua and Costa Rica, then through the Isthmus of Panama into Colombia until it met Corps No. 2 coming north. Corps No. 2, under the direction of Mr. William F. Shunk, proceeded to Quito, Ecuador, and then surveyed northward to Colombia and through that republic and the Isthmus of Panama until it met party No. 1 coming from the north. Corps No. 3, under Mr. J. Imbrie Miller, M. Am. Soc. C. E., went to Quito and thence surveyed southward through Ecuador and Peru to Lake Titicaca, on the confines of Bolivia. On account of illness Captain Steever was succeeded at the head of Corps No. 1 by Lieutenant Montgomery M. Macomb and Mr. Miller was succeeded at the head of Corps No. 3 by Mr. W. D. Kelley, M. Am. Soc. C. E.

The instructions to the field parties stated that the surveys should be made sufficiently in detail to obtain the data necessary for the preparation of a topographical map and profile of the lines selected. Notes were also taken of the general topography of the regions traversed, their general geological formation, the nature of the soil, climatic conditions and the character of the agricultural and other industries, of the population, and of the materials available for railway construction. In all measurements the metric system was used.

Corps No. 1 was supplied with instruments for determining the latitude and longitude of the more important points in its territory, which afforded a means for detecting any accumulation of error that might creep in from a sole dependence on a transit survey. This corps also covered the belt of country surveyed from the Mexican frontier to Volcan Momotombo with a rough triangulation. As this took much time and the appropriation was limited it had to be dropped and the work confined to a preliminary railroad survey.

In all three corps the main line of the survey was a transit line, the horizontal lines being determined by stadia measurements and the vertical measurements deduced from angles of elevation and depression checked by readings of the aneroid barometer. In order to save time in passing through the forests of dense tropical growth in Eastern Costa Rica and on the Isthmus of Panama Corps No. 2 abandoned the stadia method and determined both the direction and length of the course by sound. In Southern Ecuador and Northern Peru Corps No. 3 was obliged to hasten its work, and to this end a mountain top would be cleared and a tall, straight tree selected, stripped of its bark, furnished with a top cross-arm, measured and then used as a stadia rod, the maximum distance thus read being as great as six miles. In addition to the main lines of the surveys, side lines were run with the odometer, compass and aneroid barometer.

The report has tables showing the number of miles of existing railways and the miles of new railway necessary to complete an all rail line from New York to Buenos Ayres. The distance between these two cities is 10,228 miles, of which 4,772 miles are now constructed, leaving 5,456 miles to be built. The cost of this uncompleted portion is estimated at about $174,000,000, or an average of $32,000 per mile.

The report is issued in four large volumes and three portfolios, weighing 31 pounds, beautifully printed, and containing a large number of engravings of scenery along the lines of the proposed railway. While it has been a considerable time in preparation, the result is highly creditable to the executive officers of the commission, Mr. A. J. Cassatt, president; Lieutenant R. M. G. Brown, U. S. N., executive officer, and Captain E. Z. Steever, U. S. A., secretary.

HYDRANT BRANCHES.

Some twelve years ago the Belfast Water Company, of Belfast, Me., made an agreement with the city to furnish, at places designated by the city officials, forty-five hydrants of approved pattern. In the contract there is a further stipulation that if the city should desire five more hydrants, located so that no more pipe was necessary to connect them than the first forty-five required, the company was to furnish them without additional charge, provided they were set during the construction of the works. The contract provided: "All hydrants are to be so piped as to receive an abundant and sufficient circulation among and in all of the same." In another section of the contract the company agreed "to connect up all said forty-five hydrants, located as aforesaid, and all such additional hydrants, in such manner that none of said hydrants shall come on pipe smaller than 6 inches in diameter in the clear." In 1893 two hydrants were connected by a 6-inch pipe to a 4-inch main laid through one of the streets of the city. Payment was refused for the use of these hydrants, on the ground that the main pipe, with which they were connected, was less than 6 inches in diameter. The company claimed that the clause quoted as requiring the pipe to be 6 inches in the clear referred only to the five additional hydrants which might be placed without extra charge during the construction of the works. All other hydrants, the company insisted, were to be so piped as to receive an abundant circulation of water. Suit was accordingly brought to recover the rental of these hydrants.

The case finally reached the Supreme Judicial Court of the State, and there was decided in favor of the city. Judge Savage, who wrote the opinion, states that the words of the contract which have been quoted must be taken to include all new hydrants. Even, however, if these words were not so considered, the contention of the plaintiff that it acted in good faith and substantially complied with the requirement in question, is held to be not well founded. "We cannot say," the decision reads, "that furnishing pipe of less than half the capacity called for by the contract is a substantial compliance with its provision."

NOTES.

"The Engineering Record" will be obliged if its readers will send to it an account of any methods of melting lead from pipe lines 2 to 4 feet in diameter, other than with wood fires.

The Value of Water Meters was recently the subject of the following statements by Mr. Joseph J. Pater, of Hamilton, Ohio: "The quantity of water wasted through leaky fixtures, if same are connected to sanitary sewers, is astonishing. A ½-inch tap if turned on full will waste 72,000 cubic feet of water in 30 days, which, at $1 per thousand, will amount to $72 per month. Hamilton has a double system of sewers, storm and sanitary. As the sanitary are not sufficiently used, it requires flush tanks to keep them free from stoppage. Last week we placed a meter on a ½-inch tap supplying a flush tank, and it registered 2,400 cubic feet in 24 hours. We have 70 flush tanks in operation in our city, and if they are turned on only one-quarter and charged at the lowest rate it would amount to $8,000 per annum. This will be reduced as soon as more connections are made to the sanitary sewers. A general complaint is, that water meters are not calculated the same as gas meters, that is, that we have a minimum rate of $5 a year if only $1 of water is registered. Aside from the expense of looking after such meters and keeping them in repair, the object is to induce the public to use at least $5 worth of water for sanitary purposes."

The Famous Sewage Pollution Suit between Platt Brothers & Company and the City of Waterbury, Conn., has advanced one step farther. Judge Shumway, of the Superior Court, has rendered a decision which states in substance that the plaintiff owns premises entitling it to the natural flow of the Naugatuck River. Since July, 1884, the city has discharged into this river the effluent from its sewerage system, contaminating the water and causing it to give off offensive odors which render it unfit for use. The manufacturing establishment of the plaintiff has been injured by this condition and will be until the city is restrained from discharging sewage into the river. The damages sustained up to the time of bringing the action have been assessed at $500, and the city is enjoined from discharging any sewage into the river above the plaintiff's dam after April 1, 1902. The city attorney has stated that the case would be appealed to the Supreme Court, but it is noticed that the local papers put little faith in securing a reversal of this finding. The suit was first brought in April, 1891, and has been fought so stubbornly by both sides as to be one of the best known cases of this sort now in progress. All side issues and technicalities have been swept away at last, and the trial has finally been conducted on the merits of the case. Many witnesses were examined and a large amount of expert evidence introduced on both sides. Although the city has contested the suit so stubbornly, it has nevertheless apparently profited by the experience of Worcester, Mass., and decided to be prepared for an adverse decision. Mr. Rudolph Hering was engaged some two and a half years ago to study the subject of sewage disposal, and a year previous there was secured from the Legislature authority for an issue of bonds in the sum of $300,000 to pay for works.

SEWAGE DISPOSAL AT WOONSOCKET, R. I.

The city of Woonsocket first began to construct sewers in 1895, during which year about 1,000 feet were built. This amount was increased each year until at the end of 1898 there had been completed 6.6 miles, including a considerable length of 36-inch trunk sewer leading to a disposal plant. Owing to the location of the city on the banks of the Blackstone River a number of syphons are necessary; when the system is completed there will be seven river crossings, in addition to two crossings of mill trenches, a number of which are already constructed. The 36-inch brick trunk sewer passes under the river just before reaching the disposal plant, in three lines of vitrified pipe 8, 12 and 18 inches in diameter. These pipes are placed 12 inches apart, outside to outside, and are bedded in Portland cement concrete, which is 12 inches thick under them and on the sides and has a minimum thickness of 8 inches over the top. On the upper end of the pipes are reducers and gates by which the sewage can be turned through any one or more of them. The use of three small pipes instead of a large one is due to the fact that the volume of sewage is small at present, and will flush and keep clean a small pipe much better than a large one. As the volume increases the larger pipes can be used. The pipes are 9¾ feet below the level of the sewer and are laid to a grade of 6 inches in 100 feet. The manholes at each end of the syphons have sumps. A retaining wall was necessary on each bank, and this has a brick arch over the con-

crete containing the pipes. The joints in the earthen pipe were calked with yarn and then filled with Portland cement mortar. At the upper end there is a 24-inch overflow through which the sewage can be turned into the river while the syphon is being cleaned or repaired. The syphon is 168 feet long from center to center of manholes, and was built by means of a coffer dam. Figure 1 shows horizontal and vertical sections and also a cross section of the pipes embedded in concrete.

The receiving basins, pumping plant and filter beds are located near the bank of the river below the city. There are to be eight receiving basins, of which two are now completed and in operation. They are each 50x140 feet and about 12 feet high, and are situated side by side, being separated by a brick wall 24 inches thick. The north and west walls are of granite, while on the east side, where rock was found, a brick wall was built and the space between the wall and ledge filled with concrete. On the south side is a brick channel for turning the sewage into and drawing it from the basins. Over this is a gallery from the pump well along the end of the basins, giving access to the latter and also serving to ventilate them. On the south side of this passage and channel openings were built in the wall for future basins, but were bricked up until such basins are built.

The bottom of the basins is made of a series of inverted arches of concrete grouted with Portland cement grout, and lined with 4 inches of brickwork. The roof is of brick arches supported by brick columns 3 feet square and 6 feet 3 inches high to the springing line. There are 33 of these columns in each basin, arranged in three rows and spaced 11 feet 11 inches center to center between the columns, and 13 feet 3 inches center to center between the rows. Each pier was built on a foundation of Portland cement concrete 6 feet square on the bottom, 3 feet 9 inches on the top, 2 feet 8 inches high, and thoroughly incorporated with the concrete bottom of the basin. The line arches between the columns are 20 inches thick at the crown and 24 inches at the springing line, and carry a skewback for the barrel arches, which are 12 inches thick. The roof over the basins is coverëd with concrete and there are drains at the low places to carry away the surface water. It is designed to carry 5 feet of earth, and may be used in the future to carry filter beds or precipitation basins when chemical precipitation may be required as an auxiliary treatment.

The trunk sewer is brought down in the eastern wall of the present basins and discharges into a well, from which it may be turned through screens directly into the pump well or into the channel discharging into the basins. The concrete used was made of 1 part of cement, 2 parts of sand and 5 parts of gravel or broken stone. The cement used in the concrete of the lower part of the bottom of the basins

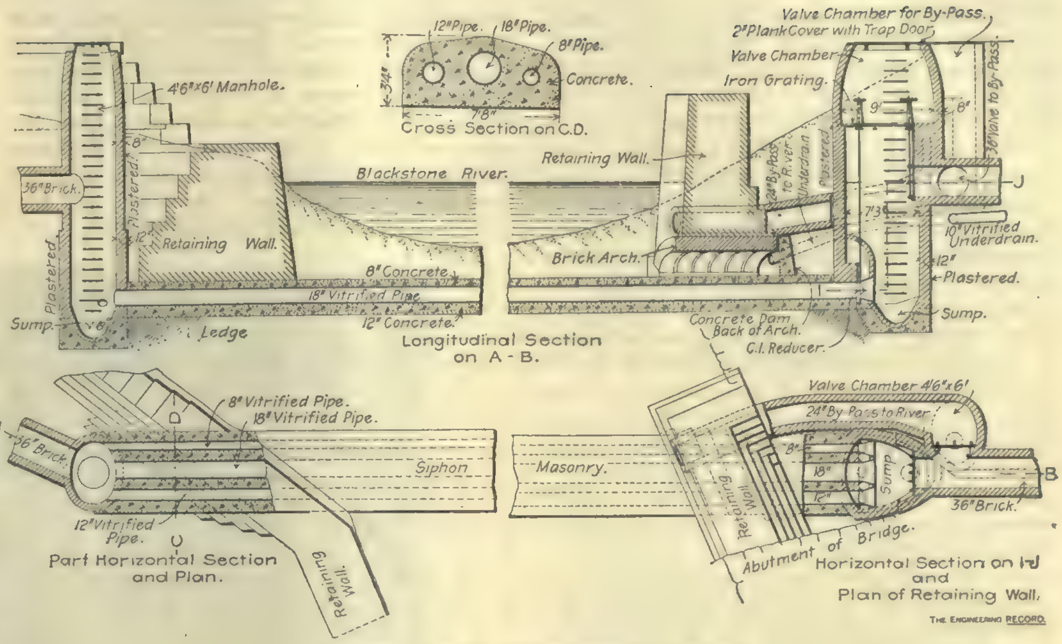


FIGURE 1.—PLAN AND SECTIONS OF SYPHON.

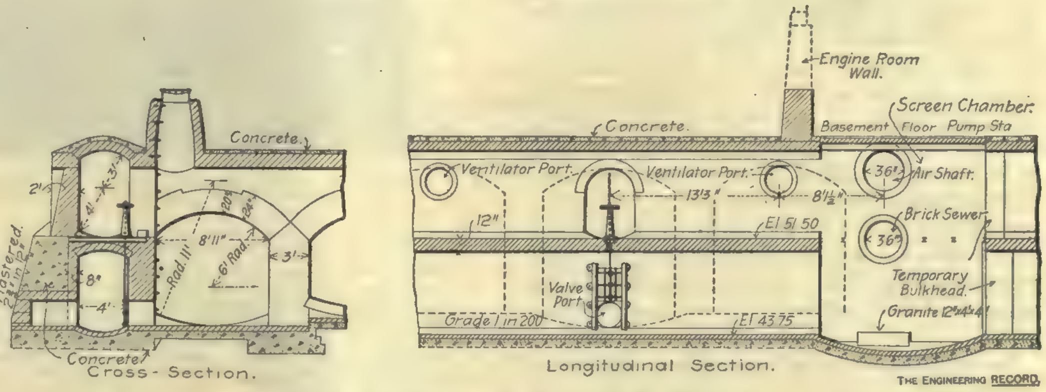


FIGURE 2.—SECTIONS OF GALLERY AND CHANNEL.

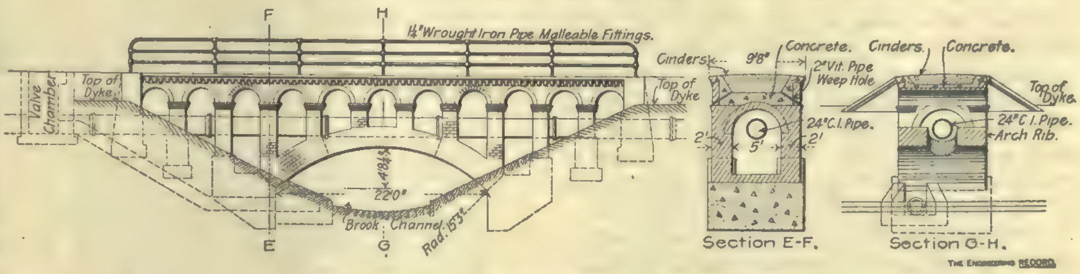


FIGURE 5.—MASONRY ARCH BRIDGE CARRYING SEWER

was a mixture of Portland and Rosendale in equal parts. The rest of the concrete was made of Portland cement. The brickwork up to the arches was laid in Portland cement mortar, and that of the arches in Rosendale cement mortar.

In the accompanying illustrations Figure 2 is a cross-section and part longitudinal section of the gallery and channel between the pump well and receiving basins. The cross-section is not taken on one straight line, but is made up to show the openings into a future basin as well as the openings into the present basin. Figure 3 shows a view of the receiving basins while under construction, and Figure 4 is an interior view of one of the basins.

As the sewer and receiving basins are at a low level it is necessary to lift the sewage before it can be turned upon the filter beds. For this purpose there are two centrifugal pumps which raise the sewage about 20 feet. They were required to have a minimum capacity of 1,700 gallons per minute with 370 revolutions. The actual test was 2,100 gallons per minute with 345 revolutions. They are run by two 25-horse-

FIGURE 3.—RECEIVING BASINS DURING CONSTRUCTION.

FIGURE 4.—INTERIOR OF RECEIVING BASIN.

BASINS OF THE WOONSOCKET SEWAGE DISPOSAL SYSTEM.

F. H. MILLS, CITY ENGINEER; RUDOLPH HERING, CONSULTING ENGINEER.

power engines built by the Ames Iron Works, and steam is furnished by two Allen boilers of 40-horse-power each. All are installed in a neat building of brick located in the center of the area to be covered by the eight basins.

There are to be 23 filter beds arranged in two rows along the bank of the river, and having a total area of about 16 acres. Two of these beds with an area of about one acre each are now completed, and each is designed to filter 200,000 gallons of sewage in 24 hours. They were excavated to sub-grade, and on the foundation thus prepared was placed a layer of screened gravel 18 inches thick. On this is a layer of coarse sand 28 inches thick and then a layer of medium fine sand 14 inches thick. These materials were found on land owned by the city and are of very fair character. The sewage is carried from the pumps to the beds in a 24-inch vitrified pipe, which runs in an embankment between the two rows of beds. Opposite the center of each bed is a 15-inch pipe outlet and between each pair of beds is a 15-inch pipe running half the length of the bed and having 12-inch branches to the right and left at the end. The sewage is thus turned on each bed at two points. At each branch outlet there is a manhole with gates, to control the flow. From the main outlet the sewage is distributed over the beds by means of a carrier made of planks running out toward the center of the bed. This is narrow at the far end and increases in width by right angle offsets as it nears the pipe. The sewage drops on to the beds at the offsets through the space between the narrow and wider portions. The outlet pipe is protected from the embankment by parapet and side walls of concrete.

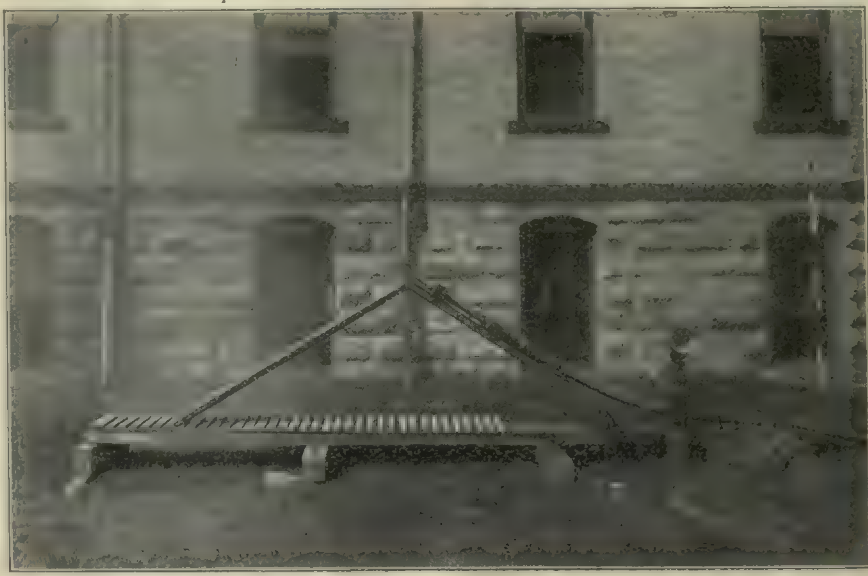
Beneath the center of each row of beds is an underdrain varying in size from 8 to 12 inches. There are two outlets to the river, that for the upper 12 beds being already constructed of 15 and 18-inch pipe. On the bank of the river is a gate-house and weir for measuring the flow of the effluent. The branch drains are four inches in diameter, and there are three of them under each bed, placed about 46 feet apart. There is one manhole in each bed placed at the junction of the main drain and the lowest branch drain. Across the site of the receiving basins was a brook running in an irregular course, for which a new channel has been constructed between the receiving basins and the filter beds. An arch bridge of brick and concrete was built over this channel to carry a roadway and the pipe from the pumping station to the filter beds. Figure 5 shows the elevation and two sections of this bridge. Between the beds and the river an embankment was necessary, and between the basins and the river a rubble wall had to be built. The upper corner of the receiving basins is built into this wall. Mr. Frank H. Mills, city engineer, to whom "The Engineering Record" is indebted for this information, was the designing engineer and Mr. Rudolph Hering, M. Am. Soc. C. E., was the consulting engineer of the works.

A PHOTOGRAPHIC STUDY OF FIRE STREAMS.

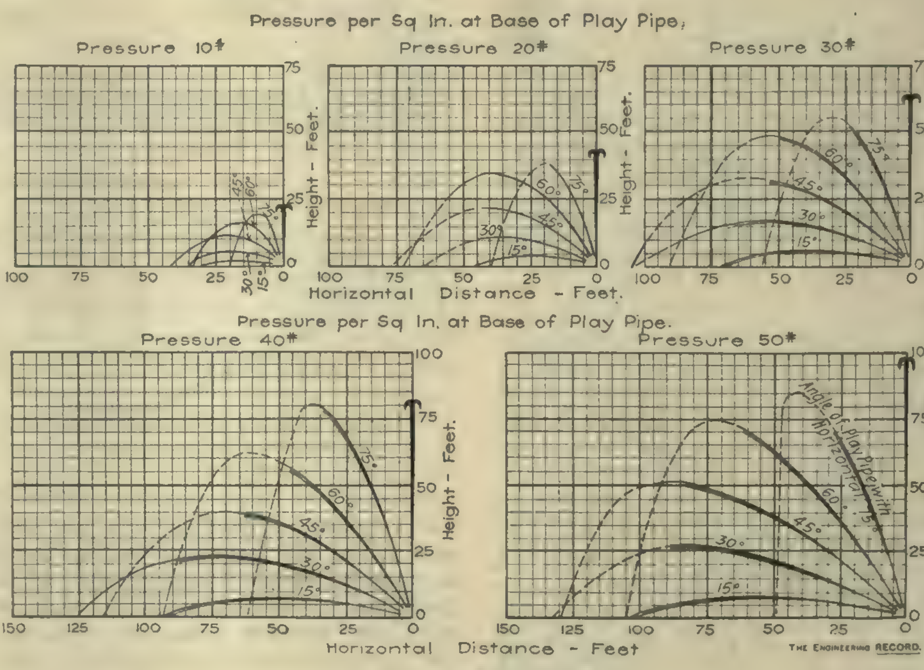
Among the papers presented at the recent meeting of the Iowa Engineering Society was one of unusual value and interest by Prof. A. Marston, director of the civil engineering department of the Iowa State College at Ames. It will be printed in full with the discussion in the Society's annual publication, but the following abstract is believed to present the leading features of this interesting series of experiments:

The object was to obtain data for the diagrams of fire streams given in the accompanying illustrations. These diagrams show to scale the paths which fire streams from each of the six different kinds of nozzles most commonly used in vicinity were found to follow under different pressures at the base of play pipe and with the latter held at different angles with the horizontal. It was thought that such diagrams would present information useful to hydraulic engineers in a form more complete and in some ways more convenient than the ordinary tables of fire streams, but Professor Marston says frankly that the results have not been what was hoped as to accuracy, and that their imperfections are fully realized.

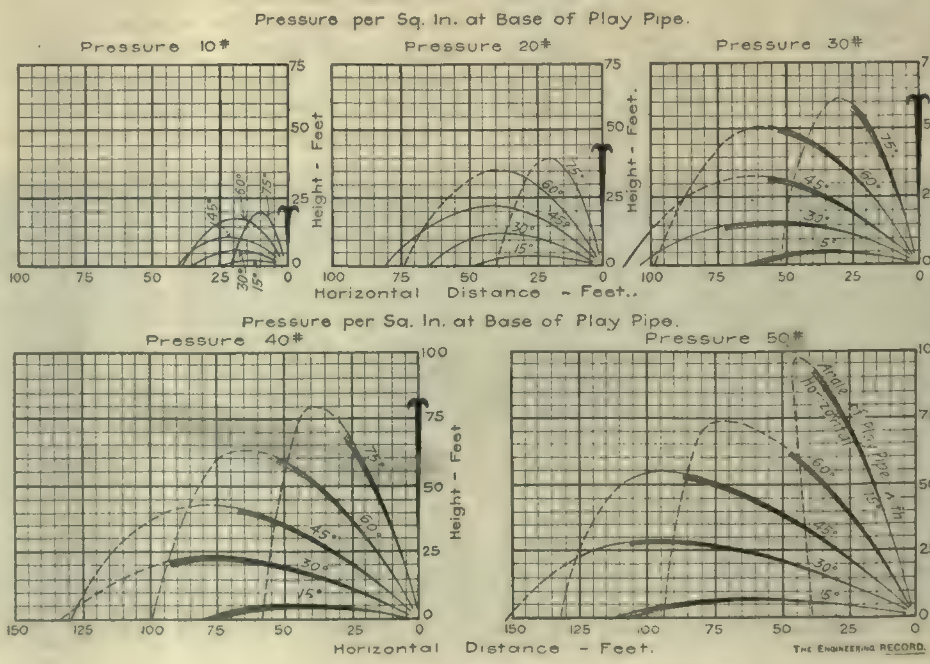
The suggestion that a photographic study of fire streams would be feasible and desirable was made by Mr. John R. Freeman (Trans. Am. Soc. C. E., Vol. xxi., p. 454) in the paper in which he presented to the American Society of Civil Engineers the results of his own experiments on the hydraulics of fire streams. These are the most extensive and reliable ever made relating to this subject; in fact, before his ex-



ARRANGEMENT OF PLAY-PIPE FOR FIRE-STREAM TESTS.



1 INCH RING NOZZLE.



1⅛ INCH RING NOZZLE.

EXPERIMENTAL RESULTS WITH RING NOZZLES.

periments were made very little reliable data existed to form a basis for fire stream tables. Mr. Freeman investigated many other subjects besides the reach of jets, among them being the loss of head by friction in hose, the best form of nozzle, and the quantities of water delivered by different fire streams. In connection with jets he experimented with vertical jets, and with jets inclined at 75 and 60 degrees with the horizontal. In each case he noted not only the heights of the extreme drops, but also the heights at which, in his judgment, the streams could be considered fair fire streams and good fire streams. He also experimented with jets usually inclined at about 32 degrees to the horizontal, in order to ascertain the greatest horizontal distances possible to be reached with different fire streams.

So far as they come within the limits of these diagrams the results of Mr. Freeman's experiments on the reach of jets are platted on the diagrams given herewith, both for ready comparison with the experiments at the Iowa State College, and to furnish a check on the accuracy of the diagrams.

The method employed for determining the paths of the jets in the college experiments was to photograph the streams in such a way that each photograph would be a scale drawing, from which the paths could be determined for platting on the diagrams.

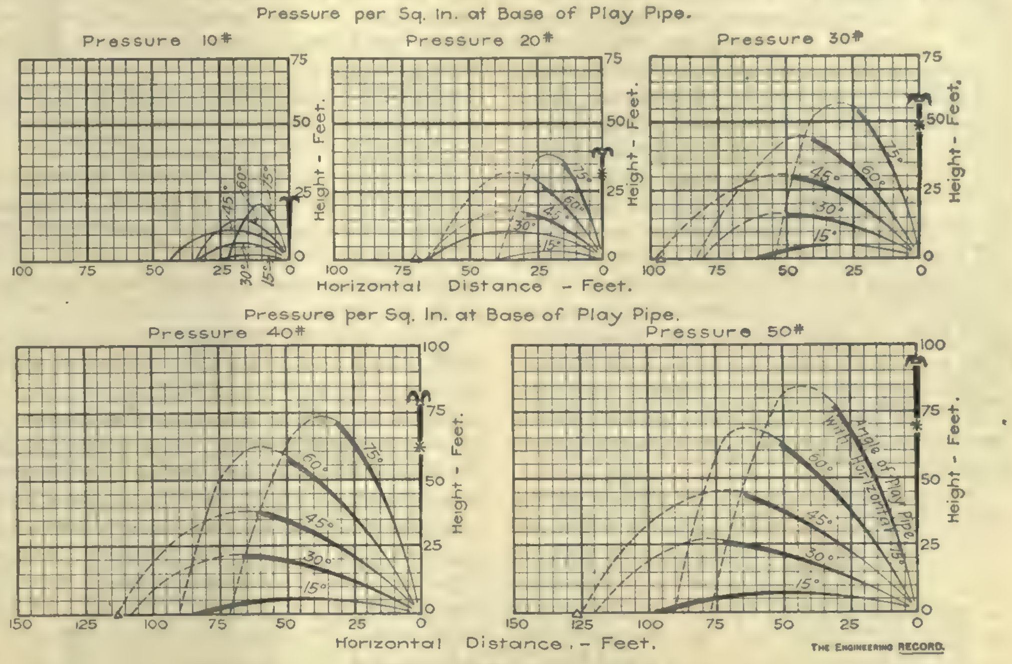
The fire streams were so nearly the color of the sky that great difficulty was experienced in obtaining photographs on which the streams showed clearly. It was found necessary to have a building in the background, and even then the stream did not usually show clearly where it was completely broken up into showers of spray. In the majority of cases part of the path could not be distinctly traced on the negative. The main building of the college formed the background for the views, while the camera was placed in a fixed position on the roof of another building near by.

A rectilinear lens was used, which had been tested and found sufficiently accurate for the work. The camera was kept carefully lined up so that the sensitive plate was vertical and parallel to the plane of the jets. Marks were set on the ground in the plane of the jets at known distances apart, which in the photograph served to determine the scale. This scale was approximately 35 feet per inch.

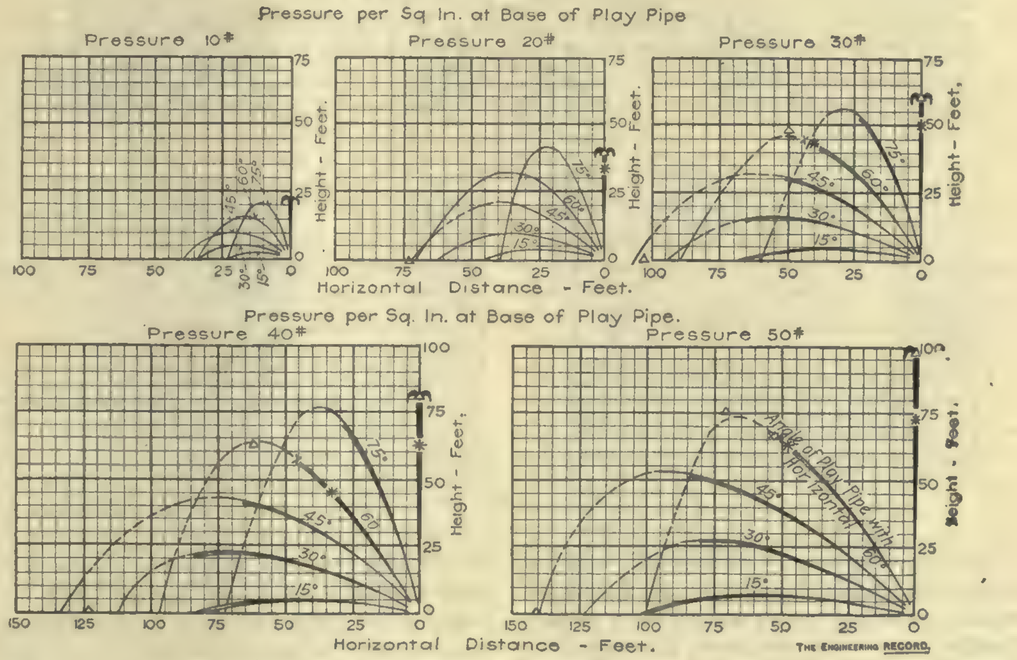
To admit of measuring the pressure a piezometer coupling about 5½ inches long, made of brass, was inserted at the base of the play pipe. Encircling the outside of this coupling at about the middle of its length was a small enclosed channel, communicating with the interior of the coupling by four small openings 90 degrees apart. The channel had also one outside opening, from a nipple in which a piece of small flexible hose led to the pressure gauge. This coupling was almost exactly like the one used by Mr. Freeman in his work.

For measuring pressures a Crosby gauge was used, reading to single pounds, and estimated to tenths of a pound. This was calibrated before, during and after the tests. It is believed that the pressures are correct to within a few tenths of a pound per square inch. The pressures observed in the experiments and shown on the diagrams are the indicated pressures at the base of the play pipe, and at the level of the base of the play pipe, while the stream was flowing. The origin for horizontal distances and heights on the diagrams is the base of the play pipe. Particular attention is called to the above points, as in them the experiments differ somewhat from Mr. Freeman's experiments and from the ordinary fire stream tables. While there are some advantages in the plan adopted, Professor Marston wishes that the effective pressure at the orifice had been used and the orifice taken as the origin. To get the effective pressure at the orifice the pressure on the diagrams would have to be corrected in each case for differences in height between the orifice and the base of play pipe, and for the velocity past the piezometer openings. The correction varies from nothing to + 1.7 and to — 1.1 pounds per square inch.

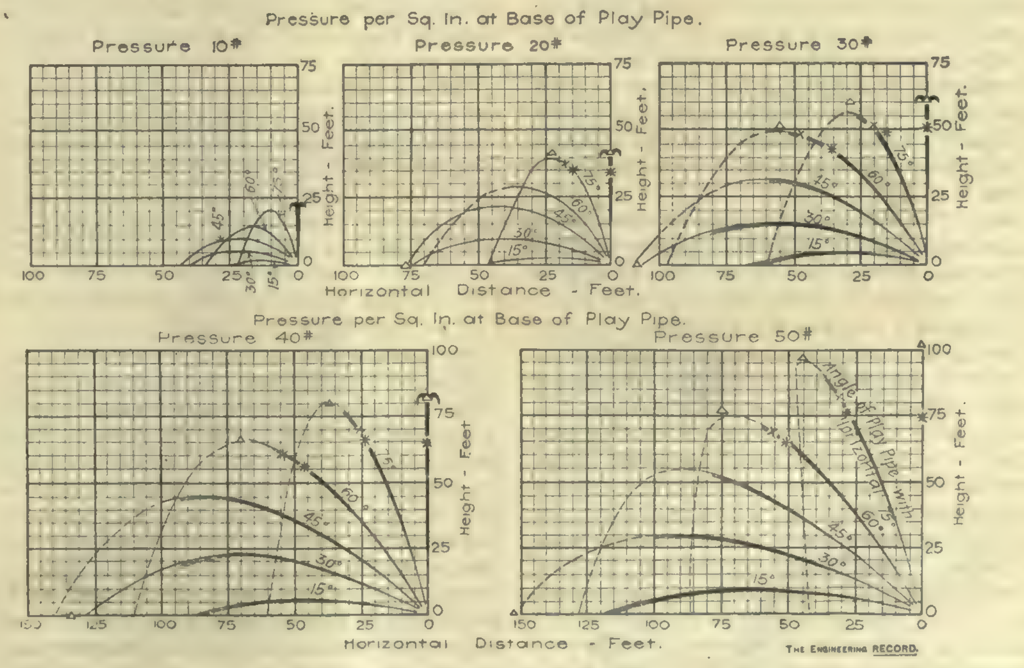
During the work the pressure was in every case furnished by gravity from the college elevated tank, the high-water line of which is 150 feet above the ground. The smooth nozzles used were the ordinary smooth cone nozzles, and the



¾ INCH SMOOTH NOZZLE.



⅞ INCH SMOOTH NOZZLE.



1 INCH SMOOTH NOZZLE.

Freeman's Experiments Plotted thus. { Extreme Drops △ Fair Fire Stream × Good Fire Stream ✳

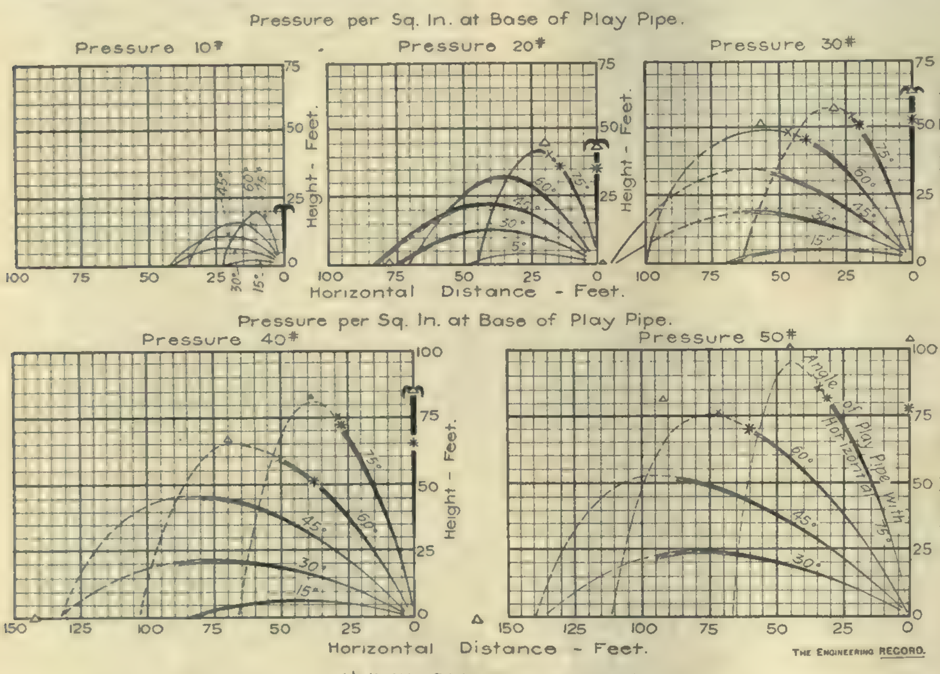
EXPERIMENTAL RESULTS WITH SMOOTH NOZZLES

ring nozzles were of the undercut type. All the nozzles were used just as furnished by the dealers, and are part of the college fire-department equipment. The same is true of the play pipe, which was 30 inches long.

On the diagrams the lines for the extreme drops are drawn full where they could be distinctly traced on the negatives. These lines were also located accurately at the points where they strike the ground, by observations taken during the work independently of the photographs. Where the lines are drawn broken they were sketched in free hand, regard being had to analogy with other streams and with the results of Mr. Freeman's experiments.

Of course this does not give reliable results, but it may be remarked that the effect of the slightest breeze on the parts of the stream where they are so broken up into spray is very great, and would cause so much difference in streams observed at different times that lack of accuracy in locating this portion of the stream is of less importance than might at first be thought.

The paths of the streams are shaded on the original diagrams accompanying the paper for pressures of 30 pounds and upwards, where the negative showed a clearly defined solid stream of appreciable width indicated approximately by the width of the shading; owing to differences in the negatives this shading does not indicate with perfect uniformity the distance to which the streams held together well. The reproduction of these diagrams on the reduced scale of the accompanying engravings has made it difficult to show the shading of the originals exactly, but they are believed to be fairly accurate.



1⅛ INCH SMOOTH NOZZLE.

EXPERIMENTAL RESULTS WITH SMOOTH NOZZLES.

Beyond the points shaded the streams were in general so broken up as to be greatly affected by the slightest breeze. In fact, the most difficult thing about the work was to secure times for carrying it on when the wind was still. The experiments were in progress about two months, and work was usually carried on only for a couple of hours at sunrise and sunset on the stillest days. Yet an inspection of the diagrams makes it very apparent that those parts of the streams where they were broken up into spray were greatly affected by the wind. A few of the high pressure readings were taken with a moderate breeze blowing, because the apparatus had to be taken down by a certain date. The 1-inch smooth and 1-inch ring nozzle streams at 75 degrees elevation and 50 pounds pressure are examples. The negatives of the 1-inch smooth and the 1⅛-inch ring nozzles were other examples, and proved entirely valueless. In platting Mr. Freeman's experiments on the diagrams, some interpolating had to be done in his tables and diagrams to get the exact pressures. A study of the diagrams will show that in general the reach of the extreme drops of the jets checks fairly well with Mr. Freeman's experiments, and that even where the extreme drops do not reach his points the shaded parts of the streams come close to them.

Professor Marston's knowledge of the work and a careful study of the diagrams have led him to the following conclusions:

First, that the curves on the diagrams for pressures of 10, 20 and 30 pounds per square inch can be considered as quite closely correct, although in a few cases the half of the jet away from the nozzle has been somewhat affected by the wind.

Second, that on the diagrams for pressures of 40 and 50 pounds per square inch the shaded portion of the curves can be considered as quite closely correct and not seriously affected by what wind was blowing. The curves beyond the shaded portions have been accurately located where drawn full on the diagrams and where they struck the ground, but in many cases have been affected considerably by the wind, and where drawn broken are only roughly sketched in. The jets are largely broken up into spray beyond the shaded portions, and no two observations on that portion of the path with the wind blowing at all would be apt to give the same results.

Third, a hydraulic engineer would be able to tell quite closely from the diagrams what part of a building he could reach with a fire stream holding together well enough to do good execution from a given position, and with a given pressure, not exceeding 50 pounds per square inch at the base of the play pipe.

STANDPIPE WITH BRICK CASING AT RACINE, WIS.

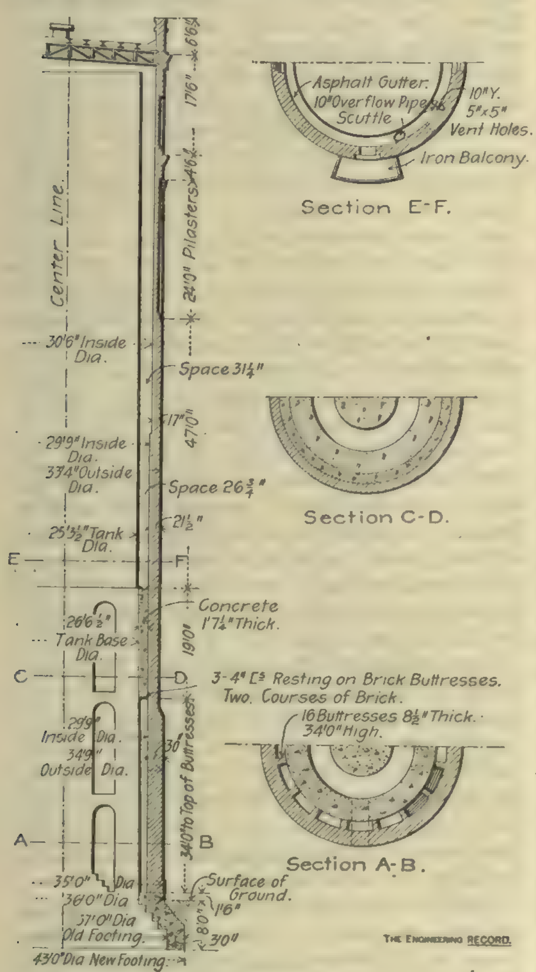
The standpipe of the Racine Water Company is of wrought-iron, resting on a pedestal of concrete. It is located upon the highest ground in the city, 57 feet above the level of Lake Michigan, and about 1½ miles from the pumping station. The pedestal on which it rests rises 55 feet above the ground and extends 7 feet below the surface. It is 37 feet in diameter at the bottom, and 26½ feet in diameter above ground. For 7 feet above the foundation the structure is solid and above that it consists of an inner core 10½ feet in diameter, and an outer ring 4 feet thick, leaving an annular space between them 4 feet across. The core and outer ring are joined together by arched floors, of which the upper one is 4 feet thick at the crown. The standpipe is 90 feet high with an internal diameter of 25 feet, and has a capacity of 330,000 gallons. The bottom plates are ½ inch thick and the sides vary from ⅝ inch at the bottom to ¼ inch at the top. It was built up of 18 rings, 14 of which are double riveted, and was completed about 12 years ago. The outlet to the system of mains is 16 inches in diameter, and the force main is 10 inches in diameter, fitted with an electrically controlled gate which can be closed from the pumping station, and the whole force of the pumps exerted on the supply mains. The tank is anchored to the concrete foundation, and in heavy winds the anchors were somewhat strained. To prevent this and to prevent the formation of ice in the tank, which was 12 feet thick at one time, it was thought best to build a casing completely enclosing the standpipe.

This consists of a brick shell upon a foundation of concrete, and was completed in the fall of 1897. The foundation pit was in hard blue clay, and was excavated with vertical sides to a point 3 feet outside of and to the bottom of the old foundation. This was filled in with concrete to a height of 4 feet, and then stepped back for the next 4 feet to the top of the foundation, where the additional ring is 4 feet 9 inches wide. The concrete consisted of one part of Portland cement, one part of sand, one part of screened gravel averaging ½ inch in diameter, and four parts of crushed stone not exceeding 1½ inches in diameter. The cement and sand were thoroughly mixed dry, the gravel and broken stone were then added and the whole mass sprinkled with water and turned over until it was thoroughly mixed and without excess of water. It was placed in 6-inch layers and thoroughly rammed, each ring around the old foundation being completed before the next was begun. To protect the inlet and outlet pipes a 4-inch brick arch was turned over them with a clearance of 2 inches. For 34 feet above the foundation the brick casing was connected with the pedestal by means of 16 buttress walls of brick 8½ inches thick. For the next 19 feet the space between the pedestal and casing was filled with concrete made of one part of Louisville cement, two parts of sand, and four parts of gravel not exceeding 1 inch in diameter, and mixed in the same manner as that used in the foundation. This was laid in 4-inch courses thoroughly rammed, and was carried up as soon as possible after the brick wall was laid. Special care was taken with this so as to leave no crevices which might be filled with the weeping of the tank. Each course of concrete was sprinkled with water before the next one was laid. To support this concrete, 4-inch channel bars were placed on the brick buttresses and carried two courses of brickwork. A gutter was made in the top of the concrete to carry away all of the natural condensation and weeping of the tank and whatever leakage there might be. It was lined with 1 inch of paving asphalt mixed with coarse sand and of such a composition as to be elastic at temperatures ranging from 30 to 80 degrees. This was carried over the edge of the tank base and up against the brick wall to make a tight floor. The gutter was dished 2 inches at the center, and had a uniform grade to the opening of the drain, which was 8 inches below the top of the tank base. In the upper 18 feet of the backing-concrete a passageway was left with a ladder leading from the old upper doorway to the second story. Between the tank and brickwork is an air space 26¾ inches wide in the lower portion and 31¼ inches in the upper.

The brickwork was all of local common hard brick, furnished by the company, and laid in mortar of one part of Louisville cement and two parts of sand, mixed dry and then sprinkled and turned until of the proper consistency. All bricks were wet before laying, and were laid with thin, full-shove joints, both side and end, and every sixth course was a header course.

The courses were kept level, the corners and angles plumb and the true circle of the wall was preserved. All of the outside joints were neatly pointed and the upper surfaces of all set backs of more than 2 inches were sloped with a layer of Portland cement mortar worked true and even. All other set backs were well pointed and left clean. The battlement walls from the roof to the top were laid in mortar of one part of Portland cement and two parts of sand.

The roof is of iron beams and tie rods with arches of corrugated, galvanized-iron roofing plates between the beams. The arches have a 4-inch rise and are covered with a mixture of one part of Portland cement and four parts of sand and gravel. This is 4 inches thick at the crown of the arches, and a short incline was formed of it around the entire circle of the tower to turn the water away from the brickwork. Flashings of 4-pound lead were used at the junction of roof and wall, and the entire surface was covered with a ½-inch layer of paving asphalt and sand. A manhole and two



THE RACINE STANDPIPE CASING.

ventilating scuttles were built in the roof. The roof is supported by a steel truss 30 inches deep, designed to carry a distributed load of 20 tons in addition to its own weight. All of the roof iron was painted with two coats of magnetic oxide paint, one being applied in the shops and the other immediately after erection.

A drain of 10-inch vitrified pipe was carried up the full height of the tower. Where the wall is more than 17 inches thick the pipe was enclosed in it. From the 17-inch wall corbels were set under each hub projecting one-half the diameter of the pipe. Each length of pipe was anchored to the wall with ¼ x 1-inch galvanized iron straps and bolted to ⅝-inch anchors built into the corbels on each side of the pipe. This pipe was used to carry away the rain water from the roof, and also to act as an overflow for the tank. A Y was put in opposite the manhole at the bottom of the tank to take the silt when the tank is cleaned. An opening about 6 x 18 inches was cut in the top of the tank to act as an overflow, and was connected with the drain pipe by means of a trough and funnel. Doors and windows were built into the brick wall where required. The windows were closed with sidewalk glass ¾ inch thick, excepting those in the upper story, which have clear plate glass ⅜ inch thick. An 18-foot ladder and two balconies were removed from the old concrete base and a new balcony erected outside the brick casing. A swinging crane of 1½-inch square iron was erected over the balcony and fastened by means of eye-bolts through the wall. Four 5 x 5-inch ventilating passages were left through the second story wall 6 inches above the floor, the inner ends being closed with galvanized wire netting. The accompanying cut shows a half vertical section and three half horizontal sections. The architect for the casing was Mr. L. H. Bacon, of Boston, Mass., and the work was done under the direction of Mr. W. J. Laing, superintendent of the Racine Water Company, to whom "The Engineering Record" is indebted for this information.

PETROLEUM RESIDUUM AS A FLUX FOR ASPHALT.

In the article on recent municipal work in Washington in "The Engineering Record" of February 11, reference was made to an investigation by Mr. A. W. Dow, inspector of asphalts and cements, to determine whether petroleum residuum is a good softening flux for asphalt. As this is a subject of much interest to engineers in general, and to those interested in asphalt and asphalt pavements in particular, the description of this investigation is printed in full as follows:

In speaking of petroleum residuum, I refer to that manufactured from the petroleum oils of the eastern United States. It is that portion of the petroleum that remains after the light oils and lubricating oils have been removed by distillation. These residuums are composed largely of the higher members of the paraffin series, with some unsaturated hydrocarbons, and must not be confused with those of the western and some foreign petroleums which are composed largely of hydrocarbons belonging to unsaturated series and are asphaltic in character. It may be well before proceeding to explain why this point, which appears of little moment, is of sufficient importance to investigate. In the manufacture of asphalt pavements, it is often found necessary, on account of the hardness of the asphalt in use, to soften it by the admixture of a softer asphalt or oil. This is the case with all the asphalts used in this city, and the large majority of those used throughout the country. In the case of Trinidad asphalt, which is used more extensively than any other, petroleum residuum is used as the softening agent, and for the manufacture of a desirable paving cement an average of 18 pounds of residuum is mixed with 100 pounds of refined Trinidad asphalt, and when we consider that the refined asphalt is but 56 per cent. pure bitumen, it is seen that the bitumen of a Trinidad asphalt cement is composed of 24.32 per cent. residuum and 75.68 per cent. of asphalt bitumen. When so large a quantity of flux is necessary it is very important that it should possess properties that would suit it for paving purposes, and also that the asphalt bitumen should be completely soluble in it.

On looking into the physical properties of the better petroleum residuums, it is found to be a heavy, thick oil at 70 degrees Fahrenheit, which begins to solidify at 58 degrees Fahrenheit, and becomes solid on cooling to 48 degrees Fahrenheit, this solidification being due to a crystallization of a portion of its constituents. At a temperature of 90 degrees Fahrenheit it becomes very limpid. It is very non-adhesive in character, and when in a solid condition from cold or other causes it is very waxy in consistency and entirely lacking in cementing properties. As regards its stability, it gradually loses its fluidity with age. This seems rather strange, as it is composed largely of saturated hydrocarbons, and it would be only natural to suppose, from theory, that they would be very stable bodies—much more so than oils composed more largely of unsaturated hydrocarbons. This theory was so ably discussed by Mr. Clifford Richardson about a year ago that I will not go into it. The theory in question, however, is lacking in this very essential point, that it is not carried out in practice. The truth of this is forcibly illustrated by examining the condition of the samples of residuums which have been submitted by the several paving companies in this city during the past four years. These samples are in quart cans, well corked, and have been kept in a room in which the temperature has seldom gone below 70 degrees Fahrenheit. On examining the samples over six months old, with the temperature of the room at 75 degrees Fahrenheit, a large majority were found to be of the consistency of jelly, some stiffer than others. On examining all the samples over a year old, with the temperature of the room at 90 degrees Fahrenheit and after a week of warm weather, during which time the temperature had not been below 85 degrees Fahrenheit, out of 40 samples 12 were found in a solid condition. It is hard to account for why this hardening takes place, but it can be induced and made more rapid by exposing the residuum in small quantities to a moderate heat or an intense cold for a short time. It is apparently caused by the separation from the residuum of a light-brown, apparently amorphous solid, which, after having once formed, alters the physical character of the residuum in this respect, that the temperature of its solidifying point is much raised.

On examining a drop of fresh petroleum residuum under the microscope by transmitted light it is found to be an amber-colored fluid with more or less paraffin crystals and a black substance floating through it. This black substance is often mistaken for coke, but it is completely soluble in carbon disulphide, chloroform and turpentine, and insoluble in petroleum naphtha. If this drop of residuum is put aside for several days and then again examined with a microscope, it will be found that another substance has made its appearance in the shape of a light-brown amorphous solid, which melts at a temperature of about 105 degrees Fahrenheit. The formation of this substance can also be induced by heating a drop of residuum for five minutes at a temperature of 170 degrees Fahrenheit, or by exposing to a temperature of 10 degrees Fahrenheit or lower, for about half an hour. This latter indicates that this formation is brought about by molecular change rather than by an evaporation or oxidation. It is evidently the formation of this solid which causes the residuum to gradually lose its fluidity with age, as before mentioned. By the use of polarized light the large majority of these oils are found to contain minute paraffin crystals, which I find increase largely in size and number after the residuum has been heated to a high temperature for even a short time. On being kept at a high temperature for a length of time (400 degrees Fahrenheit for 30 hours in a closed retort), although they lose but little in distillate yet they are considerably altered in composition and consistency, so much so that it is very evident that the change is not due to the small loss of light oil, but to molecular change. In some very few cases the character of the residuum appears to be benefited by this heating, as it is less susceptible to change in temperature than formerly, and when cooled until solid is more cementitious. In these few cases the molecular change above spoken of can not be noticed.

As to the solubility of asphalt bitumen in petroleum residuum, I have devoted all my time so far to Trinidad asphalt, as it is by far the most extensively used here as well as in other cities. As I have before stated, the bitumen of a Trinidad asphalt cement is at least one-fourth petroleum residuum. When so large a quantity of softening agent or flux must be used, it is only reasonable to suppose that the best results

can not be obtained unless the bitumen of the asphalt is completely soluble in the flux used.

The point as to whether petroleum residuum completely dissolves the bitumen of Trinidad asphalt has been an open question for many years past. Peckham, in 1895, criticises the use of petroleum residuum for this purpose, and states that the asphalt is insoluble in it, but gives no reason for the statement. In an article by myself on specifications for asphalt pavements, written in 1896, I object to the use of residuum for fluxing asphalts, and among other objections I make to it is that I do not believe the asphalt completely soluble in it. This opinion of mine was based on observations made while trying to soften some of the harder asphalts by admixture with residuum. In some cases I found it impossible to dissolve the asphalt in the residuum even after prolonged stirring at a temperature above the melting point of the asphalt, while these same asphalts were easily miscible in western petroleum having an asphaltic base.

Other circumstances have in the past led me to infer that there was no complete solution, but until the present I have never attempted to make any definite demonstration of the truth of my convictions. About a year ago Mr. Clifford Richardson claimed to prove that the bitumen of Trinidad asphalt is completely soluble in petroleum residuum; but the two experiments on which he bases his claim are by no means convincing, as can be seen. In his first experiment in which he allows a tank of Trinidad asphalt cement to stand in a melted condition for a week without agitation, he finds upon examining samples from the top and bottom of the tank, that there is no particular difference in the composition of these samples as far as the constituents of the bitumen are concerned, and merely an increase of 5 to 6 per cent. of mineral matter in the bottom over the top. The fact of his getting such a slight increase of mineral matter in the bottom over that from the top shows that the subsidation was very incomplete, and surely not sufficient to allow any insoluble bitumen, which is of about half the gravity at least of the mineral matter, to subside. In the other experiment he extracts the bitumen from the Trinidad asphalt with chloroform, evaporates off the solvent, and adds to this pure bitumen the quantity of petroleum residuum equivalent to the amount used in making an asphalt cement. On examining this asphalt cement with a high-power microscope, he finds that it appears to be perfectly homogeneous. One great fallacy in this experiment is in the pure bitumen extracted from the refined asphalt by means of chloroform. I have found in trying to obtain a pure bitumen by extracting with chloroform and carbon disulphide and evaporating off the solvent that it is impossible to remove all the solvent from the bitumen without heating it to such a temperature that it would destroy the original character of the asphalt. I know of other experimenters who have experienced the same difficulty in removing all the solvent and have at times thought themselves successful, as not the slightest odor could be noticed on the sample, but on opening the box containing the sample after it had been packed away for several weeks the odor of the solvent could be plainly detected.

In beginning my work on this subject I was much puzzled as to how to accomplish my end. The impurities in the asphalt, amounting to 44 per cent., made microscopic examination useless, and as I was unable to get the asphalt in so liquid a state from heat that it would filter even under an exhaust, I had to abandon the idea of working on the pure asphalt bitumen. I then tried filtering an asphalt cement taken from one of the paving yards, made of 100 parts of refined Trinidad asphalt and 19 parts of petroleum residuum, but with no better success even when rendered quite liquid with heat and using a high exhaust. After the addition of a quantity of residuum to this cement sufficient to make a mixture having equal quantities of refined asphalt and residuum, filtering through a Goosch crucible was again tried with an exhaust of 24 inches of mercury and with the mixture kept in a liquid condition at 325 degrees Fahrenheit. Only a small fraction of a cubic centimeter was obtained before the filter gummed up. This filtrate upon microscopic examination at normal temperature was found to be composed of two bitumens, one suspended in the other in the form of small globules. On heating, these globules disappeared and apparently went into solution in the other bitumen. These globules did not immediately form on cooling, but required at least 24 hours before again developing. I then added double the quantity of residuum, making a mixture of two parts residuum to one part refined Trinidad asphalt, and incorporated them by stirring at a temperature of 300 degrees Fahrenheit. I was now able to filter about 20 cubic centimeters through the Goosch crucible kept at a temperature of 300 degrees Fahrenheit, with an exhaust of 24 inches of mercury. The filtering was very slow, and in an hour or two had practically ceased. The filtrate was examined under the microscope and was found to resemble the last one, except that the globules of the insoluble bitumen were fewer in number. Analyses to determine the total bitumen soluble in carbon disulphide and petroleum naphtha, which were made on this filtrate and on the portion left in the Goosch filter, which was largely composed of the unfiltered mixture, resulted as follows:

	Filtrate per cent.	Residue per cent.
Bitumen soluble in naphtha..........	93.75	67.38
Bitumen insoluble in naphtha, soluble in carbon disulphide..........	6.20	7.02
Earth residue and foreign organic..	0.05	25.60
Portion of total bitumen soluble in naphtha	93.79	90.56
Portion of total bitumen insoluble in naphtha..........................	6.21	9.44

From the above it is very evident that there is a marked difference in the bitumen that filtered through and that left on the filter. In taking these results and those from the microscopic examination of the filtrate, we are led to the conclusion that the bitumen of Trinidad asphalt is not completely soluble; that it is more soluble in hot residuum than in cold, and that this extra amount that goes into solution on heating separates out on cooling. As these experiments were carried out on a mixture much richer in petroleum residuum than is ever used in practice, it was considered advisable to make further investigations that could not be open to this criticism. Two cements were obtained from a paving yard, one such as used in the topping mixture, composed of 100 parts of refined Trinidad asphalt and 19 parts of petroleum residuum. The other, such as is used in the binder course, composed of 100 parts of refined Trinidad asphalt and 25 parts of residuum. A third cement was made in the laboratory by thoroughly incorporating 100 parts of refined Trinidad asphalt with 27 parts of a good quality asphaltic oil, or as some have called it, a California petroleum residuum. Portions of these three asphalt cements were melted into large test tubes, these tubes being filled to within an inch of the top. They were then placed in a hot oven in a vertical position and kept at a temperature averaging 300 degrees Fahrenheit for 48 hours, thus allowing a subsidation to take place while the cements were in a melted condition. After being allowed to cool, the tubes were broken and analyses made in each case on material taken from the top and bottom of the tubes, care being taken, however, to discard the immediate top of each tube as they showed signs of being oxidized. These results will be found in the accompanying table.

	Topping Cement			Binder Cement			Asphalt Oil Cement		
	Original. Per Cent.	Top of Tube. Per Cent.	Bottom of Tube. Per Cent.	Original.	Top of Tube. Per Cent.	Bottom of Tube. Per Cent.	Original. Per Cent.	Top of Tube. Per Cent.	Bottom of Tube. Per Cent.
Total bitumen soluble in carbon disulphide.	63.91	71.86	36.88	......	80.57	41 22	65.42	76 10	[illegible]
Naphtha soluble bitumen	45.86	53.06	25.62	......	62.61	30.71	49.08	56.95	[illegible]
Earthy and foreign organic matter..........	36.09	28.14	63 12	......	19.43	58 78	34 58	23 90	64.00
Total bitumen soluble in naphtha..........	71 66	73.87	68.06	......	77 71	74 50	75 02	74 84	74.83
" insoluble "	28.34	26.13	31.94	......	22.29	35.50	24.98	25 16	25.17

On examining these results we find in the case of the two cements made with petroleum residuum that several per cent. of the asphalt bitumen has been rendered insoluble by the addition of the residuum, and that this insoluble bitumen is held in suspension and will settle out as so much inert material. It is impossible to even approximate the quantity of insoluble bitumen, but it must be quite some more than has settled in these experiments, for being of much less gravity it is only reasonable to believe that proportionally less of it would settle than of the mineral ingredients, and there are still quite some of these held in suspension. Combining with all this what we learned in the previous experiment (that more of the asphalt bitumen was soluble in hot residuum than in cold), the quantity of this bitumen insoluble in the residuum at normal temperatures must be considerable. In the case with the cement of asphalt oil we find that even though there was quite as much mineral matter subsided, yet the bitumen is of uniform composition throughout the tube, showing a complete solution. Judging from the physical properties of petroleum residuum and its chemical relation to asphalt bitumen, it is not a desirable flux, but it should not be judged too strongly in the absence of physical tests carried on on the asphalt cement made with it. Such an investigation is in progress comparing asphalt cement made with petroleum residuum and several asphalt oils as fluxes with Trinidad asphalt, along with several other well-known asphalt cements.

The comparisons to be made are: Susceptibility to change in temperature, rapidity of aging, loss and change in consistency on keeping at high temperatures for a length of time, and the action of water on paving mixtures made with the several cements. Some results have been obtained on this investigation, but they are too few and incomplete to be of use in forming conclusive opinions.

There is one thing before closing that can be said, and that is that the old objections raised to asphaltic oils as fluxes are no longer tenable. I have found asphalt oils that lose less and are much less changed in all respects on being kept at high temperatures than some of the best petroleum residuums. There are several asphalt cements that I have found, two of which are on the market, that contain no petroleum residuum, but yet lose less and are less altered in consistency than a Trinidad asphalt cement made with residuum.

RUSSIAN PORTLAND CEMENT SPECIFICATIONS.

In the course of an interesting lecture on cement specifications and tests which was recently delivered by Mr. R. W. Lesley, Assoc. Am. Soc. C. E., before the Engineers' Club of Philadelphia, he cited the specifications of the Russian government as of particular value because of their provision for two distinct series of tests, one to be made in the scientific laboratory of an expert tester and the other with the more limited facilities and ruder methods available on the site of the work. Through the courtesy of Mr. Lesley "The Engineering Record" is able to present the following abstract of these novel requirements:

Rule 1.—It is to be desired: That casks of cement furnished for building purposes be of

uniform weight, say, 180 kilos gross and 170 kilos net. That upon each cask be plainly stamped the trade mark of the factory and the weight, both gross and net. That the loss of cement from spilling and for difference in filling casks should not exceed 2 per cent.

Rule 2.—Cement intended for building purposes should always be of the slow-setting kind, for such cements are more easily worked, are more reliable and possess greater power of adhesion. Cement is considered slow setting when it does not set before the expiration of three-fourths of an hour after mixing the paste. Portland cement hardens more slowly as the temperature falls; therefore, to avoid misunderstandings, all tests should be conducted in a room having a uniform temperature of 15 to 18 degrees Centigrade, and only water of about the same temperature should be used. During the process of setting slow-hardening cements generate but little heat, while with the quick-setting a considerable rise of temperature may ensue. To ascertain the time of setting, a cake of pure cement, prepared upon a glass plate, is taken. After the lapse of the above mentioned time this cake must have acquired such a degree of hardness that the passage of a finger nail gently grating it should leave no trace and no water ooze out when the surface of the cake is lightly rubbed.

Rule 3.—A cement cake prepared upon a glass plate and immersed in water some time after setting should, after remaining under water 28 days, show no cracks or warping on its edge.

Rule 4.—Portland cement must be milled into as fine a powder as possible. After passing through a sieve of 900 openings to the square centimeter there should in no case remain upon the sieve a residue exceeding 20 per cent.

Rule 5.—The adhesive power of Portland cement is determined by submitting to tests of rupture a mixture of cement and sand, 7 and 28 days after making the mortar, and also the pure cement after 7 days. The tests must all be made with the same apparatus, with samples of similar section, in an identical manner. For normal tests normal sand is employed, prepared from natural quartz sand, which is passed through a series of sieves and washed. The section of samples at the point submitted to rupture must be 5 square centimeters. In making samples, all their component parts must be taken by weight.

Rule 6.—A mixture of one part of cement to three of normal sand, 28 days after setting, must bear, as its minimum power of resistance to rupture, a strain of 8 kilograms to the square centimeter. Normal sand used in massing samples is prepared thus: A quantity of natural sand is passed through sieves of 64, 121 and 225 meshes to the square centimeter. Next the portion which shall have remained upon the sieve of 64 meshes and that passed through the sieve of 225 meshes, are thrown away, and the sand remaining on sieves of 121 and 225 meshes is mixed in equal parts; this mixture constitutes normal sand. To make cement paste or mortar water is added in the proportion of 50 per cent. by weight of pure cement, or 12½ per cent. by weight of the dry mixture of cement and sand. This rule is to be applied if the manufacturer whose cement is being tested does not beforehand state what proportion of water is best used with his cement. To attain all possible uniformity of quality, in cases where cement of the same brand is received in several lots, tests of pure cement are made.

In choosing cement for construction preference is given to that factory whose cement, all other qualities being equal, gives the greatest resistance to rupture after 7 days tested pure. Pure cement after 7 days must, when tested by rupture, bear a strain of no less than 21 to 25 kilograms on the square centimeter.

In preparing samples out of pure cement water in proportion of one-third of the weight of cement is added, i. e., when the process by absorption is used. Samples intended for testing must remain exposed to the open air during the first 24 hours after they are made and then be kept in water till the moment of being tested. At each stage (7 and 28 days) of the experiment, ten briquettes must be broken when testing cement of an unknown firm or brand for the first time; for cement of a known brand at least five briquettes are necessary. When the normality of a cement is determined in a laboratory then simultaneously with the test after 28 days, a test of the mortar after 7 days must also be made, and the ratio of the two determined. It is necessary to know this ratio when making quick control tests. Mortar consisting of one part cement and three parts of normal sand must have a tensile strength after 28 days of 8 kilograms on the square centimeter, or, after 7 days, of not less than 5 kilograms to the square centimeter.

Rule 7.—All the tests enumerated in the preceding rules determine the normality of a cement of a given brand. For cement of a known brand, in order to save time (especially when tests are necessary at the location of constructions) control tests are allowed to determine: *a*, The time of setting. *b*, The property of briquettes made from pure cement to remain free from cracks and warping during 7 days. *c*, The fineness of the grain. *d*, The resistance to rupture after 7 days of pure cements and mixtures with sand. The resistance of a mortar composed of one part of cement to three parts of normal sand, 7 days after being mixed, must in no case be less than 6 kilograms per square centimeter. Should the cement respond to all requirements from *a* to *d*, excepting *d*, then the tests may be adjourned for 28 days, when the cement must undergo all the tests provided for in Rule 6.

The following explanations of these rules are given:

Rule 1.—Uniformity in the weight of casks of cement is proposed in the interest of buyers, because prices are usually made at per cask. The weight of 180 kilograms is suggested because it is the weight per cask now most frequently met with in international commerce. As a general thing furnishing cement in sacks is considered inconvenient except when it is to be used at the place of its manufacture or in a locality in easy communication with its factories.

Rule 2.—It rests with the manufacturer to give to his cement the property of not setting before a certain given time, for this depends chiefly on the component parts and of the process of burning. For determining the time of setting a sufficiently thick paste is made out of pure cement and poured upon a glass plate, in the shape of a cake having a thickness of about 1.5 centimeter in its middle and thinning down to nothing at the edges. Water is added in the proportion of one-third of the weight of cement.

When determining the time of setting for any cement it is desirable always to have stated how long the cement has been in the warehouse. Although cement setting in half an hour may be said to be slow-setting, still, in view of the difficulty of observing the true moment of setting and the lessons learned from several years of experience with these specifications the least time of setting now appointed is three-quarters of an hour. Any cement answering in all other respects the requirements of these rules, but setting before three-quarters of an hour, not sooner, however, than 30 minutes, may be accepted, but preference must be given always to a cement setting more slowly.

Rule 3.—Cracks and warping on the edges of the cake show that all the processes of the formation of silicates did not proceed conjointly; also that free lime is present. As a consequence of these defects the power of resistance in the already hardened cake is diminished. When experimenting according to Rule 3 the cake of cement is immersed in the water one hour after setting. The defects in cement mentioned in the rule may appear even sooner than 7 days after the mixture of the mortar.

Portland cement which had been warehoused during a month and a half or two months in a dry place is preferable for use to fresh cement.

Another test having reference to this rule is to pour a thick paste of pure cement in the shape of a cake, thinned down toward its edges, on a tile or brick which has been soaked in water and then had its outer surface dried. The cake on being immersed with the brick in water some time after setting must cling to the brick or tile and show no warping or cracks at the edge.

Rule 4.—Cement is almost exclusively used with an admixture of sand, often in large proportions, and we know that the finer the grain of cement the greater the force of resistance acquired by the mortar, for a greater number of particles of cement enter into adhesion with the grains of sand. Therefore milling cement as fine as possible is of great importance, as fine cement adheres more closely and strongly to the grains of sand. Experiments have demonstrated that with the present degree of perfection attained in cement manufacture it is quite possible to require the residue on a sieve of 900 meshes to the square centimeter to be no greater than 20 per cent.

Rule 5.—The best test for Portland cement is to submit it to the action of mechanical forces and determine its resistance to rupture or to crushing. Although in practice cements are usually subjected only to pressure, yet having in view the expense of apparatus for making compression tests and their difficulty, it is generally conceded to consider tests by rupture as sufficient, the more so as experiments prove the existence of an almost constant ratio between the resistance opposed by cements to rupture and that to crushing, namely, about one-seventh to one-eighth. For experiments by rupture the apparatus of W. Michaelis, Berlin, which has also the necessary appliances for making briquettes, is recommended.

Rule 6.—Although the quality of cement mortar depends upon the properties of the component parts of the cement and the fineness of the grain, still the decisive tests in this case (with mortar) must be the power of resistance exhibited by a mixture of cement and sand; for, by experimenting with pure cement alone, no true determination of the power of adhesion between the particles of cement and sand can be obtained.

To attain results as true as possible a mixture of cement with a large proportion of sand is taken, namely, one part of cement to three parts of normal sand by weight. The 7-day tests of a mortar do not yet give a definite conclusion as to the power of adhesion between the particles of cement and sand, for it may happen that cements showing inferior power of resistance at the 7-day test may surpass others in that power at the 28-day test.

Lastly, it is deemed useful to submit pure cements to tests, as this may induce manufacturers to produce cements of a superior quality, for it has been noted that the adhesive power of comparatively inferior cements may be to a certain extent increased by milling them to a finer grain.

When normal sand is prepared for a whole series of experiments it is best to repass it, from time to time, through sieves.

The water in which samples lay immersed must be changed as often as possible.

Rule 7.—Experiments have demonstrated that in control tests it is not sufficient to determine the fineness of grain and power of resistance of pure cement at the 7-day test, therefore it is enjoined to submit to test also a mixture of cement and sand in the proportion of one to three. Such a mixture in control tests must show at 7 days three-fourths of the resistance determined in the 28-day test, for it has been found impossible to obtain a normal resistance on the 28-day test from a mortar whose power

of resistance at 7 days is not equal to from two-thirds to three-fourths of the 28-day test.

Instructions for Making Briquettes.—Briquettes for tests must all be prepared in as uniform a manner as possible according to certain fixed rules and propositions adopted in the standard specifications.

Cement and Sand Briquettes.—Having weighed the cement and sand in the ratio of one to three, these ingredients are carefully mixed; then water is added in the ratio of 12½ per cent. by weight of the dry mixture and the mass is kneaded until it becomes perfectly homogeneous. In this state it presents the appearance of a very thick paste resembling freshly dried earth, and can easily be kneaded by hand into lumps. This paste is then put into molds, which have been well cleaned and slightly wetted with water. The molds must be filled at once and considerably heaped over. Next the mixture is beaten down into the molds with an iron spade weighing 150 to 200 grams; at first gently, then more and more vigorously until the mass becomes elastic and water begins to ooze out on the surface. Then the mass rising over the mold is carefully trimmed with a knife. When the briquette is sufficiently hardened it is carefully removed from the molds and placed upon an elastic (gypsum) plate, with some sheets of slightly moistened blotting paper below it. Adding cement paste after once the molds have been filled is not allowed.

Neat Cement Briquettes.—A paste is made of pure cement and one-third of its weight of water, which is poured into molds placed on some porous highly hygroscopic plate or surface, preferably on a slab of gypsum, slightly moistened paper being put under the molds. Next the plate is lightly struck with a hammer or moved to and fro. By so doing the cement in the molds is put into motion and settled more evenly. For this same purpose also, before the paste stiffens the molds are turned upside down, so that the portion of the paste which has been at the bottom now comes on top. A little more of the cement mixture is added and the molds are again shaken.

As soon as clear water disappears from the surface the surplus paste is cut off with a straight and pliable knife, and after gently striking the molds they are gently lifted off the briquettes. After a little while the blotting paper is removed from under the briquettes and they can then be put on glass or marble plates.

In making sample briquettes of pure cement it is of the greatest importance to see that the gypsum plates on which they are set be highly hygroscopic, that they are cleaned and carefully dried and replaced by new ones when required. All this care will prevent the weakening of the briquettes.

In these standard specifications it is everywhere understood that the sample briquettes of pure cement are prepared by this process.

THE STATE, WAR AND NAVY DEPARTMENT BUILDING, WASHINGTON.

(By G. W. Baird, Chief Engineer, U. S. N., Superintendent.)

The building of the State, War and Navy Departments, in Washington, D. C., is the official home of three executive departments, which are domiciled under the one roof, affording the most convenient intercommunication one with the other. The building is of granite, iron and brick, and is probably as near being fireproof as any building in the world. It cost ten and a third million dollars. Its east and west dimension is 342 feet, and its north and south dimension, 565 feet. It has a center wing and two court yards. It is seven stories in height, surmounted by four pavilions. The stairs are of granite; the balusters of deoxidized bronze; its frescos and decorations are in the highest state of the art. On the east pavilion is a pole on which the "time ball" is raised, and dropped at noon from an electric connection from the Observatory. The pole is about 22 feet high and the ball drops 21 feet. The height of the curb, at the east wing, is about 56 feet above mean tide, and the height of ball above ground is 171 feet, or about 218 feet above mean tide. The latitude of the pole is 38° 53′ 51.18″ north; longitude, 77° 02′ 19.16″ west. The corridors of the building are tiled in black and white marble and aggregate a little over 2½ acres in area. Two acres more are taken up by the court yards of the building and the surrounding pavements. It has eight hydraulic elevators, running at a mean speed of 275 feet a minute, and in the cellar there are eleven steam boilers, aggregating 745 horse-power, and twelve hot-water heating-boilers, aggregating 300 square feet of grate surface and 21,196 square feet of heating surface. The heating plant, which has been described in these columns,* was constructed and installed by Messrs. Bartlett, Hayward & Company of Baltimore, and is probably the largest hot-water plant in the world.

The building was provided originally with 6,000 gas jets, and it was found that the mean number of jets used for 24 hours a day was 144; subsequently an electric-lighting plant was installed, commencing with 1,500 lamps in 1890 and increasing to about 2,600 in 1899, and the mean number of lamps in constant use now is 360. When the building was completed, its machine tools were a jeweler's lathe and a grindstone, operated by foot-power; to-day it has a machine shop, plumber shop, smithy, a small brass foundry and four carpenter shops. In these shops are up-to-date power tools, which enable the men to make most all the repairs. The buiding is under the care of the Secretaries of State, War and Navy, who have an engineer officer of the Navy as Superintendent. On the rolls of the Superintendent are 214 people, 61 of whom are watchmen, 10 engineers, 28 firemen, 80 char-women, 10 conductors, 17 laborers and 8 skilled mechanics. On the rolls of the three Departments there are 3,100 people, officers, clerks, messengers and laborers.

The electric plant is in duplicate, and the Edison three-wire system is used. In each plant there are two 40-kilowatt bi-polar Edison dynamos, driven by a 14½x15-inch McIntosh non-condensing engine, with rope transmission; the engines make 250 and the dynamos 1,000 revolutions per minute. For want of available funds at the time, the wiring was cribbed. There are five risers, which connect to the crib circuits on each of the seven floors, but as subsequent funds became available switches have been introduced into the cribs, and some independent circuits run. The dynamos also light the Executive Mansion and three small buildings which are used by the War Department. The total number of lamps in the State, War and Navy building is 2,591, in the Executive Mansion 997, and in the small buildings 48, making a total of 3,636 lamps. There are 347 electric fans in the building and 14 in the Executive Mansion. There are 15 electric motors in the main building, two in the Executive Mansion and one in the small building. The number of watts required to bring the lamps to a glow is 181,250, to drive the fans 34,674, and to drive the power motors 24,618, making a total of 240,000 watts that might be required. As the output of both plants is 160,000 watts, it appears that the possible requirements exceed the maximum output by 50 per cent. It happens that the light is needed mostly in daytime by the clerks in the State, War and Navy Building, but at night only in the Executive Mansion. During the year 1898 the maximum indicated load, which did not last one hour, was 25 per cent. in excess of one plant. The mean load for a day was 34.2 per cent. of the capacity of one plant, the mean load during office hours 48.6 per cent. and the minimum load on Sunday 9.42 per cent.

*An illustrated description of the ventilation and heating of this building was given in "The Engineering Record" of January 22, 1887.

The overload occurs but seldom, and on these occasions the other plant is started.

There are, besides, two printing offices in the building, one having three presses and the other four presses, a cutting and a stitching machine. These presses were formerly driven by steam engines, which were much too large for the work, and were connected with long and crooked steam and exhaust pipes; besides this, the engines were kept running whether the presses were in operation or not. Motors have been substituted for the engines, one for each machine, and a saving of coal was at once observed. Unfortunately, there was no means of measuring the quantity of steam the engines used, or, in fact, of separating the steam used for different purposes, but the saving of coal was apparent. The motors are of the Crocker-Wheeler make, compound wound, with accumulator coils, having both armature and field regulation, giving a wide range of speed, with the least consumption of current. Each motor has an automatic circuit-breaker, the purpose of which is to break the circuit in event of an overload.

A number of fan motors were tested, and averaged 95 watts per fan; they were 12-inch fans, Lundell, Holzer-Cabot and other makes.

A great variety of makes of lamps have been used in the building, but none are accepted without test. They must come within 5 per cent. of the specification, which requires at 112 volts 16 candle power and 3.1 watts per candle power. A lamp of 16 candle power which will give a candle power for 3.1 watts will glow about 500 hours and costs 18 cents. In 1,000 hours two of these lamps would be consumed, at a cost of

$$\left(\frac{3.1 \times 16 \times 500 \times \$.04}{1,000} + \$.18\right) \times 2 = \$2.34,$$

the cost of the current being figured at 4 cents per 1,000. But a 4 watt lamp, at the same price per lamp, would glow 1,000 hours and would cost

$$\frac{64 \times 1,000 \times \$.04}{1,000} + \$.18 = \$2.74.$$

The saving would be in favor of the 3.1-watt lamps by nearly 14 per cent. The lamp which will glow a great many hours will become red and lose brilliancy. A 20 candle power lamp at 12 volts will become about a 16 candle power lamp at 105 volts, and its duration more than doubled, but it will require much more current per candle power. Salesmen who understand this so well might readily impose on a customer. The photometer used in the building is provided with means for testing gas as well as electric lamps, the volume and pressure being measured by a Heine & McIlhenny meter. The volt indicator has a rheostat by which the voltage may be conveniently reduced.

Any lamps sent for test receive attention, though the manufacturers are sometimes disappointed. An officer in the Soldiers' Home sent us some lamps for test. They had been placed in his circuit and glowed brighter than his other lamps, although both of the lots were marked 110 volts, 16 candle power. The lamps averaged from 19.6 to 23.3 candle power at 110 volts and required 2.9 watts per candle power.

Another lot of lamps sent for test were marked 20 candle power and 70 volts; they gave 20 candle power at 68.5 volts, 3.2 watts per candle power. The test was made by varying the voltage until 20 candle power was reached.

Another lot of lamps marked 16 candle-power, 112 volts, averaged 16.05 candles, varying from 15 to 17.6, using 3.02 watts per candle-power. Another lot marked 20 candle power, 112 volts, gave a mean of 19.97 at 2.94 watts per candle-power.

An old Edison lamp which had glowed about 1,000 hours gave 15.44 candle-power at 4.14 watts per candle-power, having lost nearly 23 per cent. of glow and required 33 per cent. more current.

An old "Economic" lamp which had glowed at least 1,000 hours was reduced from 16 to 5 candle-power, and required 8.9 watts per candle-power.

One-hundred-and-twelve-volt lamps are bought, as that is the mean indicated pressure on the lighting lines. The pressure ranges from 113 to 115 volts at the poles, depending on the load, which is regulated by the voltage on the second floor, where most current is used. As the lamps glow perceptibly below candle-power, they are shifted nearer the dynamos, where the pressure is higher, and when they drop to about 12½ candle power we reject them. In this way we get a better service from our lamps, having reduced the renewals to 60 per cent. of the installation annually. This, I think, is a better result than central stations can get, for the reason that their customers nearer the station would object to being served with old lamps.

In the State, War and Navy Building there are about 6,000 gas jets, most of which are on chandeliers, answering admirably for the general illumination of a room, but not for the desks of clerks. I have put about 500 Welsbach burners on gas jets, which give more light and use less gas than the original tips. Some of the mantels have been in use two years, others are soon destroyed. The destruction of mantels is more from the little explosion that occurs in lighting than from their use.

Following is a number of tests on gas jets:

Name of burner.	Press. in. of water.	Ft. of gas per hour.	Candle power.	
International incandescent..	1	8	28	(1)
Welsbach	1	2	29	....
Richardson	1.1	2.2	32	(1)
Richardson	1.	4.	17.5	(2)
Ballard	1.	6.3	23.	....
Ballard	1.1	1.35	0.8	(3)
Ballard	1.	5.3	22.4	(2)
Ballard	1.	5.	18.8	(4)
Ballard	1.	5.2	16.	(5)
Beacon Co.	1.	8.	16.	(6)
Beacon Co.	1.1	5.	21.1	(7)
Acme	1.1	1.7	12.	....
Matchless	1.	4.2	17.6	....
Matchless	..	0.05	..	(8)
Argand	1.	4.1	16.8	....
Bray	1.	4.	12.1	....

(1) Similar to Welsbach; (2) lava-tip fish-tail; (3) brass-tip pin-hole, flame, 4 inches high; (4) iron-tip fish-tail; (5) brass-tip fish-tail; (6) two jets on one cock, fish-tail; (7) lava-tip, two pin-holes; (8) turned down to its stop.

The area of the copper roof of the building is about one-third of an acre. The framing of the roof is iron, with channel bars for purlines, under which is corrugated iron plates, allowing for expansion; on the corrugated iron is cement and on top is the tinned copper sheathing sufficiently curved between the creases to allow for expansion. Notwithstanding it requires the labor of one workman to keep the copper tight. During the last three months of 1898 he put on 122 patches and soldered 66 leaks.

A constant source of anxiety is the plumbing. There are 217 water closets, 92 urinals and 40 sinks in the building. During the past three years 75 water closets have been replaced, some having been in use 20 years. None but tank closets are now put in. These give a strong, copious flush, without wasting the water. The closets are all ventilated into a triangular space surrounding the large chimneys of the building, exhausting the air from them so that the building is always free from disagreeable odors.

The city water flows into the buildings from three directions, but the pressure is so feeble that it will not in day time carry the water above the second floor. A Davidson house pump in each wing pumps into tanks. To economize fuel I connected the water service of all the wings and found that one pump, a No. 8½ Davidson, was sufficient for the purpose. This pumps into the highest tank, which is provided with an alarm. The other tanks, which are about 3½ feet lower, have been provided with automatic valves which close and prevent overflow. On the pump I have placed a counter, enabling the quantity of water used in the building for all purposes to be calculated excepting that supplied the boilers. For the last half of 1898 the water per capita per day was 56.5 gallons. A year ago it was 77 gallons. The reduction is due largely to the increased number of employees, but partly to the introduction of tank closets. There is a constant loss, such as the automatic flushing of urinals, leakage, etc., which diminishes per capita as the personnel is increased.

THE STATE, WAR AND NAVY BUILDING, WASHINGTON, D. C.

There were originally six steam boilers, isolated from one another, each requiring a separate fireman. Since the building was completed five boilers have been added, set in pairs as far as possible to utilize labor. One fireman now attends a pair of boilers. Three steam engines operating elevators have been replaced by hydraulic machinery. The aggregate grate surface in the steam boilers is 209½ square feet and in the heating boilers 300 square feet. We burn about 4,800 tons of hard white ash anthracite per year. It is weighed on our scales in the courtyard and payment is made for it as soon as it is delivered. The coal mines bid on the coal and better prices are realized than many of the local dealers obtain. None but smokeless coal is burned in our furnaces.

The building is as nearly as possible fireproof. The ceilings are arched, of brick and iron, cemented on top; the floors in the rooms are of wood, in the corridors, of tile. The partition walls have iron laths. Beside the carbonic acid fire extinguishers, placed conveniently, I have put the Grinnell automatic sprinklers in all places where a fire is apt to occur, such as carpenter shops, cabinet shops, printing press rooms, waste paper rooms, etc. In this sprinkler a fusible alloy plug melts at 125 degrees, releases a valve and starts a stream of water. There are also fire-alarms, which are operated by push buttons.

There are 22 Gardiner clocks in the building which connect with the Observatory and correct at noon. The time ball, on top of the building, is in line with the principal avenue of the city, and its fall is watched by many people.

Though there are six disbursing offices in the building, it rarely happens that any great amount of money is ever locked up in their safes, as large payments are made by Treasury draft. The watchman's time clock, a monitor which never forgets, obliges these guardians to make their tours and "turn in" their signals at stated hours.

There are 16 entrances to the building, 12 of which are closed at 2 P. M., for at that hour the Secretaries begin to sign their mail, and must not be disturbed.

The charwomen come to work at 6 A. M. and finish by 9. The corridors are scrubbed every day with a strong alkali and are swept every day.

There are 1,572 windows in the building. They are not as large as it was formerly the custom to put in large buildings, but they are so placed as to light the desks better than in any building in Washington.

In the reception rooms of the Secretaries are the portraits of all the past Secretaries, and some few very distinguished officers, as Generals Washington, Grant and Sherman, Commodore John Paul Jones and others.

In the Department of State the original Declaration of Independence and other great State papers are kept. Here, also, are all the treaties ever made by this Republic, the signatures of kings, princes and potentates, among them an autograph letter of Queen Victoria expressing sympathy at the death of President Lincoln.

Each department has its own library, and, though the shelves are full, yet few works of fiction are found there. Each library is devoted to the literature, principally history, peculiar to its own arm of the public service and of similar branches of foreign governments. The files of newspapers are bound in the building, and extend back into the time of the Colonies. The libraries are as nearly fireproof as it is possible to make them. The floors are tiled; galleries, staircases and book-stacks are of iron.

All the telegraph and telephone wires to the building are under ground; there is nothing to mar its beautiful exterior. All the window shades are of the same color, and at the end of the day's work the shades are placed at half height, which adds to the uniformity of appearance. The accompanying illustration is a view of the north and east fronts decorated with American flags on a holiday.

THE MUELLER PUBLIC BATHS AT MUNICH.

Through the generosity of a Munich engineer, Mr. Karl Müller, the Bavarian capital was recently enabled to erect for public use a large bathing establishment of the class already owned, in some size, by many of the important German cities. The design of the structure was entrusted to Mr. Hocheder, who described it in a recent issue of the "Centralblatt der Bauverwaltung." Before the actual planning of the baths was undertaken this architect visited Berlin, Hamburg, Bremen, Elberfeld, Crefeld, Dusseldorf, Cologne, Frankfort and Stuttgart, cities in which large public establishments of this sort had been in operation for a longer or shorter time. His impressions of this tour of inspection are reported as follows: "However great was the profit from the point of view of the practical carrying out of the work, in artistic matters few precedents were found, for the Munich bath was to have a unique detached site, while in most of the places visited the exterior

did not lend itself to treatment; moreover it was generally the case that only a part of the bath faced the street, while the remainder extended back into the courts. The only entirely detached baths were those on the Schweinemarkt and in Eimsbüttel in Hamburg, at the Schillingsbrücke in Berlin, and particularly the city baths of Bremen. The Cologne bath has a palace-like appearance from the street, which does not give an impression of the purpose of the building, and the same is true of the more simple Elberfeld structure. The Crefeld bath resembles, outwardly, a dwelling house built for rental, and in Stuttgart parts of the bath are backed up like stone walls on the street."

The Munich building covers an area of nearly 4,000 square meters, without the court but inclusive of a dwelling house which was originally intended for public purposes, but will probably be turned to private uses. This house blends the style of an adjoining block on the south side of Zweibrückenstrasse with that of the bath. An old street, which had to be retained as much as possible, leads to a reentrant court and across it to the entrance of the bath. A street which formerly passed over the site of the bath has been turned aside to an arcade 19 2-3 feet wide, running under the dwelling house previously mentioned and affording access to a nursery and the city electric station. An excellent view of the building will be obtained from the Ludwigsbrücke and Quaistrasse, both places noted for their picturesque outlooks, and these varied conditions called for clean-cut blocking of the masses of the building, agreeable outlines and harmony with the attractive surroundings. The accompanying view of the building, Figure 1, shows the river front.

The determining feature in planning the rooms was the separation, beginning at the office, of the two main portions of the building for men and women, respectively. It was also necessary to provide corridors by which both sexes could reach the Roman-Irish bath, which was to be used by each sex alternately, and the lunch room; these corridors had to be reached without entering the part of the building where the rooms for the men and women were cut off from each other. It was also desirable to locate the swimming pools in the back of the building in order to make the passageways as short as possible. In accordance with this programme, the establishment has a swimming pool for men, one for women, a Roman-Irish bath for both sexes, 102 tub baths divided equally among the men's and women's quarters, and shower baths in the basement, reached by an independent entrance.

The rooms are divided among the several stories in the following manner. In the basement there are, in addition to the shower baths for 21 persons, the laundry and drying rooms, apartments for the employees, an engine room, lavatories, six medical baths and other chambers. The light court runs down to the cellar. On the first floor, of which Figure 2 is a plan, the visitor steps through an entrance hall into the office, which is located under the tower. On each side is a waiting room, lighted from a court above, on the right for men and on the left for women, from which passageways lead to the tub baths or the pools. Behind the office, in the main axis of the building, is the tank for men, while that for women is reached by a corridor running to the left. On the men's side of this floor are 16 tubs and a barber shop, while on the women's side there are but 6 tubs, the number being reduced to provide room for the lunch room and the Roman-Irish bath. On the first story are placed most of the tub baths, 19 on the men's side and 29 on the other, with the necessary lavatories and storage rooms. Fourteen of the tub-bath rooms on the men's side can be cut off from the remainder and put in communication with the women's section of the building if its accommodations are not sufficient at any time. The second story contains 12 tub baths for men, and rooms for the use of the janitor.

The shower baths could be placed to advantage in the basement on the river side of the building, because the walls are exposed and the lighting of the interior leaves nothing to be desired. The baths are reached through a stairway at the left of the entrance hall. Near the foot of the stairs is the waiting room for a few medical baths and the 21 shower cells. Each of the latter consists of a dressing and a douche room, the douche room being provided with marble fittings for greater cleanliness.

The plunge bath for men is in a room with an arched roof, and is a basin 100.4 feet long, 40.2 feet wide and 8.2 deep at the lowest part, lined on the bottom and sides with enameled tiles. The iron rods placed along each side of the pool for the bathers to grasp are overhung by the coping stones, so as to avoid any danger of their catching the feet of men diving from the sides. The water is handled by pulsometers and passes in a slow, continuous stream into and from the tank, which is entirely emptied and cleaned twice a week. The dressing rooms are so arranged that the visitor can reach them only through an outer passageway, and can have access to the swimming rooms only after disrobing. The rooms are arranged in two stories along each side of the swimming hall, with 44 rooms on each floor, and a large open dressing room at one end of the upper floor. On the ground floor below this large room is the washing room for men and boys, with a warm room

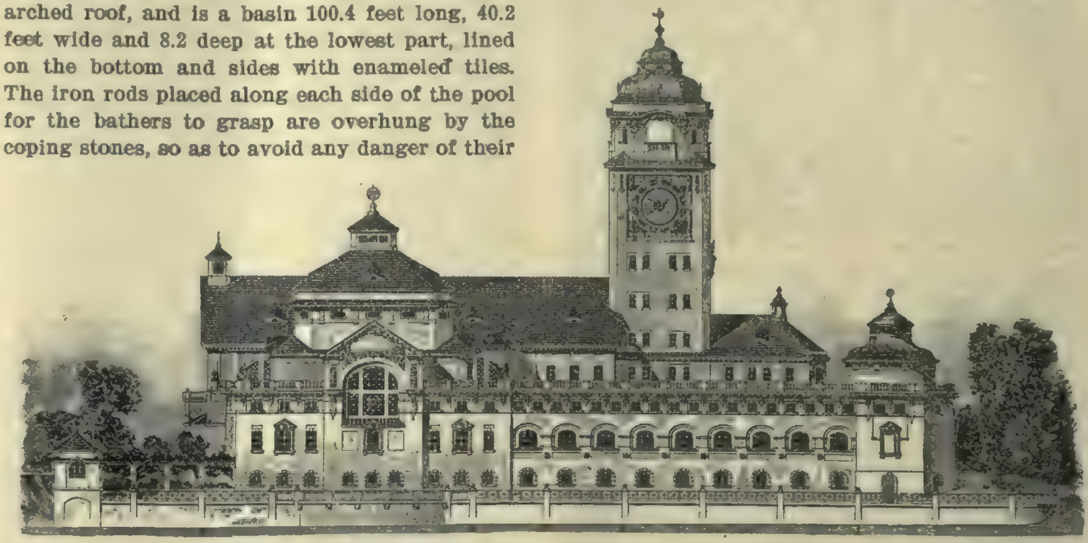


FIGURE I.—VIEW OF THE MUELLER BATHS FROM THE WEST.

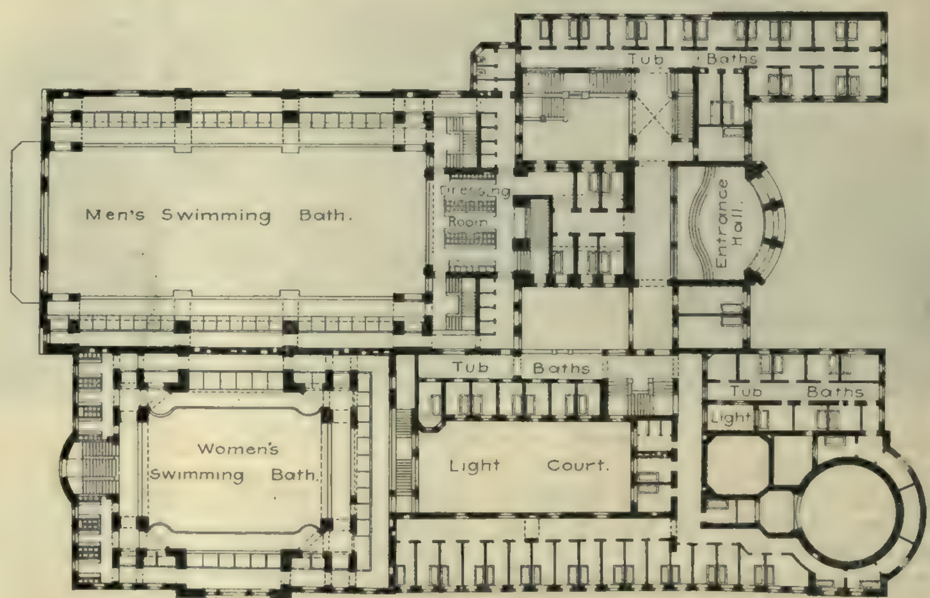


Fig.3 First Floor.

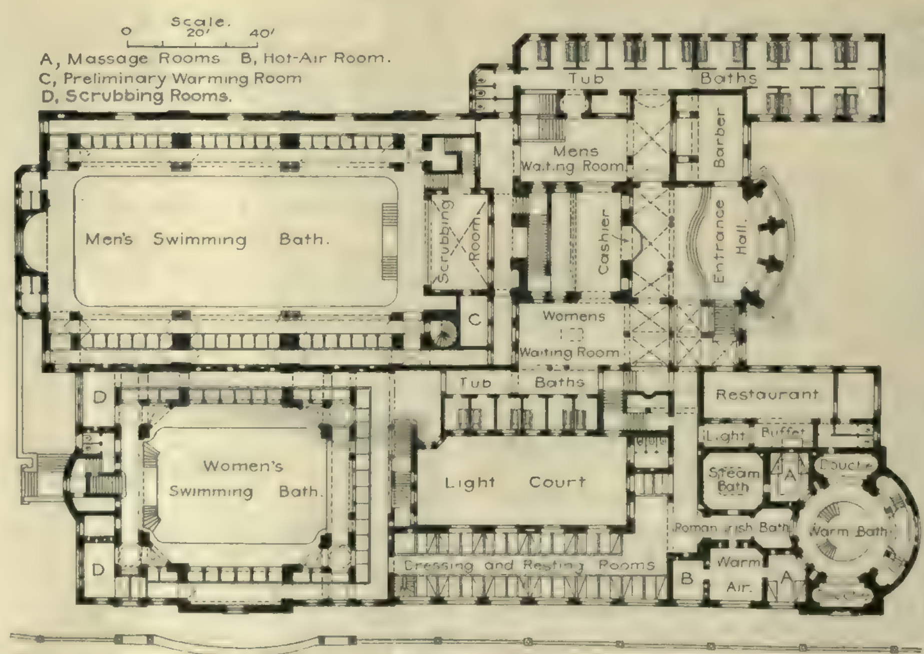


Fig.2 Ground Floor.

FLOOR PLANS OF THE MUELLER BATHS, MUNICH.

opening off it. The washing room is provided with douches and foot baths, and here every bather must be washed before he is allowed to enter the tank. The dressing rooms have wood partitions. The outer doors leading into them open inward and are held fast during the use of the room by a folding seat. The inner door opening into the passageway to the swimming hall can be locked by the bather. Ample lavatory accommodations are provided on each floor.

The women's swimming tank is 57.8x35.1 feet in plan, and is fitted out like the men's tank. There are 33 dressing rooms on the ground floor and 34 above, with a large public dressing room at one end, over the washing room.

The 102 bath tubs in the different stories are of masonry, lined with enameled tiles, and are sunk a third of their depth in the floor, so as to be used more easily. The floors are of concrete, covered with tiles, which are also used on the walls to a height of 5.9 feet. Each room is heated and ventilated and completely independent.

In the Roman-Irish bath the visitor passes from the entrance hall into the dressing and resting rooms, there being 29 of the latter. From these the bather passes into either a steam room or a warm-air room communicating with a hot-air room. From these he goes to the massage rooms, the douches and the plunge bath. The last is to be attractively fitted out, with a circular, luke-warm pool in the center and three recesses around the circumference for douches and a cold pool. The floor and walls, to a height of 13.1 feet, are to be covered with limestone slabs, those on the walls being polished. While the dry-air baths are fitted with the customary decorations of rooms, the steam bath will receive special treatment on account of its dampness, and its walls and ceiling will be entirely covered with tiles. The Bloch apparatus has been selected for this room. The hot air of the bath room is passed over finely divided sheets of water and is thus saturated without the attendant mist and vapor which many bathers find unpleasant in other steam baths.

The establishment will be heated by steam from the electric power station in the vincinity, and have electric lights. The water supply is to be furnished in part by the municipal works, and in part drawn from an old well. It is expected that the structure will be opened early in 1900, and that its total cost will amount to $375,000. The basement and ground floor are at present completed, so far as the heavy work is concerned.

THE FIRE RISK IN FIRE-PROOF BUILDINGS.

In view of the fact that the fire losses in this country average about a third of the annual appropriations of Congress, the subject is evidently an important one, and it is not surprising, therefore, that the Chamber of Commerce of New York has ordered printed an interesting paper by Mr. R. W. Gibson on a special feature of fire risks, those in high buildings. The great height, exposure and internal arrangement of such structures have increased the risk materially. While the owners of buildings as investments may prefer to pay a double insurance rate to introducing the best fire-proof construction, nevertheless the occupants of the offices, whose business affairs are so deranged by fire that no insurance can compensate them for the loss, will regard the matter in another light and consider the increased immunity from danger worth the increased rent.

As a basis of comparison of different types of construction in a large office building, Mr. Gibson assumes a structure of the following general dimensions and design:

The building is about 50 feet front, on a street so wide that the opposite side does not affect it. It is about 100 feet deep and 16 stories high, built under the present regulations of the New York building law for fire-proof buildings with liberal expenditures in customary lines. It has on one side a similar fire-proof building, and on the other side a six-story building of non-fire-proof construction. The rear has on one-half its line fire-proof and the other half non-fire-proof buildings. There are windows on all sides in considerable numbers without shutters, or with a few shutters which are not regularly closed. The windows toward the fire-proof building open on a court used in common, being recessed into both buildings. The rear windows open on a yard. The other side windows open over the roof of the combustible building, or on a court slightly receding from it, which is practically the same. This building is insured at an annual premium of 16 cents on $100. This is not stated as a constantly correct estimate of the risk, but only as an assumption for purposes of comparison, because the clearest method of comparison of details is evidently in terms of their value in insurance premium, and, if the stated rate is too much or too little for the building described, the rates calculated therefrom can be all reduced or increased by the percentage of error.

The building has brick and stone walls, partly massive and partly filled in on a steel skeleton. Floors are of steel beams with terra-cotta arches finished with tiling in halls, etc., but with wood in offices, and under the wood are spaces where the tops of beams are exposed. There should be concrete filling up to the bottoms of sleepers, at least, and covering the beam tops, and on this a filling between sleepers of mineral wool or dry sand, or other material, up to under side of floor boards, to prevent fire entering. The soffits of beams and girders are covered sometimes with terra-cotta, but often with only 1 inch of plaster on metallic lath. The covering, if of plaster, should be in two layers, one close to the metal, the other furred out with an air space between the two. The columns are of steel or cast-iron, with 2 inches of terra-cotta covering, but it is carelessly bonded and anchored, and often pipes are admitted beneath it, and it is, consequently, too easily knocked or warped off.

The main partitions are of terra-cotta, but they have numerous sashes and doors for light and access to halls, and these are all of ordinary wood and glass, and they have rough wooden frames and posts built into the partitions, so that practically the whole structure has very little fire resistance. There are secondary partitions of metal lath plastered solid and fire-proof, but they often stand upon the wood floor with spaces beneath, and when the floor burns they of course drop away from the ceiling and partly fall. All partitions should stand on the fire-proof elements of the floor. All the windows have sashes and frames of wood.

The stairs have iron strings and risers and marble treads, all exposed underneath. There should be a plaster soffit on metallic lath, and terra-cotta or plaster covering to the strings, and if there are windows near, by which flame might reach the stair, the soffit should be doubled by first plastering close to the treads and risers. The elevator shafts are all open to every floor and to one another.

The insurance rate on this building is assumed to be 16 cents on $100, as before stated, and the main purpose of the paper is to show the effect of partial improvements on this maximum rate. The items must be taken in a certain order, because the later ones depend upon the earlier; for example, metallic sashes must be introduced before wire glass can be utilized. Each item represents, not the value separately, but the sum of it and all the preceding items. "The table makes clear two important points, the interdependence of many of the items and the comparatively small value of any one taken alone. A strong tendency arises in recognizing the need of an improvement to attach an excessive value to it, and only by bringing all into sight at once can their true places be found in the total and their relative worth assigned."

ITEMS OF IMPROVEMENT.

a. If all windows and frames and trim made incombustible iron or fire-proof wood (but ordinary glass and no shutters), 7.

b. If in addition to above, all wood wainscots and base boards, wood partitions, jambs and trim abolished (but doors and partition sashes remain wood and glass), 11.

c. If in addition to above, all flues made distinct, so as not to lead fire by two rooms being on same flue, 12.

d. If in addition to above, all doors fire-proof in fire-proof frames, and all partitions standing on fire-proof elements of floors, and all sash in partitions glazed with wire glass in fire-proof sash and frames, 18.

e. If in addition to above, all doors have door springs, self-closing, and partition sash not to open, 20.

f. If in addition to above, all wood floors, packed underneath with mineral wool or asbestos or other fire stop, solid up to top of sleepers, 23.

g. If in addition to above, remainder of iron construction, covered with terra-cotta or plaster or concrete, including tops of beams and girders (minimum, 1 inch), 25.

h. If in addition to above, all floors solid fire-proof of concrete or tile, and all partitions solid fire-proof, without any wood studs or frames and no glass sash or transoms, 33.

j. If in addition to above, all fire-proofing on girders and columns properly bonded and anchored, and done independent of partitions and pipes, etc., 35.

k. If in addition to above, all fire-proofing on posts and girders two thicknesses 1-inch plaster, one close and one making air space of 2-inch hollow terra-cotta, and all floor beams covered 1 inch on top and 1½ inches underneath, minimum, 40.

l. If in addition to above, stairs and windows, so arranged that flame from without cannot block or injure, 42.

m. If in addition to above, all elevators and windows arranged as last, 44.

n. If in addition to above, all stair and elevator iron supports covered as other structure, including strings, soffits and posts and sheave beams, 47.

o. If in addition to above, elevator shafts, completely enclosed with fire-proof screen partitions and separated with same, and with tight fire-proof doors, instead of lattice, 49.

p. In addition to above, a tank on roof with one gallon of water to every 100 cubic feet of building, and fire mains with one 3-inch riser to every 250,000 cubic feet, and branches and hose on every floor, commanding all parts of building, 52.

q. If in addition to above, the fire mains, etc., are all of fire department standard sizes and strength, with risers collected in main at curb with screw connection for fire engines, 55.

The result of all these improvements is, according to Mr. Gibson's figures, the reduction of the net improvement on $100 from 16 to 10½ cents. There remains another set of improvements affecting the vulnerability of the building to fire originating outside it. These naturally vary greatly with the nature of the surroundings. Mr. Gibson has considered the effect of improvements to the assumed building on these external risks in the same general manner as for internal risks, and estimates that by making them the premium of 16 cents can be reduced to 10 cents. The total possible reduction due to avoiding external risks is 7½ cents, although this amount is not considered practicable. The total premium of 16 cents per $100 may be considered made up of 7½ cents on account of the building's exposure and 8½ cents on account of its internal risks.

Combining the results of practicable improvements in both directions, the result is a reduction of the total premium to 4½ cents, 2 cents for exposure risks and 2½ cents for those within the structure.

This analysis has been carried several steps farther by Mr. Gibson, by assuming buildings with less exterior exposure, and the financial aspect of the subject is then discussed at some length. These sections are, however, hardly within the province of this journal, and for them the reader is referred to the full paper.

GAS PIPING IN BUILDINGS.

The unusually large number of recent cases of asphyxiation by gas led Mr. John Lyman Faxon to contribute to the Boston "Transcript" an interesting article on the dangers from gas fixtures and methods of avoiding them. The subject is one of such general importance that the following abstract of the article has been made for these columns:

The Building Department and Board of Health, of Boston, have recently formulated a new code of regulations governing the installation of gas piping. While it is quite specific upon comparatively unimportant points, it misses altogether the prime essentials and all-important features of the matter, viz., the system or plan of such installation. It is all very well to be specific as to the kind of piping, joints, couplings, etc., and method of securing them, but herein do not lie the chief causes of danger. The bulk of work put in by gaspipers is not installed in an imperfect manner or with inferior materials, as things go. Under the present antiquated system of installations, fatalities are just as likely to occur where the piping has been installed with the best materials and honest workmanship. Further fatalities will continue to occur, under any system, when deliberately planned for suicide and until the public discontinues the senseless and dangerous habit of turning the gas down to a low candle-power, as is often done in the case of sickness, or because some person can't go to sleep in the dark, or because the householder wishes to save the gas bills.

Cases of suicide by gas are probably not one in 100 of fatalities, and 99 out of 100 are due to improper installation as to system or plan of the work. The habit of turning down the gas, so far as saving gas by turning down the flame is concerned, has the following result: A clean burner at full cock consumes about 5 feet of gas per hour and gives approximately 12 to 15 candle-power light; the same burner at half-cock consumes 2½ feet per hour and gives approximately 3 candle-power light; and the same burner turned down to 0.75 candle-power consumes 1¼ feet per hour, so in proportion as the light is turned down the consumption of gas is increased disproportionately, due to incomplete combustion. While saving something in the size of gas bills, such reduction of the flame increases the danger.

The natural flow of gas in piping, when under pressure or free of obstructions, is upward and toward the freest combustion; it can be forced, by pressure, through down pipes, but if the pressure is unequal by reason of imperfectly disposed piping or by larger consumption at other points, its flow will be towards those parts of the system which are under greatest pressure or freest consumption. It is, therefore, of the greatest consequence that the pressure in any system of piping shall be equal and constant at all points; the pressure in vertical pipes increases about 10 per cent. for every 30 feet of rise, and a relaxation of pressure of about 5 per cent. for every 30 feet down; so that the difference in pressure between two burners 60 feet apart, vertically, will be about 15 per cent. of the initial or normal pressure, which accounts for the extinguishing of the gas flame when turned down low.

The present system of gas piping is radically wrong, entirely inadequate and extremely dangerous. Building laws are framed to safeguard life in respect to structural stability, fire, egress and effects from electricity and sanitation; but in respect to gas piping practically no improvement has been made for a quarter of a century, and it is still the rule to follow the same old dangerous system.

It ought to be clear to the lay mind—and certainly so to the architect, builder and gas fitter—that no gas pipes in a building be run vertically down, and yet thousands of pipes are so installed.

Generally the present method or system of installation is to take the main supply pipe from the meter to some central point in the basement of the building; thence, from this point a vertical riser is run up to the top story of the building, diminishing in size as it ascends and taking off at each floor a branch supply pipe, with tap circuits or feeders to the ceiling and wall lights of the story below, all ending in dead ends and rarely any subdivision of the system into individual circuits. Generally the outlet taps are taken off the bottom of all horizontal lines of piping, instead of off the side or top of the pipe, thus causing all such taps and the appended fixtures to constitute receptacles for impure condensation instead of providing for the return of condensation to the base; and further, with no provision whatever for equality of pressure throughout the entire system. Now, under this system let us state a case, and a common one, in any building of three stories or more. For instance, time 10 o'clock P. M., room on a lower floor; occupant sleeping; gas flame turned down to one-quarter candle-power, windows and doors closed, no ventilation. Twelve o'clock or later party returns from theater with friends to room in top story, turns on all burners to full cock; flame in lower room extinguished by indrawing of the flame into the pipe, caused by the excessive use of gas in upper rooms; in a few moments the draught is relieved and gas is ejected into the lower room through the open burner; and the occupant is asphyxiated in three or four hours if the accident is not discovered.

The proper system for installing gas piping Mr. Faxon outlines as follows: (1) Each and every separate story or apartment in a house, hotel, office building or other, liable at any time to contain a sleeping occupant, should have its individual circuit from the base or initial source. (2) All gas heaters and gas stoves should have separate circuits from the initial source. (3) All corridor, hall and vestibule lights should have separate circuits from initial source. (4) All circuits should have equalizing pressure pipes, making complete circuits throughout individual systems from initial sources, up, around and back to initial source. He has found in practice that the sizes of such equalizing pressure pipes need to be about five-eighths the size of the main supply circuits, and that proper installation costs 20 to 25 per cent. more than under the old system. (5) The individual main-circuit supply pipes should be taken off a properly calculated header or drum, and each circuit cut off by a suitable valve at the header; thence the individual circuit should be run to a center of distribution of branch and tap circuits. All vertical pipes should be run up and not down, and all off takes should be at the side or top of pipes, and in no case off the bottom. All piping should pitch toward the initial source for drip of condensation; the main circuit or supply pipe should be continued throughout and around the entire individual system, and returned from the farthest point to and connect with the base or initial circuit pipe; this is of utmost importance. Properly installed, the danger of gas service will not only be reduced to the minimum—provided people exercise care in the use of burners—but the quality and illuminating power of the gas will be materially increased.

This system Mr. Faxon has used for ten years or so in his practice, so it is not an untried theory in any sense.

The preceding abstract of Mr. Faxon's interesting article may be rounded out with the following quotations for the specifications for the East Boston high school building, of which he is the architect:

"Pipe the building throughout for gas, to the several outlets indicated by red (*) stars on plans and sections; also for all outlets and fixtures in and for the benches, hoods, and other apparatus, in the several laboratories, according to best work and requirements; all pipe and fittings are to be best make, and care to be taken to see that lines and fittings are free of scales and obstructions, and of standard sizes for supply to the number of burners at individual outlets. All piping in and for the chemical laboratory to be of finished brass tubing and fittings, iron-pipe sizes.

"Main supply to be entered from street service, and meter provided and set in boiler room; the main from meter is to supply a 'drum' or header, off which are to be taken the several circuits hereafter specified, and each circuit pipe is to be fitted with a finished brass full-way valve and tagged with a nickel-plated name-plate, designating the individual circuit.

"Mains and branches are to be run as direct as possible, along with electric conduits, and in no case passing under or over said conduits when avoidable; and all outlet ends are to terminate in outlet boxes (provided by electric contractor), the rims of which are to be set flush with face of finish plastering. All branches are to be taken from the side or top of mains, not from the bottom, and all piping for wall outlets to be run up and not down; all piping to have even and constant grade and pitch to initial sources, and all traps or pockets to be avoided; all piping and fittings to be secured by iron hold-fasts; no screws or nails will be allowed, and all outlets to have the quarter-fitting within the outlet boxes and not back of them, and outlets capped.

"All main circuits are to be installed so as to provide for a continuous and connected circuit and circulation from the initial source, up, over, and down, and returning to the base of supply, to ensure a constant and even pressure throughout and at each individual outlet; the amount of lighting power at each outlet is to be equal to the combined candle-power provided for at each outlet.

"The gas-fitter is to co-operate with the electrical contractor, and effect the installation of gas-piping parallel to and in connection with the installation of electric conduits.

"The complete installation is to be tested by the gas company, at the expense of the contractor, and the company's certificate of inspection and approval is to be deposited with the architect."

THE CARE OF STEAM BOILERS.

(Continued from Page 239.)

The pressure shown by the steam gauge is very liable to deceive the attendant, as gauges often register light, and show zero, or no pressure, even when a few pounds' pressure still exists in the boiler. Hence it is very important that the safety valve or tester tap should be opened to the atmosphere, and that the attendant should satisfy himself that all pressure has been released before breaking any joints.

If one boiler of a range is at rest, it is of the first importance that before it is entered for any purpose the following precautions should be taken to ensure the safety of the person entering it:

(*a*) Open all the manholes and mud holes some time before, so that the boiler may be ventilated and be filled with fresh air.

(b) See that the steam junction valve and the blow-out tap are closed.

(c) Acquaint those working in the boiler house that some one is inside the boiler at rest, so that nothing may be done which would endanger his life or limb.

Neglect of these precautions has led to many serious accidents, such as scalding, owing to the steam valve being opened, or through other boilers being blown down when the blow-out tap of the boiler at rest was open.

When a boiler is intended to be left at rest, say for a month or two, then, except in the winter months, if the water be non-corrosive, often the most convenient way will be to fill the boiler entirely with water, and occasionally, during the period of standing, place a fire in the furnace so as to keep the flues dry. Boilers, however, should never be left full of water when at rest in the winter months, or at any time when they are liable to be frozen. Freezing of water at rest has often led to very serious damage to the boiler. If boilers are to be at rest for longer periods, say twelve months or longer, usually if the boiler be set in brickwork, the brickwork where in contact with the boiler should be as far as possible removed so as to reduce the risk of external wasting at these parts. The shell of the boiler externally should then be thoroughly scraped, all oxide being cleaned off, and it should receive a coat of paint. Internally, after the boiler is cleaned, in order to absorb any moisture, two or three hundredweight of quick lime should be placed on trays in the bottom of the boiler, and left there. The boiler should be closed and made as air-tight as possible, and should be examined about every six months, and the lime renewed if found slaked. In the case of boilers which work in the open, such as portable and quarry boilers, care should be taken in frosty weather to entirely empty the boiler whenever it is at rest, and also the pressure gauge should be taken away, and reattached before commencing work. Pressure gauges which are frozen, as they generally will be when left outside in frosty weather, are usually rendered quite inaccurate and unreliable.

Most large boilers are set with external brickwork flues. These flues serve the purpose of directing the course of the gases about the external surface of the boiler. It is very important that all this brickwork should be kept in good order. If the brickwork be allowed to become open and loose, leakage of air into the flues follows, causing waste of fuel and spoiling the draught. Try for air leakage with a candle, and examine the brickwork joints regularly, and fill up any cracks. Usually the flue brickwork where it is in contact with the plates should not anywhere exceed 9 inches in thickness, and the lower seatings on which the boiler rests should not be more than about 3 to 4 inches across the face, and the front cross walls not more than 4½ inches where in contact with the plates. Wide surfaces of brickwork in contact with the plates increase the risk of external corrosion, and cover up useful heating surface.

Great care is necessary in order to ensure that such brickwork is kept dry. If the brickwork becomes damp owing to leakage from the boiler, or from rain on the top, or moisture arising from the ground, serious corrosion of the plates may be caused, and many disastrous explosions have been brought about in this way. Whenever any dampness is suspected, or is known to be present, that part of the boiler should be immediately bared of brickwork or other covering and carefully examined.

The flues should be regularly cleaned. The proper period for cleaning will usually depend on the time the boiler has been at work, but, generally, flues should be cleaned at intervals of not more than three months, when all soot should be cleared off the plates, which should then be brushed with a hard wire brush or thoroughly scraped, and all flue dust should be removed from the flues. Accumulations of soot and flue dust cause waste of fuel.

The tops of boilers above the external flues are generally covered in some way so as to reduce as far as possible loss of heat by radiation. It is always desirable that, where practicable, every stationary boiler should be protected from the weather by a suitable boiler house and roof. If this be done, the best covering for ordinary use is porous composition. There are many useful kinds of this composition in the market. Such composition should be a good non-conductor, and should also soften if there be any leakage or moisture present, so as to show the presence of this and enable it to be prevented before serious damage to the boiler has been caused.

Sometimes boilers are covered by brickwork and similar impervious coverings. These coverings prevent loss of heat by radiation, but they are objectionable, inasmuch as the existence of any leakage or dampness beneath them cannot be detected, and frequently serious corrosion has arisen from wasting brought about in this way.

If a boiler is covered with brickwork or any other impervious covering, it should be regularly bared at intervals of a few years for examination.

The defects to which the shell of the boiler is liable are very varied in character, and a complete inspection and determination of their importance can only be made by specially trained men. These defects include internal corrosion, external corrosion, bulgings, distortions, blisters, laminations, cracks, and other kinds and forms of deterioration. Amongst the most important of these are internal corrosion and external corrosion, and a few notes in reference to these points are given in the following:

Internal corrosion is generally caused by the acid action of the feed water eating the metal of the plates away. The manner in which the plates are eaten away varies considerably with different feed waters. In some cases the corrosion consists of small pit holes, each of them separate from the other, and which, being isolated, only affect the strength of the boiler to a comparatively slight degree. With other kinds of feed water the corrosion affects the plates more generally, wasting them either smoothly or with an irregular surface, and considerably reducing their thickness, and so causing the margin of strength of the boiler to be less.

One of the most serious forms of internal corrosion is that known as grooving. This generally occurs near the seams. It is common at the longitudinal seams when these are below the water level, also at the ring seams of the shell and the flue tube, and at the end plates of Lancashire and Cornish boilers, over the furnace angle iron.

The presence of scale or incrustation in a boiler is not in itself sufficient to indicate whether the water is corrosive—that is to say, will cause wasting of the plates or not. Sometimes feed water which deposits a considerable amount of scale on the plates is also corrosive at the same time, and the corrosion progresses beneath the scale. In all such cases the cleaning of the boiler requires special attention before the thorough examination is made. It is of the first importance that the scale should be removed so that the actual surface of the plates may be seen. If the wasting be then found very deep it may be necessary to have holes drilled so that the remaining thickness of the plates may be gauged. Usually, after a hole has been drilled in the plate to determine the thickness, the thickness of the plate should be gauged by means of making a small gauge to fit over the plate at the edge of the drilled hole. It is very important, however, that before gauging the thickness of the plate at the drilled hole the burr or roughness formed at the edge of the hole when the drill passes through should be removed, otherwise a false idea of the thickness may be obtained. Holes which have been drilled in this way may be filled up by a screw plug or a rivet.

External corrosion, in one or other of its many forms, is the most common cause of deterioration of steam boilers, and more explosions arise from this particular cause than from any other. In almost all cases it arises from the presence of dampness or moisture in contact with the plates. This dampness or moisture sometimes is due to leakage from the joint of a fitting block to the boiler shell, or from one of the ring seams or longitudinal seams of the boiler itself. In other cases, as about the top and flue coverings of the boilers, or the front cross wall or the side seatings, the dampness may arise from external causes. Thus, about the blow-out pit, it is a common practice to slake ashes at the front of the boiler, and the water from this finds its way into the blow-out pit, causing dampness of the brickwork and surrounding parts, and results in severe wasting, while the damp ashes lying against the front end plate causes wasting here, necessitating expensive repairs.

Generally, wherever moisture gets into brickwork it is absorbed by it, and is kept in contact with the plate. This is the most favorable condition for external corrosion, and causes very rapid deterioration of the plates or other parts of the boiler which are in contact with the brickwork. Wherever there is any indication of damp brickwork the part should be at once bared, so that the cause of the moisture may be ascertained and prevented before serious damage occurs, and the affected plate should be fully examined. On the tops of boilers leakages from steam-pipe joints overhead often cause dampness of the brickwork and wasting of the plates, and of course in the case of unhoused boilers the moisture due to rain may run down into the brickwork, and, being kept in contact with the plate, give rise to serious wasting. It is therefore more important that in the case of boilers which are unhoused and exposed to the weather that the parts in contact with the brickwork be bared regularly.

Also leakage at a seam, or at one of the joints of the fittings, may pass under the covering and moisten it, thus causing external corrosion.

The remedy for external wasting and the mode of preventing it is to take every precaution to keep the entire external surface of the boiler clean and dry and free from leakage.

Blisters and laminations most commonly show themselves in the furnace parts. They are caused by a separation between the layers of metal which has taken place during the manufacture. This separation of the layers checks the transmission of heat, and so leads to overheating of the outer layer, which first bulges or blisters and afterwards splits off.

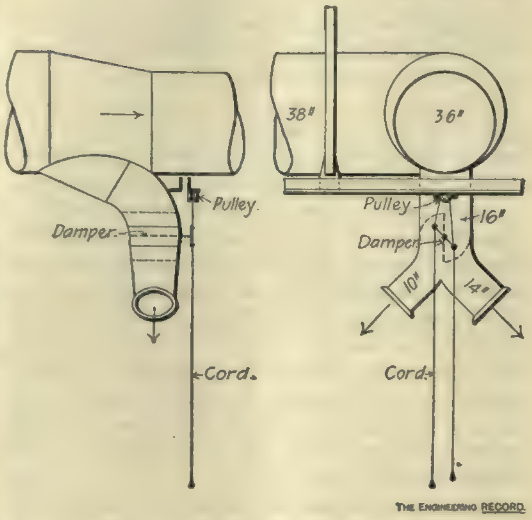
VENTILATION AND HEATING OF A RAILROAD SHOP.

The car shops of the Cincinnati, Hamilton & Dayton Railroad, at Lima, O., were fitted up during the past year with an interesting hot-blast heating system. The shops, like those of most railroads, consist of different detached buildings, devoted to different departments, and in this case they are warmed by a heated supply of fresh air delivered from a single source.

The shops comprise a power house, with boiler and engine rooms, a wood-working and machine shop, and a passenger-car erecting shop. A plan of the buildings, showing, however, but a small portion of the erecting shops, is given in an accompanying drawing. Air for all the buildings is heated by a stack in one end of the engine room, first entering the building through the

adjacent window, being confined in its passage to the stack by a galvanized iron casing connecting the two. The air is drawn through the stack to a 9-foot blower, by which it is discharged overhead in a galvanized iron duct 5 feet 8 inches in diameter. The heater, which, as well as the blower and engine, was furnished by the American Blower Company, has a total heating surface of 3,300 square feet. The blower is driven normally at a speed of 175 revolutions per minute by a 12x10-inch steam engine direct connected to the blower shaft. At this speed the total amount of air discharged per minute is about 52,000 cubic feet, and is of sufficient volume to fill the buildings three times per hour. The total surface of the heating stack is considered ample to heat this quantity of air to a temperature of 150 degrees whenever the thermometer may register zero out of doors.

The air, in its passage from the blower, takes a straight line, crossing the wood shop at one end and terminating in the erecting shop beyond. A section of the building along the main line of air distribution is shown in an accompanying cut. The hot air pipe rises as it leaves the power house to the side sloping roof of the wood shop, 10 feet distant. The central, or main, portion of this building is lighted by a monitor roof, and the hot air pipe, continuing up the slope of the side roof, upon which it rests, enters the building at the riser of the monitor. The part of the air supply thus exposed to the weather, some 35 feet long, is protected by a concentric pipe of galvanized iron of 4 inches greater diameter, affording a 2-inch air insulation. At its entrance into the wood shop the cross section of the pipe is changed from the circular to the rectangular to avoid any cutting of the roof otherwise necessary, and the main pipe extends across the shop to the other side of the monitor roof. There are two branches taken



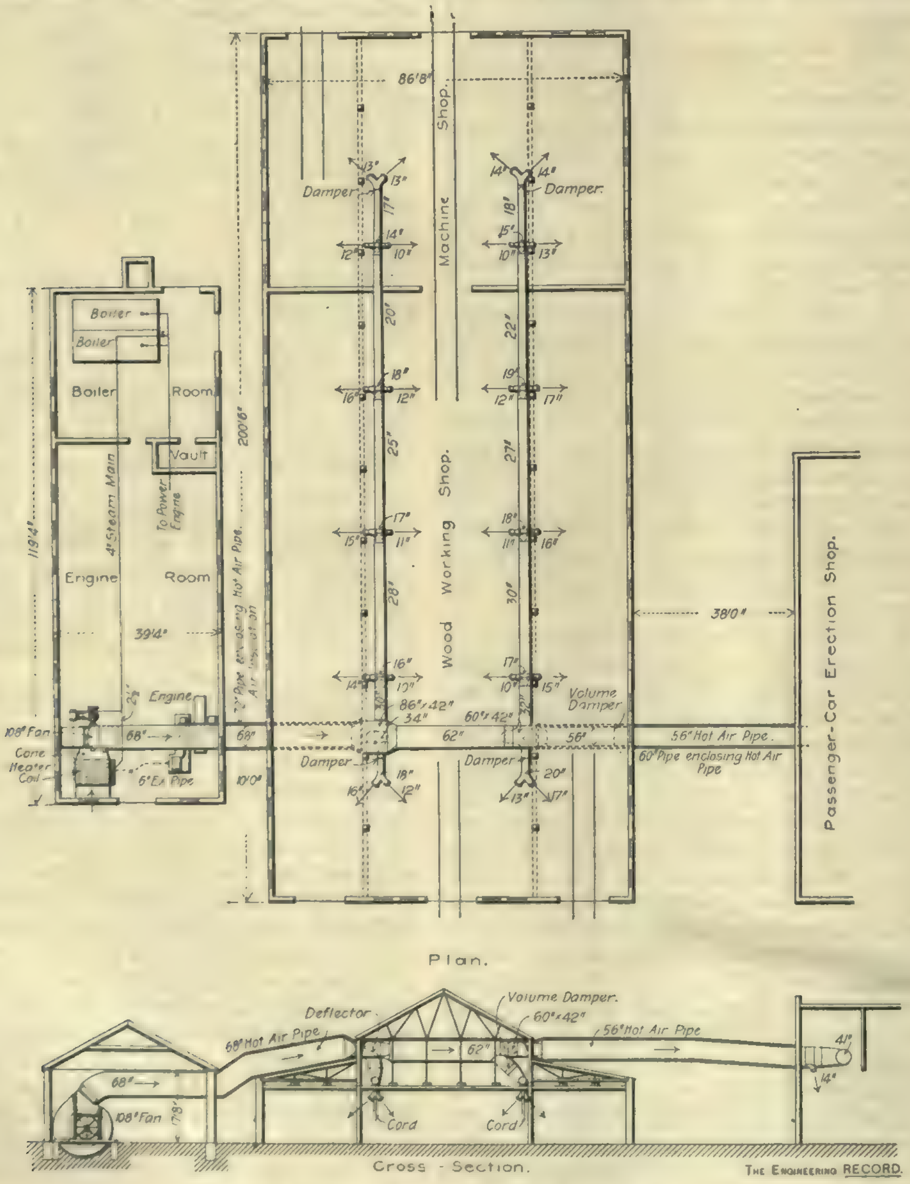
DETAIL OF OUTLETS.

from the main, extending lengthwise of the building and supplying short connections directing the air on each side of the branch. The first of the branches receives its supply through the agency of a hinged damper, diverting the proper portion of air from the main supply. The second branch is taken from the main at a sharper angle than that made by the first connection, so that the conjunction of the branch with the continuation of the main duct forms a rudimentary diversion damper, the effect of which is supplemented and a proper proportion of air made more certain by two volume dampers, so called, one in the branch and one in the continuing main. These dampers are to regulate the volume passing by them by restricting the area of flow, and are provided with a fastening device when once they are adjusted. The large main is circular across the wood shop, becoming rectangular for a sufficient distance to permit its passing through the second riser of the monitor roof. This large pipe is suspended from the roof truss, while the two branches for the shop, which are at a lower level, are carried on the lateral beams supported from the roof trusses. The branch pipes travel the length of the wood shop, reducing in sections as portions of the air are diverted, and entering and supplying the machine shop at the distant end of the building. The short connections by which the hot air flows into the shops leave at the bottom of this pipe in the manner shown by the accompanying detail drawing. The vertical stem of the connection divides into two short outlets, throwing the air at about 45 degrees with the vertical, one toward the center of the building and the other toward the outer part. Just above the point of division a circular damper, mounted on a horizontal axis, and called a blast gate, controls the two outlets. The air issues at a height of about 10 feet above the floor, but the blast gate may be operated to open or cut off the air supply whenever desired by cords attached to a projecting end of the damper. A single cord is used, as shown in the drawings, passing over a pulley above and long enough to come within the reach of a man's hand when standing on the floor. The area of the outlet is in general larger the greater the distance from the supply, and the area of the opening directing the air toward the sides of the building is considerably larger than its mate, discharging into the center.

The erecting shop is warmed by an entirely similar system. The main continues in a clear span of about 61 feet from the monitor roof of the wood shop to this building, and, like the other exposed section of the pipe, is insulated by 2-inch annular air space enclosed within a pipe 4 inches larger in diameter. Inside the building the air pipe divides into two branches, extending on each side of the length of the building, and each provided, near the point of division, with a volume damper. This shop measures about 105 feet by 228 feet, with space sufficient for nine tracks, upon which cars are built. The outlets in this shop discharge about 14 feet above the ground, and are spaced closer together than in the wood shop, being midway between the tracks, about 22 feet apart.

Exhaust steam, at 5 pounds pressure, is depended upon almost entirely for supplying the coils of the heating stack. Part of it comes from the small blower engine in a 4-inch pipe, and the rest of the required heat is derived from the exhaust steam of the adjacent power engine in a 6-inch pipe. Each of the exhaust pipes rises from its engine above the power-house roof, as an outboard exhaust, but is equipped with a back-pressure valve, and supplies a horizontal pipe near the ceiling provided with a valve near the connection and dropping to the steam header of the stack. The header is 5 inches in diameter and is divided into two parts by a flange. The stacks, as made by the American Blower Company, it may be remembered, are built with two drip headers, one taking care of the water condensed in transit and the other collecting the water of condensation in the coils, and therefore larger. The drip headers are 1¼ and 3 inches, respectively. The drip from the smaller header is trapped by a pot trap, while the water from the other header drains to a tank trap, and the water from both of these may be discharged either into the sewer, in case there is no desire to retain the hot but grease laden water, or back through a 3-inch pipe laid in a trench below the engine room floor and pitching ¾ of an inch in 10 feet to a tank in the boiler room, where it may be pumped into the boilers. The live-steam pipe to the blower engine continues to the 6-inch pipe, carrying the steam from the power engine, as shown in the plan drawing, so that live steam at boiler pressure may be used in the heating stack whenever desirable.

The plant was designed and installed by the American Blower Company, of Detroit, Mich.



SHOP VENTILATION AND HEATING, LIMA, OHIO.

THE PRESERVATION OF CLIPPINGS.

The article on the preservation of clippings, which was printed in these columns on January 21, has resulted in so many letters on the subject that a few notes on other systems of filing are presented. Mr. E. J. Landor, M. Am. Soc. C. E., calls attention to a plan proposed by Mr. David A. Curtis, which is readily understood by assuming that the problem is to file and index an article headed "Professor Jones' Explorations in Java." This is put in an envelop or filing case numbered, say, 139, first marking the clipping with the same number. The article is then indexed under E by a card marked "Explorations—Jones in Java, 139"; under J with one marked "Jones, Professor—Explorations in Java, 139," and another marked "Java—Jones' Explorations, 139."

The clipping is marked with the envelop or case number to insure its return after use without going to the trouble of consulting the index. The cross-indexing is carried out to as many heads as appear desirable. "If all articles of the same nature are kept in the same receptacle," Mr. Landor writes, "the indexing when done for one article on a given subject is done for all articles on the same head, and all that it is necessary to do so far as subject matter is concerned is to cut out the clipping, mark it with its receptacle number, which has to be found from the index, and file the clipping. The receptacle may be an ordinary letter file, or an open-end cardboard box to fit given pigeon holes or to fill, with others, shelving spaced the right distance apart. Such a box may contain envelops to subdivide the contents, the envelops being endorsed with the box number and marked to indicate their contents. Those interested in the subject will do well to look into the form of index book published by the Folding Paper Box Company, of South Bend, Ind., which makes a specialty of receptacles for use in the Broomfield system of filing."

The plan followed in the office of "The Engineering Record" is to fill one case after another with all clippings and pamphlets which may be of future value. Each clipping is marked with the number of the case, and is also indexed on the side of the latter. These cases are folding envelopes of heavy manila paper, about an inch thick when filled, and large enough to take a page measuring 9 x 6 inches. The numbers used on the backs are bought in the form of printed, perforated and gummed sheets. No attempt whatever is made to classify the material in different cases.

The value of the system lies in the card index, which is kept in the drawers of a roll-top desk. The cards are the smallest size made by the Library Bureau, and measure a little less than 5 x 2 inches, with guide cards about 5 x 2½ inches. The index has no subheads. For example, there are independent guide cards for "Pavements," "Pavements, asphalt," "Pavements, brick," and so on, and also for "Asphalt" and "Brick, paving." It has been found better in this office to make a full index and attempt no classification of the clippings than to follow Mr. Landor's system, but such matters are largely questions of personal taste.

The feature of this index, however, is that it is also used as a commonplace book. Brief notes which are liable to be lost are written out on the cards, lists of important works of various classes are recorded in the same way, and short sections of books which it may be useful to refer to in the future are indexed like clippings, except that the reference is made to the books. This index is still youthful, but it seems to be fairly satisfactory; further experience may bring out defects, however.

A number of other systems were described in Volume xvi. of the "Transactions" of the American Society of Mechanical Engineers. One of these consists of a scrap cabinet having drawers and shelves. The drawers are all labeled and the clippings are placed in them under the heads to which they belong. Then one drawer is taken at a time, the clippings are trimmed to the proper size and pasted on perforated sheets, which are afterwards made into scrap books. The clippings are pasted on only one side of the sheets, and are marked with the date and name of publication from which they are taken. These sheets are finally bound in their proper order in a scrap book and placed on the shelves of the cabinet. The dimension of the sheets can be determined by each engineer, but a size of 8½ x 11 inches has been found convenient. They are of good manila paper, so that they may be written on with ink. On the left-hand edge of the sheet is pasted a separating strip, 1 inch wide, which keeps the book from widening on the opening side. The sheets are placed between covers and fastened together with ordinary brass fasteners. For convenience in rearranging and culling it is best not to page the books at all. Any number of sheets may then be taken out and thrown away, and the rest bound together again without any trouble. The cabinet is closed with a rolling front, like that of a roll-top desk, which is not in the way when open and keeps out the dust when closed.

Another method described consists of plain 9 x 12-inch envelops without flaps, made of heavy manila paper, and open on one of the long sides. These are filed by laying them flat on the shelves of a cabinet in piles of 6 to 40, according to the volume of their contents, and with the open side at the back of the shelf. Circulars, letters, patent copies, page clippings, etc., of which a large number can be placed in a single envelop, are generally placed in folders about 8¾ x 11 inches, open on three sides, any one of which can be withdrawn from its envelop without disturbing the others. Column clippings, notes, etc., are placed in similar folders, to one leaf of which are pasted pockets for holding the clippings, or, preferably, narrow flaps, for keeping in position on the leaf of the folder removable pockets or column-width folders in which the clippings are placed. On one side of the column-width folders are written the titles or catch phrases of the contents, to avoid searching through a number of folders for an item wanted. No matter how fast the collection grows, there is no rearranging of material except to split up the contents of a large folder or envelop into two or more.

Another cabinet is made up of pigeon holes 4¼ inches wide, 3 inches high and 10 inches deep, for clippings; 6½ x 3 x 10 inches for pamphlets; and 9 x 3 x 12 inches, and 8 x 8 x 12 inches for catalogues. The pigeon holes are made by inserting horizontal tin shelves into a saw-kerf, 3/32 inch deep, in wooden uprights ½ inch thick. The outer edges of the tin shelves are bent down and back upon themselves for strength, to prevent cut fingers, and to enable them to retain themselves in the saw-kerf. A title slip is placed on top of each shelf and under its own clippings. The clippings are folded and filed with their titles on top so as to be seen and read as soon as withdrawn.

A system which has been used to index some 300,000 or 400,000 subjects consists of a combination of the Harvard card catalogue system and seven sizes of envelops and boxes, filling one box of each size before using another. All clippings, etc., are filed and indexed as they arrive and each box is added to the collection as books to a library. For reference to patents and periodicals which are not cut up, a small form is used on which is printed the head, sub-head, date, author, number of the paper, and the sequence of the envelop in the drawer.

RECENT TECHNICAL BOOKS.

For a number of years there has been no book in English giving a general view of present engineering practice in sewerage, plumbing and the disposal of sewage and city refuse. The developments in this field in the last decade have been many and important, and it is only by a tedious search through technical journals and the publications of numerous scientific societies that the information has been obtainable. Accordingly the announcement by Longmans, Green & Company, New York, that they had in press an important reference book on these subjects aroused considerable interest. The work has now appeared as an elaborately illustrated volume of over 600 octavo pages, bearing the title of "Sanitary Engineering" and sold at $10, which is a low price for the excellent treatise Col. E. C. S. Moore, the author, has prepared. It is the only book yet received by "The Engineering Record" which presents a good description of the various biological systems of sewage disposal now attracting so much attention. It contains a large number of new hydraulic tables of undoubted value as time and labor saving aids in computations. Its illustrations of sewer details are numerous and well chosen. The subject of sewage disposal in general is treated in an interesting manner, and the information on British systems of refuse cremation it will be difficult to secure elsewhere in so convenient a form. The importance of good plumbing is recognized properly, something which can be said of very few works; and, possibly, too much space is given to various patented appliances, although the information concerning them could not be obtained, by American engineers at least, without wide correspondence. The book is very good from beginning to end, and will be a valuable addition to the library of any one who wishes to learn the general theory and practice of so much of sanitary engineering practice in Great Britain as is embraced in its scope. The discussion of various theories of the flow in sewers, and the tables to assist in applying them, is a feature which is alone worth the price of the volume.

There is something very attractive about hydraulic machinery to most engineers, and a good book on the subject will probably prove interesting to many who are not directly concerned in the design and use of such apparatus. Mr. Robert Gordon Blaine, Assoc. M. Inst. C. E., has undertaken to supply such a work under the title of "Hydraulic Machinery," a volume of nearly 400 octavo pages, published at $5 by Spon & Chamberlain, 12 Cortlandt Street, New York. It is a good piece of technical writing, concise and to the point. Various typical forms of presses, rams, pumps, water-wheels, elevators, cranes and similar machinery are described, and the main theoretical principles of their design and operation are stated. The author is one of the staff of the Finsbury Technical College in London, and the book contains many hints of the characteristic spirit of this famous school; for example, in the following extract from the preface: "The present work is the result of a suggestion by Professor Perry, F. R. S., whose treatment of the theoretical portions of the subject I have followed; and I venture to think that, although in some cases it has seemed necessary to make use of elementary applications of the calculus, the proofs are simple, easy and satisfactory. The student who does not possess the small amount of knowledge necessary to follow the reasoning had better accept the results without proof than attempt to master those often given." It must not be understood by this that the author claims all of the theories he presents are exactly applicable to practice, for the contrary is the case. In explaining the theory of the flow of water in pipes he is careful to point out the influence of eddy action, and in deducing the commonly accepted laws of the sudden contraction and enlargement of pipe sections, he says: "I do not know whether these laws for loss of head due to the sudden change of area have been authenticated by any complete and reliable ex-

periments. If so they are worthy of that respect which a study of the usual proofs given of them does not inspire. There does not, for instance, seem to be any good reason for assuming anything of the nature of impact. Energy is wasted in eddies set up by internal friction, yet we deduce a law independent of viscosity and seeming to indicate that with a given pipe and flow there would be the same waste whether the fluid were tar or water, which is at least very doubtful." It is such remarks as this, scattered through the book, which make it of particular value to those taking up hydraulics for the first time, because most works on the subject fail to point out the limitations of the theories they give.

A number of years ago Prof. Mansfield Merriman wrote a paper on the theory and calculation of continuous bridges, which was printed in Van Nostrand's Science Series. These bridges are now out of use, except for revolving draw spans, and their successor is the cantilever. As Professor Merriman's paper is out of print, the publishers, the D. Van Nostrand Company, New York, commissioned Mr. R. M. Wilcox, one of the instructors at Lehigh, to prepare a similar paper on the cantilever. It bears the title of "Theory and Calculation of Cantilever Bridges," a comprehensive name for one of the little volumes of this valuable series, but the author elsewhere gives its scope to be merely an explanation of methods of calculating stresses in the members of such a structure, and not an essay on designing, which are two very different subjects. Within these limitations the book seems to be a clear statement of some of the leading methods of calculating, easily comprehended and concisely stated.

Twenty-three years ago the late Colonel Waring wrote, for public health associations, a couple of papers on the sanitary condition of houses. They attracted considerable attention and led to an interesting discussion in the columns of the "American Architect." The papers and discussion were reprinted as one of the volumes in Van Nostrand's Science Series, and recently passed into a second edition. They are written in the vigorous style characteristic of the author, and while some of the pages contain statements not in accord with present ideas, the book is a very good one to put in the hands of a man who fails to understand the importance of good plumbing, dry walls and well ventilated rooms.

Transition curves are threatening to become as numerous as the engineers who use them, and to range in complexity from those requiring time, patience, a treatise on the calculus and a volume of mathematical tables for their application to others for which a slide rule and a little mental arithmetic are alone needed. As long as the temperaments of engineers differ there is bound to be a difference in opinion concerning the relative value of different curves. The views of Prof. C. L. Crandall on this subject will be found in a second edition of his book, "The Transition Curve by Offsets and by Deflection Angles," just issued by John Wiley & Sons, as a small volume bound in limp morocco, and retailing for $1.50. His curve is of the real transition type, the radius decreasing directly with the distance. In the new edition the tabular matter has been increased and considerably improved, particularly with regard to sharp curves for electric railways.

SOCIETY AFFAIRS.

At the meeting of the Civil Engineers' Society of St. Paul on February 7, Mr. W. A. Truesdell described some interesting improvements at the local stock yards, 172 acres in extent. They lie along the river for 1¾ miles, separated from it by a levee, for their level is several feet below high water. The yards have been overflowed to a depth of 3 feet, but the five sewer outlets are now provided with flood gates and there are pumping facilities for handling surplus water. Other addresses were made by Mr. A. H. Hogeland and Mr. G. L. Wilson.

The American Society of Civil Engineers met February 15, Director James Owen presiding. A paper by E. L. Corthell, M. Am. Soc. C. E., entitled "The Approaches and Transportation Facilities of the Paris Exposition of 1900," was presented and the author supplemented it by lantern slides and an explanation of some of its principal topics, including the design and methods of construction of the Alexander III. and Mirabeare bridges, the surface and underground railroads and the moving sidewalk. The death was announced of W. R. Michie, Greensburg, Pa.

The eleventh annual meeting of the Iowa Engineering Society was held in Iowa City January 18 and 19. The following topics were presented and brought forth much valuable discussion: "Advantages of the Metric System of Weights and Measurements," "How to Succeed," "The Retracing of a Government Survey," "Some Experiments Relating to Standard Methods of Testing Paving Brick," "The Chemistry of Water," "The Bacteriology of Water," "The Uses of Cement," "A Study of Methods of Water Measurements," "A Photographic Study of Fire Streams," "Relief Map Construction" and "Methods of Purifying and Sterilizing Water." The society expressed itself as in favor of the adoption of the metric system of weights and measures and appointed a committee to study the subject and to report at the next meeting. A committee was also appointed to take up the matter of standard tests of paving brick with the National Brickmakers' Association. A discussion of "the advisability of legislative license for engineers" was opened by a paper from Professor Williams of Cornell College. This discussion aroused a great amount of interest, as it is a topic that has been before the Society for some years. The idea finds many friends in the Society, and strong hopes are entertained that the coming year will witness practical results along this line. The following are the officers for the coming year: President, C. S. Magowan, Iowa City; vice-president, M. L. Newton, Waterloo; secretary-treasurer, E. P. Boynton, Cedar Rapids; directors, C. R. Allen, Ottumwa; Anson Marston, Ames.

PERSONAL AND OBITUARY NOTES.

Mr. William J. Hillery has been appointed superintendent of streets of Buffalo, N. Y., succeeding Mr. John H. Shifferens.

Mr. A. E. Wetherbee has been elected superintendent of the water and sewerage works of Rome, N. Y., succeeding his father, the late H. S. Wetherbee.

Colonel Park Woodward has been unanimously re-elected superintendent of the Atlanta, Ga., water-works, and Mr. W. R. Dimmock has been chosen secretary of the water board.

Mr. Peter Neu, a member of the well-known contracting firm of Heldmaier & Neu, now building the San Pedro breakwater, was thrown from a coach in Los Angeles on February 5, and killed. He was one of the most prominent contractors for government work in the United States.

M. Picard, commissioner-general for the Paris Exposition of 1900, has been chosen an honorary member of the Institution of Civil Engineers, succeeding the late M. Schneider, the Creusot ironmaster. The selection has caused much satisfaction in Paris, where M. Picard presides over the engineering and industrial section of the Conseil d'Etat. He is the senior inspector-general of the famous Corps des Ponts et Chaussées.

Mr. J. Y. Bassell, Jr., fell from a window of a Columbus, Ohio, hotel on the evening of February 6 and was instantly killed. He was graduated from Lehigh University, and afterward took post-graduate work in mining engineering and metallurgy. For two years he was editor of the "Colliery Engineer," and afterward engaged in mining at Cripple Creek. He served on the gunboat Wilmington during the recent war.

Recent army orders contain the following announcements concerning members of the regular and volunteer engineer corps: Lieutenant-Colonel Hiram M. Chittenden, chief engineer, will proceed to St. Louis and relieve Captain Graham D. Fitch, Corps of Engineers, of his present duties. Captain Fitch will proceed to Oswego, N. Y., and relieve Major Thomas W. Symons, Corps of Engineers, of the fortification and river and harbor works, transferred to him by Major William S. Stanton, Corps of Engineers, and of the charge of the improvement of the harbor of Wilson, N. Y. Major George E. Lyon, of the Third Volunteer Engineers, is honorably discharged.

Mr. W. H. Wells has been appointed chief engineer of the Southern Railway, and his staff has been made up as follows: Charles B. Clark, assistant engineer, Washington, D. C., office assistant, Eastern Division: Benjamin Thompson, resident engineer, with headquarters at Greensboro, N. C.; W. F. H. Finke, assistant engineer, Washington, D. C.; F. P. Hone, assistant engineer, Greensboro, N. C.; W. E. Vest, assistant engineer, Charlotte, N. C. Western Division: B. C. Milner, Jr., resident engineer, with headquarters at Atlanta, Ga.; J. B. Newton, assistant engineer, Knoxville, Tenn.; J. C. Motley, assistant engineer, Atlanta, Ga.; J. R. Pill, assistant engineer, Birmingham, Ala.

Mr. William E. Baker, who has just been appointed general superintendent of the operating department of the Manhattan Elevated Railway, was born in Springfield, Mass., in 1857. After attending the public schools there he entered Lafayette College, Easton, from which institution he was graduated in 1877. His first employment was as a member of the engineering staff of the Chicago, Milwaukee & St. Paul Railway. Later he entered the service of the Northern Pacific Railroad, and from there went to the Canadian Pacific Railway, assisting in the preliminary survey of that line. His last service in the Far West was as resident engineer of the International & Great Northern Railroad. From 1888 to 1892 he was employed by the Thomson-Houston Electrical Company, during his connection with which corporation he supervised the electrical equipment of the West End Street Railway, of Boston. In 1892 Mr. Baker removed to Chicago, where he was in charge of the construction of the Intramural Railway at the World's Fair, on which line the first application of the "third-rail system" was seen. Since 1894 he has been general superintendent of the Metropolitan West Side Elevated Railroad in Chicago.

A New Method of Measuring Distance was used by the second corps of the Intercontinental Railway Commission on their work in Costa Rica. This is described in their report as follows: "For the survey we were obliged to extemporize an acoustic method, bandying yaups to and fro three to five times at each station by the watch second-hand, thereby ascertaining both direction and distance. Testing the method on open ground it never differed more than 6 per cent. from stadia measurements; the averages of the two methods would probably be about the same. Our experience gave us great confidence in it. Indeed, no other, no better device, at least, could be thought of if we were to make reasonable progress in such a country. Drums, gongs or the like thump-sounders might be an improvement on the voice and carry farther, but the voice has the advantage of being itself lighter to carry, an advantage very considerable. For long shots blank cartridges might be used, but we had none of these to spare, owing to the Savegre wreck."

CONTRACTING NEWS

OF SPECIAL INTEREST TO

CONTRACTORS, BUILDERS, ENGINEERS, AND MANUFACTURERS

OF ENGINEERING AND BUILDING SUPPLIES.

For Proposals see pages 272, xi and xii.

WATER.

Alton Ill.—T. A. Taylor, Supt. of Water Works, writes that about April 1 there will be required 27,358 ft. of 8, 6 and 4-in. cast-iron pipe, 20 hydrants and 25 water gates.

Logansport, Ind.—The trustees of the hospital have petitioned the Legislature for $80,000 for the erection of a new water system.

Canton, Ill.—The estimated cost of improving the water supply is stated to be $5,000.

Oconomowoc, Wis.—The Council has under consideration the establishment of a system of water-works.

Ellsworth, Minn.—Press reports state that there is talk of putting in a water-works plant.

Braddock, Pa.—The Borough Council has passed an ordinance for a bond issue of $81,500 for street, water and other improvements.

Newburgh, N. Y.—A vote will be taken at the election to be held March 14 on the proposition to appropriate $274,000 for an increased water supply.

Albany, N. Y.—Deputy Chamberlain Chas. H. Bissikummer has sold $100,000 water bonds and $30,000 free public bath bonds.

Hartford, Mich.—L. C. Colburn, C. E., of Paw Paw, writes that the letting of contracts for water-works will be delayed until the last of March or first of April, owing to some delay in securing the desired location for pump house.

Windsor, N. Y.—Bids are wanted Feb. 27 for about 300 tons of 8, 6 and 4-in. pipe and 5 tons of special castings, as advertised in "The Engineering Record."

Huntsville, Ala.—E. R. Matthews, City Engr., writes that water-works bonds to the amount of $20,000 have been sold to Briggs, Todd & Co., of Cincinnati, O.

Glens Falls, N. Y.—George P. Slade, City Engr., writes that the Board of Trustees are about to purchase 150 ½-in. to 6-in. meters. Address W. H. Haskett, Pres. of the Bd.

Salt Lake City, Utah.—City Engineer Kelsey has been directed by the City Council to complete the work of preparing preliminary plans and estimates for the contemplated increase of the water supply.

Rochester, N. H.—The City Council has under consideration the matter of securing a pure water supply.

New Brighton, N. Y.—The Richmond Borough Board has been petitioned to lay water mains in several streets.

Montreal, Que.—The Water Committee has sent a report to the Council asking for the sum of $956,929 to be divided as follows: $75,000 for new mains, $6,500 for completing conduits, $81,279 for work on the reservoirs, $62,150 for new pumping machinery, $675,000 for a new filtration system, $30,000 to prevent the stagnation of water in water pipes and the sum of $15,000 for improving the service pipe system.

Nescopeck, Pa.—James C. Brown, C. E., of Bloomsbury, Pa., writes that a vote of the tax-payers will have to be taken authorizing the Council to issue bonds to the amount of $12,000 to $15,000 for the construction of water-works.

Greenpoint (L. I.), N. Y.—A vote will be taken March 21 on the proposition to issue $36,000 bonds for the purchase of the water-works and electric light plants.

Atlantic, Ia.—The city has voted to lease a system of water-works, with an option to purchase.

Evergreen, Ala.—A bill has passed the Legislature authorizing the issue of $25,000 bonds for the construction of water-works and an electric light plant.

Fairhaven, Wash.—Bids will be asked in March for the proposed extensions and improvements to the water system, estimated to cost $10,000. T. W. Gillette, Supt. of the Fairhaven City Water & Power Co.

Memphis, Tenn.—The Water Department has been granted an appropriation of $40,000 for 1899.

St. Louis, Mo.—Outline drawing and specifications for three high-service pumping engines to replace the three engines at pumping station No. 1 at Bissell's Point have been approved.

Michigan City, Ind.—A. W. Frehse, Supt. of Water-Works, writes that about June 1 there will be required a 2,000,000-gal. pumping engine.

Dubuque, Ia.—Local press reports state that the Dubuque Water Co. has contracted with the Holly Mfg. Co., of Lockport, N. Y., for two pumps of 8,000,000-gals. daily capacity each.

Bermidji, Minn.—Bids are wanted Feb. 23 for constructing water-works. Ted Smith, Pres. Village Council.

Allison, Ia.—It is stated that bids are wanted March 7 for constructing water works. W. F. Ray, Mayor.

Bloomington, Ind.—Bids are wanted Feb. 20 for 382 tons of 6, 12 and 16 in. pipe and specials. Frank Schefold, Engr.

Pendleton, Ore.—Press reports state that extensive improvements for the water works are contemplated by the Council.

Columbus, Miss.—Water-works and sewerage bonds, to the amount of $70,000, were sold Feb. 8.

Appleton, Minn.—It is stated that the proposition to build water-works and a sewerage system will be submitted to the citizens at coming election.

Newark, N. J.—The Water Committee of the Board of Works has adopted a motion recommending to the Board that a suitable site be purchased at once for a storage reservoir capable of holding 600,000,000 gals.

Williams, Ariz.—The Owens Water Co. has been incorporated, with a capital stock of $50,000. Incorporators: Joseph S. Owens, Minor Owens and John E. Gilson, all of Williams.

Zumbrota, Minn.—It is stated that a vote will be taken at the spring election on the proposition to issue $4,000 bonds for extensions to the water-works.

Seattle, Wash.—According to local press reports, the contract for constructing the Cedar River gravity system water-works will be readvertised, the court having decided the contract awarded to Gahan & Byrne to be illegal.

Minneapolis, Minn.—According to press reports, the Ohio Pipe Co., Columbus, O., was the lowest bidder for 545 tons of pipe, at $18.98 for 6 and 8 in. and $18.96 for 12 in. pipe.

Flagstaff, Ariz.—The Common Council has passed an ordinance providing for the issue of $20,000 water bonds. C. H. Edwards, Town Clk.

Jamestown, N. D.—Bids are wanted Feb. 27 for a 6-in. artesian well. Geo. C. Eagan, City Aud.

Berlin, Ont.—We are informed that W. M. Davis, of Berlin, is making surveys and preparing a report on the best means of increasing the water supply. In the meantime driven well will be sunk as a test.

La Crosse, Wis.—An ordinance is before the Council providing for the expenditure of $15,000 for the extension of water mains.

Kettle Falls, Wash.—J. J. Fuller, City Clk., writes that it was voted Feb. 7 to issue bonds for water-works.

Atlanta, Ga.—Bids are wanted March 9 for sinking an artesian well at Fort Morgan, Ala. John Simpson, Dept. Q. M. Gen., U. S. A.

St. Paul, Minn.—Bids are wanted Feb. 24 for 11,500 lin. ft. of 6, 12 and 16-in. cast-iron water pipe, special castings, hydrants, 4 to 16-in. water gates, pig lead, lead pipe, block tin, and water meters for 1899. John Caulfield, Secy. Bd. Water Commrs.

Philadelphia, Pa.—The Select Council has adopted a resolution requesting the Chief of the Bureau of Surveys to furnish Councils with the approximate cost of the construction of an aqueduct from the Delaware Water Gap to the city, having a capacity of 250,000,000 gals. a day.

Scio, O.—We are informed that bids are now being received for the construction of water-works, to cost about $20,000. John Shaffer, Mayor.

Washington, D. C.—Bids are wanted March 11 for furnishing cast-iron water pipe, as advertised in "The Engineering Record."

Arnprior, Ont.—A committee has been appointed to investigate the matter of water-works construction.

McLeansboro, Ill.—The following bids for completing the municipal water-works system were opened Feb. 11. Owen Ford, Consulting Engr., St. Louis, Mo.: Laidlaw-Dunn-Gordon Co., Cincinnati, O., pump and appliances, $900; Ft. Wayne Electrical Co., Ft. Wayne, Ind., electric apparatus, $980; Chas. A. Stookey, Belleville, Ill., complete work, $3,650; Goulds Mfg. Co., Chicago, Ill., pump, $760; deep well pumps and erection, $893; Fuller & Tritle, St. Louis, complete electric equipments, *$1,650; N. O. Nelson Mfg. Co., St. Louis, pump, delivered, $715; Henry R. Worthington, New York City, pump and erection, including deep well pumps, *$1,550; Cullen & Stock H. & V. Co., St. Louis, Mo., pump and erection, $970; deep well pumps and erection, $590.

*Contract awarded.

Montreal, Que.—Local press reports state that the following bids were opened Feb. 9 for a new boiler for the upper level pumping station: Babcock & Wilcox, New York City, $6,410; John McDougall, Montreal, *$5,975, and George Brush, $5,680.

*Contract awarded.

Hamilton, Ont.—According to local press reports contracts for water supplies have been awarded as follows: Lead pipe to Wood, Vallance & Co., $5.10 a ton; to Gartshore-Thompson Co., for cast-iron pipe, $27 a ton, and for ordinary castings at $1.75 per 100 pounds; special castings to City Brass Co., $2.24 per 100 pounds; 500 iron stopcock boxes to Burrow, Stewart & Milne, $1.10 each; for pig lead to Adam Hope & Co., of Hamilton, at $3.90.

Cheboygan, Mich.—The following bids for sinking a 10-in. well 450 ft. were opened Jan. 21 by George N. Case, City Clk., as advertised in "The Engineering Record": Pneumatic Engineering Co., 100 B'way, N. Y. City, $3,937; Rust Well Machine Co., Ithaca, N. Y., $2,250; J. G. Spiller, Cheboygan, Mich., $3,900; Coryell Drilling Co., Saginaw, E. S., Mich., $3,762; J. J. Mason, Bay City, Mich., $3,100; Thomas Harpee, Jenkintown, Pa., $3,600; O. G. Wilson, Macomb, Ill., *$1,700.

*Contract awarded.

Wellsville, O.—The following bids for 1,000 ft. or more of 12-in. cast-iron water pipe were opened Feb. 10 by D. A. Davidson, Supt. Water Trustees; *a*, pipe, per 2,000 lbs.; *b*, fittings,; *c*, gate valves, 12 in. each; *d*, labor; *e*, lead: Kelly & Jones Co., Pittsburg, *a*, $16.90; *b*, 2 cts. per lb.; *c*, $32 and $35. James B. Clow & Sons, Chicago, *a*, $18; *b*, 2 cts. per lb. Lake Shore Foundry, Cleveland, *a*, $19. Wm. McCormick, Wellsville, **a*, $16.90; *b*, 2 cts. per lb.; *d*, $350; *e*, 6 cts. per lb.

*Contract awarded.

St. Louis, Mo.—The Board of Public Improvements opened bids Feb. 7 for supplies for the Water Department. The lowest bids received were as follows: For 4,100 tons of water pipe, the American Pipe and Foundry Co., with headquarters at Bessemer, Ala., at $18.80 per ton, or $77,080. The Magnatite Foundry of St. Louis, for 200 tons of special castings at $31 per ton. The Pleugel & Henger Manufacturing Co., of St. Louis, were the lowest bidders, and received the contract for 425 fire plugs, the bid aggregating $9,120. For 179 stop valves the Fulton Iron Wks., of St. Louis, $5,388. Patrick O'Donnell and the Mound City Construction Co. for pipe laying, $12,550.40 and $14,185.50.

New York, N. Y.—The following bids were opened Feb. 16 by Wm. Dalton, Commr. of Water Supply, for laying water mains. The engineer's estimate calls for 7,000 cu. yds. rock, 14,000 cu. yds. excavation, 20,000 cu. yds. filling; 1,400 ft. 20-in. pipe, 12,500 ft. 12-in. pipe, 24,000 ft. 6-in. pipe; 1 20-in., 10 12-in. and 40 6-in. stop cocks, 100 hydrants, 800 sq. yds. repaving, 800 sq. yds. Telford, 200 ft. curb resetting, 20 cu. yds. masonry. Farrell & Hopper, 215 W. 125th St., N. Y. City, $40,618.55; James Kelly, 651 Belmont Ave., Brooklyn, N. Y., $28,750; Frawley Rooney, 180 E. 95th St., N. Y. City, $34,850; William Dalton, 147 E. 125th St., N. Y. City, $35,661; Henry Lipps, Jr., Elliott Ave., Elizabeth St., Brooklyn, N. Y., $25,091.20; John Cornwell, Jr., 69 E. 127th St., N. Y. City, $28.763.20; Patrick F. Burns, 449 St. Anns Ave., N. Y. City, $31,105.

SEWERAGE AND SEWAGE DISPOSAL.

Meriden, Conn.—The Common Council has ordered sewers built in 10 streets during 1899.

Havana, Ill.—Bernhard Wolters, City Clk., writes that an ordinance has been passed providing for the construction of a section of the sewerage system and for the sale of bonds on Feb. 28 to the amount of $9,500 to pay for same.

Newark, N. J.—City Surveyor Adam recommends the construction of a 6-ft. brick sewer from the intersection of Morris Ave. and Dickerson St. to the northerly side of the Morris and Essex R.R. Estimated cost, $22,200.

New Orleans, La.—The Finance Committee of the Board of Drainage Commissioners on Feb. 8 sold bonds to the amount of $250,000.

Carlisle, Pa.—Plans have been prepared for a sewerage system.

Sherman, Tex.—Specifications prepared by the Sherman Construction Co. for the first section of the sewerage system call for a total length of 129,534 ft. of 24 to 6-in. terra cotta pipe.

Wilkesbarre, Pa.—It is stated that an ordinance is to be introduced in the Council asking for power to increase the indebtedness of the city so as to provide $60,000 for sewers.

Greenville, Pa.—The Council has passed an ordinance ordering the completion of the sewerage system at an estimated cost of $10,000.

Quincy, Ill.—March 6 is the date set for hearing objections to the building of Cedar St. storm water sewer. Estimated cost $8,400.

Columbus, Ga.—The Committee on Streets and Sewers recommend that an 8-in. sewer be built on 13th St. B. F. Wilson, Chmn. Com.

Bridgeport, Conn.—The Committee on Sewers has asked for a total appropriation of $42,840.50.

Hartford, Conn.—Press reports state that P. H. Harrison & Sons, N. Y. City, have secured sewer contracts as follows: Buckingham St., for $4,788, and Vine and Casper Sts., for $6,305.

Springfield, Mass.—Chas. M. Slocum, City Engr., writes that plans and estimates have been prepared for the proposed Mill River valley sewer to drain Gunn Sq. and vicinity. Probable cost $50,000.

Augusta, Ga.—Dr. Eugene Foster, Pres. of the Board of Health, in his annual report urges the construction of a complete system of sewers.

Cleveland, O.—Bids are wanted March 15 for the fourth portion of the Walworth St. main sewer as advertised in "The Engineering Record."

San Diego, Cal.—It is stated that bids have been readvertised for the construction of the 8th Ward sewer.

Schenectady, N. Y.—The Assembly has passed the bill authorizing the Common Council to borrow $135,000 for the construction of sewers.

Columbus, Miss.—See "Water."

Oakland, Cal.—The City Council has passed an ordinance appropriating $50,000 for the construction of a storm sewer in Cemetery Creek Canyon.

Cohoes, N. Y.—Engineer Edward Hayes is stated to have completed plans for section No. 2 of the public sewer system.

Appleton, Minn.—See "Water."

St. Louis, Mo.—It is stated that Commissioner Colby has let the contract for repairing Mill Creek sewer to the Herman Construction Co., St. Louis, for $3,494.

Cleveland, O.—Separate bids for the construction of sewers in several streets will be opened on the following dates: Feb. 24 and 25, March 1, 2, 10, 11 and 16.

Long Island City, N. Y.—Matthew J. Goldner, Deputy Commr. of Sewers in the Borough of Queens, in his annual report estimates the cost of rebuilding the Broadway sewer, which has caved in for a distance of 500 ft., at $25,000.

Cleveland, O.—Bids are wanted Feb. 25 for sewers in several streets. George R. Warden, Dir. Pub. Wks.

Granite, Ill.—A. W. Stevens, City Clk., writes that Julius Pitzmen, of St. Louis, Mo., is the engineer in charge of sewer construction, estimated to cost $40,000. The St. Louis Stamping Co., of Granite City, Ill., is interested.

Grand Island, Neb.—Arnold C. Koenig, City Engr., writes that he has prepared plans and specifications for 1,376 ft. of 8-in. sewer extension; bids for same will soon be asked. Other extensions of from 1,000 ft. to 3,500 ft. each will soon be made.

Memphis, Tenn.—We are informed that there will be $90,000 expended for sewer work this spring. A. T. Bell, City. Engr.

Cleveland, O.—Bids are wanted March 11 for sewers in several streets. George R. Warden, Dir. Pub. Wks.

Indanapolis, Ind.—The following bids for building a sewer were opened Feb. 13 by M. A. Downing, Chmn. Bd. Pub. Wks.: J. C. Veney, *$1.02 per lin. ft.; Wm. Bosseot, $1.02 per lin. ft.; Eugene Shehan, $1.20 per lin. ft.; W. C. Allen, $1.20 per lin. ft.; Herron & Jenkins, $1.29 per lin. ft.; A. P. Showver, $1.29 per lin. ft.; Daniel Foley $1.33 1/3 per lin. ft.; Shover & Austin, $1.43 per lin. ft.; H. C. Roney, $1.38 per lin ft. Bidders all of Indianapolis.

*Contract awarded.

Steelton, Pa.—According to press reports, the following bids were opened Feb. 8 for furnishing 13 miles of terra cotta sewer pipe, as advertised in "The Engineering Record:" Keller & Mumma, Steelton, $10,007; Arthur M. Pearson & Co., New York City, *9,529; Charles Warren Co., Wilmington, Del., $10,729 and $10,472; G. B. Stucker, Harrisburg, $10,647; John Frenze Co., Toronto, Ont., $10,887; J. E. Rhoads, Harrisburg, $10,292; F. H. Cowden & Sons, Harrisburg, $10,-200. Three bids were received for cast-iron pipe to pass under the canal and railroad. The McNeal Pipe & Foundry Co., Burlington, N. J., were awarded the contract on 20-in. pipe, $19.80 per gross ton; 12-in. pipe, $19.30 per gross ton.

*Contract awarded.

Ottawa, Ont.—Local press reports state that the following bids have been received for constructing the third section of the sewerage system: *Laverdure & Laflamme, $107,695; Jos. Bourque, $127,225; S. R. Poulin, $129,850; W. Stewart, $129,887; Taylor & Co., Syracuse, N. Y., $131,048; J. Poupore, $137,999; Robt. Grant, New York City, $138,072; Allen & Fleming, $138,889; Burns & O'Leary, $139,800; John Galt (city engineer), $147,038; LaBelle & Payette, Montreal, $149,400; E. W. Clarke, $153,498; O'Leary & Robillard, $157,500; J. Coates & Surtees, $167,-960; Heney & Smith, $196,000; J. McKnight, Toronto, $174,735; J. G. Stacey, Toronto, $221,434. Address of bidders Ottawa, unless otherwise stated.

*Recommended for award.

BRIDGES.

Topeka, Kan.—A bill has been introduced in the House authorizing Wyandotte County to issue $75,000 bonds for a bridge across the Kaw River.

Reading, Pa.—An ordinance was introduced in the Select Council asking for the appropriation of $50,000 for a bridge at Spring St. over the tracks of the Philadelphia & Reading R.R.

Chicago, Ill.—Bids are wanted April 10 (change of date) for the substructure and superstructure of a railroad bridge crossing the Chicago river near Taylor St.; also for a bridge at Taylor St. across the same river, as advertised in "The Engineering Record."

Gretna, La.—A bridge over the 17th St. canal at Lake Ave. has been petitioned for.

Topeka, Kan.—The House recommended the passage of the following bills: Authorizing Lyon County to build a bridge over the Cottonwood river and the Neosho river, and Linn County to build a bridge across the Marais des Cygnes river.

Janesville, Ia.—The construction of a $10,000 bridge across the Cedar river is stated to be under consideration.

Marietta, O.—E. Frank Gates, City Engr., writes that a vote will be taken at the election in April on the proposition to issue $70,000 bonds for a bridge across Muskingum river.

Torrington, Conn.—At the town meeting held Feb. 6 it was voted to build a bridge across the Naugatuck river between Torrington and Harwinton at an estimated cost of $10,000.

Cleveland, O.—All bids received for the superstructure of the Center St. bridge have been rejected.

Alton, Ill.—Press reports state that the Bluff Line R. R. will build a $15,000 bridge.

Toledo, O.—The construction of two bridges across Swan Creek is stated to be under consideration. Local press reports state that the Lake Shore Railway has petitioned the Harbor, Commerce and Bridge Committee for permission to replace the wooden bridge at Curtis St. with an iron structure.

Lawrence, Mass.—The construction of a bridge across the Merrimac river to cost about $75,000 is contemplated.

Pittsburg, Pa.—It is stated that the grand jury recommended the building of a bridge over Wildcat run in Elizabeth township.

New Whatcom, Wash.—The Everson County bridge has collapsed; cost to repair $10,000.

Niagara Falls, N. Y.—Press reports state that the city and the Niagara Falls Hydraulic Power & Manufacturing Co. will build an $8,000 bridge across the hydraulic canal at Main St.

Buffalo, N. Y.—The construction of a bridge across Scajaquada Creek at Sprenger St. is stated to be under consideration.

San Francisco, Cal.—It is stated that the property owners petitioned that the boulevard be connected and a bridge built across Trocadero Gulch. Estimated cost of bridge, $15,000.

Bradford, Pa.—The City Engineer estimated the cost of an iron bridge at Barbour St. at $4,362.

Floodwood, Minn.—It is stated that the citizens have filed a petition asking the County Board for a bridge across the Floodwood river.

Boston, Mass.—The issue of $50,000 for rebuilding the draw and reconstructing the Malden bridge is being considered.

Montgomery, Ala.—Local press reports state that the Mobile & Montgomery R. R. will make changes in several bridges on its line. The largest part of the work will be the rebuilding of the bridge over Tensas river and remodeling of Bayou Sara bridge. Engineer Brown is preparing plans for these changes.

Providence, R. I.—Otis F. Clapp, City Engr., writes that bids will probably be asked about the middle of March for the proposed new bridge at Mill St. Estimated cost $21,000.

Ogden, Utah.—C. R. Hollingsworth, Co. Aud., writes that the contract for a bridge over Weber river has been awarded to Andrews Bridge Co., Salt Lake City, for $3,795.

Villagrove, Ill.—It is stated that bids are wanted March 4 by the County Commissioners, Tuscola, for a highway bridge.

Grand Rapids, Minn.—See "Power Plant, Gas and Electricity."

Sarnia, Ont.—John Dalzirl, Co. Clk., writes that the Counties of Kent and Lambton will, during the present season, build a bridge over Fauchu Creek, but up to the present the proportion of the cost of a bridge and approaches has not been settled.

Algoma, Wis.—Bids are wanted Feb. 21 for a steel draw bridge. George M. Cosky, City Clk.

Bellefontaine, O.—Bids are wanted Feb. 28 by the County Commissioners for furnishing material, doing excavation and masonry work for the substructure of Kiblinger bridge over the Miami Valley Pike in Richland Township. Wilbur A. Ginn, Engr.

Cleveland, O.—Bids are wanted March 10 for a bridge over Cuyahoga River. G. W. Kittredge, Ch. Eng., Cleveland, Cincinnati, Chicago & St. Louis Ry., Cincinnati.

Albany, N. Y.—Bids are wanted Feb. 23 for rebuilding culverts Nos. 39 and 45, Eastern Division, Erie Canal. John N. Partridge, Supt. Pub. Wks.

New York, N. Y.—Mayor Van Wyck has signed the ordinance providing for the issue of $1,500,000 bonds for the steel towers and end spans of the New East River bridge.

Nebraska City, Neb.—The following bids for constructing bridges for 1899 were opened Feb. 9 by H. R. Christy, County Clerk.

	Combination 30 to 36	40 to 50	50 to 60	80 to 85	Steel. 24 to 36	40 to 50	50 to 60	80 to 85
T. J. Crummel, Auburn, Neb.	$3 15	$3.70	$4.00	$5.45	$5 19	$6.74	$7.34	$8.00
Missouri Valley Bridge Co., Leavenworth, Kan.	3 60	4 25	5.25	6 50	4.70	5.25	6.75	8.00
Canton Bridge Co., Canton, Ohio	4.50	5 50	6 25	..	5.20	5.90	6.55	7 85
Henderson Bros., Savannah, Mo.	*3.10	*3.20	*4.12	*5.00	5.00	5.20	9.25	11.20
Wayland & Co., Washington, Kan.	2.96	3.37	4.60	4.94	*4.00	*4.40	5.50	6.70

*Contract awarded.

Boston, Mass.—The following are the bids opened Feb. 2 for furnishing and erecting a stone railing, etc., Charlestown approach, Charlestown Bridge: Woodbury & Leighton, Boston, $7,144; Norcross Bros., Boston, $7,344; Cape Ann Granite Co., Boston, *$6,700.
*Contract awarded.

New York, N. Y.—The following bids were opened Feb. 16 by John L. Shea, Commr. of Bridges, for reconstructing the Blissville bridge, crossing Newtown Creek at Greenpoint Ave.: Gildersleeve & Rolf, 39 Cortlandt St., N. Y. City, $61,851.19; Degnon-McLean Construction Co., 1 B'way., N. Y. City, *$57,414.02; Frank R. Pidgeon, 315 Madison Ave., N. Y. City, $73,-610.79.
*Contract awarded.

PAVING AND ROADMAKING.

McKee's Rocks, Pa.—The Borough Council has passed an ordinance providing for the paving and grading of Bell Ave., at an estimated cost of $8,000.

Bloomfield, N. J.—Contracts for 2¾ miles of telford pavement have been awarded as follows: For Broad St. to Francis J. Marley; estimated cost about $15,465. For Bay Ave., to Francisco Bros., for $3,075.

Lawrence, Mass.—Supt. M. F. Collins, in his annual report of the Street Department, recommends the paving of Lowell St.

Grand Rapids, Mich.—It is stated that bids are wanted Feb. 24 by the Board of Public Works for paving Ottawa St. with brick.

St. Paul, Minn.—The City Engineer estimates the cost of macadamizing East Seventh St. at $14,685.

Lebanon, Ind.—Bids received Feb. 13 for paving West Pearl St. with brick have been rejected. New bids will be received March 16. H. S. Freeman, City Engr.

Reading, Pa.—Paving bonds to the amount of $100,000 were sold Feb. 8.

Jonesboro, Tenn.—Local press reports state that it is proposed to issue $100,000 bonds, to be used in the construction of 60 miles of road in Washington Co.

Denver, Colo.—Local press reports state that the only bids received for the repair during 1899 of streets and alleys paved with asphalt was from the Colorado Paving Co., as follows: Per sq. yd. for asphalt, 2½-in. wearing surface, $1.90; 2-in. wearing surface, $1.65. Per sq. yd. for Portland cement, 6 in. in depth, $1.20; 4 in. in depth, 95 cts.

Paterson, N. J.—City Engineer Ferguson estimates that the work laid out in the ordinance passed by the Board of Aldermen will amount to 60,000 or 70,000 sq. yds. Probable cost $120,-000 or $140,000.

New York, N. Y.—The Board of Public Improvement has approved the plan of President Coogan, of the Borough of Manhattan, for the curbing and repaving with asphalt of Elm St. from Centre to Great Jones St.

Scottsboro, Ala.—It is stated that bids are wanted March 1 for $125,000 bonds. R. S. Skelton, Pres. Road Com.

Cleveland, O.—Bids are wanted March 14 for block pavement on Perkins Ave. Geo. R. Warden, Dir. Pub. Wks.

Oshkosh, Wis.—City Engineer H. W. Leach, in his annual report, recommends granite block or brick pavement on streets having a large amount of traffic.

St. Augustine, Fla.—P. S. Arnus, City Clk., writes that the contract for paving with brick on St. George St. has been awarded to McGuire & McDonald.

Elgin, Ill.—The Finance Committee asks for an appropriation of $148,000 for paving.

Orrville, O.—Press reports state that Cyrus Markly, C. E., of Wooster, O., has been employed to prepare plans and specifications for paving Main St. for a distance of about one mile.

Utica, N. Y.—Resolutions have been passed to pave several streets.

Philadelphia, Pa.—Bids are wanted Feb. 23 for the completion of East Side drive, Lincoln Ave., continuation of river wall and rubble masonry. Jesse T. Vogdes, Ch. Engr. & Supt., Commrs. of Fairmount Park.

Sandusky, O.—Bids are wanted March 1 for $50,000 paving bonds. A. W. Miller, City Clk.

Boonville, Mo.—Jasper McC.Daniel, City Clk., writes that the City Council on Feb. 6 passed a resolution declaring it necessary to pave Main St.

New York, N. Y.—Bids are wanted Feb. 23 for a 12-ton steam road roller. George C. Clausen, Chmn. Commrs of Parks.

Norfolk, Va.—The Common Council has adopted a resolution authorizing the paving of Chapel St. and appropriating $5,957 for same.

Birmingham, Ala.—Mayor F. V. Evans, in his annual report, recommends the paving, with Belgian block, brick or asphaltum, of sections of several streets.

Bellevue, Pa.—Bids are wanted Feb. 25 for paving Grant Ave. Edeburn, Cooper & Co., Boro. Engrs.

Clinton, Ia.—Bids are wanted March 1 for macadamizing part of a road. L. Rutenbeck, Co. Aud.

Albany, N. Y.—The following bids for brick paving were opened Feb. 6 by Thomas J. Lanahan, Clk. Bd. Contract and Apportionment: A, Mulderny Bros., 5 St. Joseph's Terrace; B, T. Henry Dumary, 86 State St.; C, E. F. Dillon, 5 N. 1st St.; D, Robt. H. Strong, Washington Ave.

Dove Street.

	Brick, per sq. yd.	Granitecurb straight per lin. ft.	Granitecurb circular, per lin. ft.	Relaying pavement, per sq. yd.	Excavation per sq. yd.	Relaying curb, per lin. ft.	Vit. brick sidewalk per sq. ft.	Sod per sq. yd.	5 ft. flag sidewalk per sq. ft.	Relaying old flag per sq. ft.	Receiving basins, each.	Steps comp.	Replanting trees, each.	Lumber per M ft.	Vit. brick masonry per cub. yd.	Concrete foundations per cub. yd.	Blue stone coping.	Number of days.
		Cts.		Cts.	Cts.	Cts.	Cts.	Cts.	Cts.	Cts.								
A	$1 80	57	$1.00	50	18	20	09	30	16	04	$80	$40	$1.00	$18	$18	$6.00	$0.60	9
B	*1 75	37	1 00	50	15	50	09	20	15	06	80	20	2.00	20	12	6.00	.60	8
C	1 80	80	.85	25	35	25	09½	20	18	03½	65	75	1.50	20	10	6.00	.50	20
D	2.00	50	.50	30	18	05	10	35	15	07	75	40	1.00	14	15	4.50	1.65	11

Elizabeth Street.

	Brick, per sq. yd.	Granitecurb straight, per lin. ft.	Granitecurb circular, per lin. ft.	Relaying pavement, per sq. yd.	Relaying on concrete.	Relaying curb on sand.	Relaying curb on concrete.	Vit. brick sidewalk.	5-ft. flag.	Relaying sidewalk.	6-in. pipe and trenches.	Bends.	Each day's labor backfilling.	Rec basins.	Lumber	Number of days.
		Cts.		Cts.		Cts.	Cts.	Cts.	Cts.	Cts.	Cts.	Cts.				
A	*$1 65	35	$1.00	40	$1.50	20	30	09	16	02	60	50	$1.50	$75	$18	20
B	1.95	57	.57	60	1.50	25	50	09	18	03	80	50	1.50	70	18	20
C	1.70	59	.59	25	3.00	20	30	09½	16	03	55	35	1.50	65	20	25

Hamilton Street.

	Brick, per sq. yd.	Granitecurb straight, per lin. ft.	Granitecurb circular, per lin. ft.	Relaying pavement, per sq. ft.	Relaying curb.	Sod, per sq. yd.	5 ft. flag.	Relaying old flag.	Excavation per cu. yd.	Lumber per 1,000 ft.	Receiving basins, each.	6 in. pipe and trenches.	Bends, each.	Each day's labor for back filling.	Number of days.
		Cts.			Cts.	Cts.	Cts.	Cts.	Cts.			Cts.	Cts.		
A	*$1.70	57	$1.00	$1.50	20	18	16	04	21	$18	$80	60	40	$1.50	20
B	1.63	62	.80	1.50	50	20	14	06	20	18	80	60	40	1.50	15
C	1.80	60	.70	2.00	25	18	18	04	35	20	65	55	35	1.50	25

*Contract awarded as above and not as stated in our issue of Feb. 11.

St. Louis, Mo.—It is stated that bids are wanted Feb. 24 for brick paving on portions of several streets. Robt. E. McMath, Pres. Bd. Pub. Improvements.

Canton, O.—There will be 15,000 sq. yds. of brick pavement laid. Louis N. Ley, City Clk.

Atchison, Kan.—Fred. Giddings, City Engr., writes that the following contract was let Feb. 8 to the Atchison Paving Brick Co., of Atchison: Repaving South 4th Ave. with brick on old concrete foundation: 16,555 sq. yds. of paving, at 70 cts., $11,588.50; 1,088 ft. B. M. oak lumber, at $25., $27.20; 232 lin. ft. cement curb., 6½x20 in., at 48½ cts., $112.52; 492 lin. ft. cement curb., 5½x 20 in., at 45½ cts., $223.86; 490 lin. ft. curb., reset, at 10 cts., $49; 5,200 lbs. cast-iron bridge plates, at 1¾ cts., $91; 1,600 sq. ft. sidewalk brick, at 5½ cts., $88; 150 lin. ft. tile relaid, at 30 cts., $45; 2,752 cu. yds. cedar blocks removed, at 1 ct., $27.52; total, $12,252.60.

Toledo, O.—William O. Holst, City Clk., writes that the lowest bids opened Feb. 6 for paving were as follows *a*, Monroe St.; *b*, Millburn Ave.: F. E. Cole, Toledo, *a*, for asphalt, $17,574.59, with Medina curb and $17,255.39 with Berea curb. Warren Scharf Asphalt Paving Co., N. Y. City, *b*, for asphalt, $12,458.18, with Medina curb, and $12,074.68 with Berea curb. Harry G. Jennison, *a*, for Buckeye, Wassell or Lane block, $13,505.17, with Medina curb, and $13,185.97 with Berea curb; for Harris or Metropolitan block, $13,315.45, with Medina and $12,996.22 with Berea curb. Geo. H. Bodette, Toledo, *b*, for Buckeye, Wessell, Lane, Harris or Metropolitan block, $9,606.86 with Medina curb and $9,223.36 with Berea curb.

POWER PLANTS, GAS AND ELECTRICITY.

Joplin, Mo.—An election will be held Feb. 28 to vote on issuing $30,000 for an electric light plant.

Cascade City, B. C.—S. F. Quinlivan, of Cascade City, is stated to have received the contract for the removal of rock at the dam site for the Dominion Mining Development & Agency Co. Another contract will shortly be let for the construction of the 12x12 flume, amounting to about $45,000. It will be 400 ft. long and driven through solid rock. Wm. Anderson, Resident Engr.

Ada, Minn.—H. O. Peterson, Traveling Agent for the Minneapolis & St. Louis Ry. Co., is stated to be interested in the construction of an electric light plant here.

Kenosha, Wis.—W. H. Schott, of Chicago, is stated to have received the contract for lighting the city for 10 years at $78 per light per year.

Rock Island, Ill.—The People's Power Co. has received the contract for lighting the streets for 5 years at $74.37 per light per year.

Red Cloud, Neb.—H. T. Fisher is stated to have applied for a franchise for an electric light plant.

Simsbury, Conn.—J. R. Ensign is stated to have petitioned for an electric light franchise.

South Omaha, Neb.—See "Government Work."

Weedsport, N. Y.—J. D. Edwards writes that the plant of the Weedsport Electric Light & Power Co. is to be enlarged at a cost of about $7,000. It is proposed to add a 50 to 75 k. w. alternator, with boiler and engine power for same; also to erect a new building.

Sweetwater, Tenn.—J. A. Summers, an electrician of Knoxville, is stated to have applied for a franchise.

Quincy, Mich.—The citizens are stated to have voted to construct a $5,000 electric light plant.

Belding, Mich.—F. P. Smith, City Clk., writes that the contract for street lighting has been awarded to the Citizens' Light Co., Belding, for 20 arc lights at $50 per light per annum.

New London, N. C.—The North Carolina Power Co. is stated to have been formed here, to develop the water power of the Yadkin river for electrical purposes. Geo. I. Whitney, a broker, of 4th Ave., Pittsburg, Pa.; I. P. R. Polk, of Wilmington, Del.; Dr. Dillon Brown, of New York, and others are said to be interested.

St. Augustine, Fla.—An ordinance is stated to have been introduced in Council authorizing the Mayor to call an election to vote on issuing $20,-000 for an electric light plant.

Chicago, Ill.—The Cook County Light & Heat Co. has been incorporated; capital, $50,000. Incorporators: John Cameron, Warren A. Drake and Chas. C. Holter.

Boyertown, Pa.—The matter of granting I. R. Lerch, of Reading, and others a franchise for an electric light plant is said to be under consideration by the Council.

Sea Isle City, N. J.—The Council is stated to have rejected all bids received Jan. 23 for lighting the borough by electricity, and will again receive bids for same. J. T. Chapman, Boro. Clk.

Dover, Del.—The question of constructing an electric light plant is said to be under consideration here.

South Bethlehem, Pa.—Bids are wanted Feb. 20 for electric lighting for a period of five years. Chas. G. Boyer, Chmn. Lamp Com., 404 Wyandotte St.

Pontiac, Ill.—S. E. Sims and Dr. Marshall are stated to have applied for a franchise for an electric light plant.

Nebraska City, Neb.—D. P. Rolfe, Mgr. of the Nebraska City Water & Light Co., writes that an expert electrician from Chicago has been employed to make suggestions for the improvement of the power plant.

Cambridge, O.—Bids are wanted March 6 for lighting the streets with 75 arc lights for a period of five years. T. R. Deselm, City Clk.

Baltimore, Md.—Bids are wanted March 1 for installing a complete electric lighting plant at the Mount Royal Pumping Station, as advertised in "The Engineering Record."

Eldorado Springs, Mo.—The Eldorado Springs Electric Co. has been incorporated; capital, $15,000. Incorporators: C. A. Ross, F. W. Hiatt, and A. Nichols.

Humboldt, Ia.—The citizens are stated to have voted in favor of an electric light plant.

Albion, Mich.—It is stated that a committee has been appointed to investigate the advisability of municipal electric street lighting. Mr. Bruce, Mayor.

Evergreen, Ala.—See "Water."

Grand Rapids, Minn.—The House is stated to have passed a bill authorizing the Grand Rapids Waterpower & Boom Co., of Grand Rapids, Minn., to construct a dam and bridge across the Mississippi River. Daniel M. Gunn, Hurbert D. Powers and others are said to be interested.

Johnstown, N. Y.—The following bids were opened Feb. 6 for lighting the streets for 5 years: Wm. Lansing, of Little Falls, 80—1,200 c. p. arc lights for $7,600 per year, 90 lights for $8,325, 100 lights for $9,200 per year. The Johnstown Electric Light & Power Co., 80—1,200 c. p. arc lights at $91.25 per year for each light.

Minneapolis, Minn.—It is stated that all bids received for electric and gas lighting have been rejected. New bids will be asked.

Ottawa, Ont.—John Aylen, C. E., writes that the Metropolitan Electrical Co. is about to advertise for bids for work, including water power development, machinery and electric lines, to cost $350,000. Thos. Lindsay, Managing Director.

Greenpoint (L. I.), N. Y.—See "Water."

Pomeroy, O.—The Council has passed an ordinance granting a gas franchise to S. F. Pratt & Co.

Belmont, W. Va.—It is reported that the Morgan & Gardner Electric Co., of Chicago, is making preparations to erect a plant to supply power to the mines of the Belmont, Kanawha, Splint, Riverside, and Big Mountain Coal Companies.

Baltimore, Md.—The contract for incandescent gas light fixtures is stated to have been awarded to the Welsbach Street Lamp Co. of America at $12 a lamp. This includes the care of the lamps for one year. The contract calls for about 600 lamps.

Watertown, Wis.—Bids are wanted Feb. 20 for electric lighting for a term of 5 years. F. C. Hartwig, Chmn. Street Lighting Com.

ELECTRIC RAILWAYS.

Manitowoc, Wis.—Judge Isaac Craite, of this city; W. A. Walker, of Milwaukee, and others are stated to have petitioned the City Council for a franchise.

Bridgeton, N. J.—The Fairfield Township Committee is stated to have passed an ordinance granting a franchise to the Bridgeton & Millville Traction Co. This completes the franchises required by the company and the trolley road will soon be extended to Cedarville, a distance of 8 miles.

Kalamazoo, Mich.—The Grand Rapids & Kalamazoo Electric Ry. Co. has been incorporated; capital, $100,000. W. M. Hannan, Pres.; C. W. Taylor, Secy.

Streator, Ill.—Cary C. Barr is stated to have received a franchise.

Jackson, Mich.—The ordinance granting a right of way to the Adrian Electric Ry. Co. is stated to have passed a second reading.

Xenia, O.—The Xenia & Spring Valley Electric Ry. Co. has been incorporated, to build and operate a line from Spring Valley to Xenia; capital $5,000. Incorporators: C. J. Ferneding, Phillip H. Kemper, of Xenia, and others.

Indianapolis, Ind.—The County Commissioners are stated to have granted a franchise to D. P. Erwin, David M. Parry and D. M. Ransdell to build an electric railway over the National Road to Bridgeport.

Bessemer, Ala.—W. T. Kennedy is stated to have applied for a franchise.

Los Angeles, Cal.—The Pacific Electric Ry. Co. is reported to have been incorporated to operate in Southern California; capital $1,000,000. Incorporators: J. Kuhrts, Chas. Seyler and others. Principal office to be at this place.

Ypsilanti, Mich.—J. E. McGregor, City Clk., writes that H. P. Glover and R. W. Hemphill have applied for a franchise to build an electric railway between Ypsilanti and Saline. Probable cost of construction $75,000.

Riverside, Cal.—It is stated that James H. Boyd will apply for a franchise for an electric railway from San Bernardino to Redlands.

Lexington, Mass.—The Lexington & Boston St. Ry. Co. is stated to have received a franchise to extend its line.

New York, N. Y.—The State Railroad Commission is stated to have granted the Metropolitan St. Ry. Co. the Broadway & Seventh Ave. R. R. Co. and the N. Y. & Harlem R. R. Co. permission to change their motive power to underground electricity.

Kansas City, Mo.—A charter has been granted to the Missouri Electric Ry. Co.; capital $500,000. Incorporators: H. Smith, C. McDonald, F. W. Sears and others.

Georgetown, Mass.—We are informed that the Georgetown, Rawley & Ipswich St. Ry. Co. is being formed to construct about 18 miles of street railway. Edmund B. Fuller, of Haverhill, is interested.

Charleston, W. Va.—A charter is stated to have been granted to the Charleston Ry. Co. to construct a railway in this city; capital, $100,000. Incorporators: J. E. Scraggs, F. W. Sweet and others.

Kenosha, Wis.—W. H. Schott, of Chicago, Supt. Metropolitan Electric Co., is stated to have applied for a franchise to construct and maintain an electric railway.

Charlotte, N. C.—P. M. Brown, Chmn. Bd. of County Commrs., writes the State Legislature has been petitioned for a charter for the construction of a city and suburban electric railway, and when same has been granted steps will be taken to organize a company.

Braddock, Pa.—The Wilkinsburg & East Pittsburg St. Ry. Co. is stated to have received a franchise over 3 miles of streets in North Braddock.

RAILROADS.

Birmingham, Ala.—The Birmingham Southern R.R. Co. has been incorporated; capital, $1,200,000. Incorporators: G. B. McCormick, Gen. Mgr. Tenn. Coal, Iron & R.R. Co.; Nathaniel Baxter, Jr., A. M. Shook and others, all of Birmingham.

Reiley, O.—The Richmond, Oxford, Reiley & Cincinnati, R.R. Co. has been incorporated; capital $2,000. Incorporators: C. A. Shera, A. F. Sloane and others.

Des Moines, Ia.—The Des Moines, Moulton & Albia R.R. Co. has been incorporated; capital, $200,000. Incorporators: Orin D. Ashley, New York City; Joseph Ramsey, Jr., St. Louis, and others.

Little Rock, Ark.—The Little Rock & Gulf Ry. Co. has been incorporated, to construct a railroad about 120 miles long; capital $1,800,000. Stockholders: A. B. Banks, E. A. Ackerman and Charles McKee, of Fordyce; Oscar Davis, of Little Rock, and others.

Rutland, Vt.—The following bids were opened Feb. 8 by the Rutland Canadian Railroad, as advertised in "The Engineering Record."

Names of Bidders.	Addresses.	Items.	Earth Excav.	Loose R'ck Excav.	Solid Rock Excav.	Rubble Embankment. A.	B.	C.	D.	Bridge.	Highway and Ret. Walls.	Arch Culvert.	Box Culvert.	Caissons.	Cribs.	Rip-rap.	Dredging.	Stone Cutting.	Piling.	Timber Found'ns Land.	Timber Found'ns Water.	Main Track Miles.	Side Track Miles.	Frogs.	Switches.	Broken Stone. Cu. Yds.	Gravel. Cu. Yds.	Total Amount of Bids. (Varying Rubble and Time of Completion.) Plan A.	B.	C.	D.
		Quantities Price.	340,000 cu.yds.	10,000 cu.yds.	100,000 cu. yds.	500,000 cu.yds. Sept. 1, '99.	500,000 cu.yds. Oct. 1.	35,000 cu.yds. Sept. 1.	350,000 cu.yds. Oct. 1.	3,000	4,000	200	2,000	1,100	1,700	10,000	20,000	5,000 sq. ft.	24 000 ft.	30 M.	50 M.	44.	4.	30.	30.	50,000	70,000				
Weand, McDermott & Cushing	New York City		.20	.60	.90	1.30				10.00	5.00	13.00	3.00	10.00	6.50	2.50	1.00	.50	.25	30.00	35.00	400.00	300.00	37.00	150 00	1.00	.50	$1,100,010			
Brodhead Contracting Co.	Easton, Pa.		.25	.45	1.00		.85		.80	15.00	6.00	10.00	6.00	12.00	7.00	2.00	1.00	.50	.30	25.00	35.00	300.00	300.00	25.00	25.00	.95	.45		$917,300		$772,300
J. W. Whalen & Co.	Whitehall, N. Y.		.22	.50	.90	1.05	1.02	.98	.95	12.00	6.00	12.00	6.00	7.00	3.00	1.50	.20	.20	.30	20.00	22.00	300.00	300 00	10.00	15.00	.59	.40	923,450	908,450	$741 450	720,950
J. C. Rodgers, J. M. Waddle and L. B. Fitch	New York City.	Oct. 1, '99.	.24	.50	.90		.80		.77	10.00	6.00	12.00	5.00	12.00	3.50	1.50	.40	.40	.30	28.00	25.00	300.00	300 00	20 00	25.00	.60	.80	891,142	843,790	751,142	719,290
		Sept. 1, '99.	.26	.53	.95	.84		.80		10.50	6.30	12.60	5.25	12 60	3.70	1.60	.42	.42	.31	29.40	24.25	315.00	315.00	21 00	26.25	.63	.84				
O'Brien & Sheehan	"	Sept. 1 '99.	.18	.40	.40	.40				9.00	5.00	11.00	4.00	10.00	5.00	1.75	.25	.15	.30	30.00	30 00	250.00	250.00	15.00	10.00	.35	.30	499,600		439,600	
		Oct. 1, '99.	.18																												
Farrell, Hopper & Co.	"	Sept. 1, '99.	.23	.40	.75	1.25		.75		12.00	5.00	12.00	4.50	7.00	1.75	1.00	.40	.20	.30	30.00	30.00	300 00	300.00	10.00	15.00	.35	.35	988,625	888,625	626,125	
		Oct. 1, '99.	.23	.40	.75		1 05																								
Warren, Scharf Asphalt Paving Co.	"	Sept. 1, '99.	.16	.60	.83	61		.61		12.00	6.50	10.00	3.25	6.60	3.10	1 15	.44	.25	.25	24.00	30.00	330.00	350.00	25.00	35.00	.70	.56	686,440	686,440	594,940	594,940
		Oct. 1, '99.	.16																												
Ferguson Contracting Co.	"	Sept. 1, '99.	.23	50	.75	.98		.92		15.00	6.00	15.00	5.00	18.00	10.00	3.50	.35	.25	.40	30.00	50.00	350.00	400.00	25.00	25.00	.60	.50	955,850	940,850	787,850	780,850
		Oct. 1, '99.					.95		.90																						
James P. McDonald & Co.	"	Sept. 1, '99.	.1975	.47	.85	.645		.625		10.00	4.50	10.50	4.50	8.50	5.50	2.00	.35	.30	.23	35 00	33.00	425.00	425.00	15.00	20.00	775	.575	735,780	725,780	632,030	622,405
		Oct. 1, '99.					.625		.5975																						
Engineering Contract Co.	"	Sept. 1, '99.	.22	.50	.95	.86		.92		9.00	4 60	9 50	4.00	8.50	2 85	.90	.23	.30	.23	26.00	26.00	250.00	160.00	25.00	25.00	.31	.26	787,886	751,366	679,886	647,866
		Oct. 1, '99.	.197		.90		.83		.88													225.00									

NEW DEPOTS.

Boston, Mass.—The Pencoyd Iron Works, 27 State St., Boston, are stated to have received the contract for the elevated structure in Washington St. and in Main St., Charlestown, for the Boston Elevated Ry. Co. The contract calls for about 8,300 tons of metal work. Bids for the construction of the remaining portion of the system will be invited soon.

Wichita, Kan.—It is stated that the Missouri Pacific Ry. Co. will build a $40,000 station. J. W. Way, Ch. Engr., St. Louis, Mo.

Madison, Wis.—The Chicago, Milwaukee & St. Paul Ry. Co. is stated to have decided to erect a freight depot here, to cost about $50,000.

PUBLIC BUILDINGS.

East Cambridge, Mass.—Bids are wanted Feb. 25 for ventilating, heating, plumbing, etc., in the hospital of the House of Correction. Levi S. Gould, Chmn. Co. Commrs.

Valdosta, Ga.—T. G. Cranford and B. H. Roberts are said to be interested in the erection of a $50,000 hotel.

Albany, N. Y.—See "Water."

Harrisburg, Pa.—The Senate Committee on Education is stated to have reported favorably on the bill accepting Andrew Carnegie's offer of $100,000 for a state library.

Buffalo, N. Y.—The plans of Robt. A. Wallace, of Buffalo, are stated to have been accepted for a $35,000 edifice for the First Baptist Church.

Logansport, Ind.—A. P. Flynn, Co. Clk., writes that the Grand Jury of Cass Co. has recommended the building of a new jail, but no action has as yet been taken by the Commissioners.

Bismarck, N. D.—Bids are wanted Feb. 20 for a grain elevator. J. J. Newton, Secy. Missouri Valley Milling Co.

Topeka, Kan.—The Senate is stated to have passed a bill appropriating $100,000 for the erection of an insane asylum.

Grinnell, Ia.—Bids are wanted Feb. 25 for heating, plumbing, etc., in a building for the Iowa College. Dr. E. W. Clark, Chmn. Bldg. Com.

Caledonia, Minn.—E. C. Reily, of La Crosse, Wis., is stated to have received the contract for erecting a church at $11,796.

Washington, D. C.—Bids are wanted Feb. 25 for a building on the grounds of Providence Hospital. John B. Wight, Chmn. Commrs., D. C.

Cascade, Ia.—Guido Beck, of Dubuque, has about completed plans for a stone church, to cost $25,000.

Cleveland, O.—Bids are wanted March 10 for a ventilating and heating apparatus in the Children's Hospital at the City Infirmary. Wm. J. Akers, Dir. Charities & Correction.

Mankato, Minn.—Bids are wanted March 1 for the superstructure of St. Joseph's Hospital. J. B. Meagher, Secy. Bldg. Com.

Northampton, Mass.—Bayley & Goodrich, of Hartford, are stated to have completed plans for a $50,000 annex to the Bay State Hotel.

Iowa City, Ia.—Bids are wanted March 20 for finishing the basement and erecting the superstructure of the collegiate building. Wm. J. Haddock, Secy. Bd. of Regents, State University.

Oshkosh, Wis.—The Chas. W. Gindele Co., of Chicago, is stated to have received the contract for the public library, at $35,700.

Wilmington, N. C.—Bids are wanted Feb. 25 for a Masonic temple. Jas. C. Munds, Secy. Masonic Temple Corporation.

Philadelphia, Pa.—The following contracts were awarded Feb. 4 by the Commissioners for the erection of the new public buildings, for work during 1899: For copper, store, iron and bronze work, masonry, plastering, carpenter and mill work, for furnishing and fitting up rooms for Board of Public Education, also for furnishing combination fixtures, incidental stone work and repairs, and mackite blocks, to Allen B. Rorke, Borse Bldg., for $412,000; for cement, to Vulcanite Portland Cement Co., 1710 Market St., $2.35 per bbl.; bricks, to Murrell Dobbins, Builders Exc., bricks plain $6.75, pressed $16.75, hollow $7.75 per thousand; fire brick, R. C. Remmey & Sons, 2637 E. Cumberland St., $20 per 1,000, and fire clay $1 per bbl.; repairs to asphalt floors, W. S. P. Shields, 1428 S. Pa. Sq., $2.25, over wires $3.25. Contracts for electrical supplies, dynamos, engines and boilers not awarded; action postponed for present.

Pueblo, Colo.—The Pueblo Hospital Association is said to be considering the matter of erecting a $20,000 building.

Olympia, Wash.—The Senate is stated to have passed the bill providing for the erection of a Capitol building at a cost of $600,000.

Birmingham, Ala.—Bids are wanted Feb. 25 for an addition to a building. D. A. Helmich, Archt., 3d Ave. and 19th St.

Wellington, Kan.—The County Commissioners are stated to have accepted plans for a $13,000 jail.

FIRES.

Mansfield, O.—The Baxter Stove plant is reported to have been burned; loss about $100,000.

Trenton, N. J.—The plant of the New Jersey Steel & Iron Co. was damaged by fire Feb. 12 to the extent of $50,000.

Boston, Mass.—It is reported that the loss incurred by the New England Sanitary Product Co. and the Semet-Solvay Co. by the burning of the city garbage plant at Old Harbor point Feb. 10 will amount to about $100,000.

Huntsville, Tex.—The east and west wings of the State Penitentiary were burned Feb. 13; the burned buildings cost $97,000.

Chicago, Ill.—The bicycle factory and machine shop of I. Silverman & Bros., on 14th St., was damaged by fire Feb. 15, to the extent of about $75,000.

NEW INDUSTRIAL PLANTS.

The Willingham Cotton Mills, Macon, Ga., will put up a 5,000-spindle cotton-yarn mill near that city, for which plans and specifications are being prepared.

The Detroit Graphite Mfg. Co., 542 River St., Detroit, is erecting a 53x74-ft. 5-story and basement brick addition to its factory, which will be run by electric power.

L. C. Todd, Waxahachie, Tex., is interested in mill of about 5,000 spindles and 150 looms, which there is some talk of erecting during the current year.

BUSINESS NOTES.

The Mound City Ice & Cold Storage Co., St. Louis, Mo., is remodeling the plant formerly occupied by the St. Louis Car Co. It is erecting two Ball ice machines of about 250 tons capacity each, and expects to be in operation by May 1.

The Alma Sugar Co., Alma, Mich., has arranged with the Kilby Mfg. Co., Cleveland, O., for the erection of a 500-ton beet sugar plant. The building will be a 340x68-ft. brick and iron structure.

The Cahall Sales Department, Pittsburg, Pa., announces that owing to the rapid increase in the price of raw materials entering into boiler construction, it will advance the price of its boilers 20 per cent., beginning March 1.

Mr. J. W. Duntley, president of the Chicago Pneumatic Tool Co., recently gave a trial exhibition of Boyer riveters, hammers and drills before a convention of Glasgow shipbuilders, which, it is stated, resulted in their adoption in all the shipyards on the Clyde. "Engineering" of London has recently praised these tools highly in an editorial on good workmanship, in which it says: "The examination thus made showed this work to be, all things considered, one of the best examples of mechanical engineering we have ever met with."

BUILDING INTELLIGENCE.

NEW YORK, N. Y.

124 Lewis st, br stores and tenem't; cost, $25,000; o, Geo Rall; a, Fredk Jaeger.

100-102 Oliver st, br tenem't; cost, $20,000; o, Thomas Brodie; a, Horenburger & Straub.

254-256 E 7th st, br tenem't; cost, $25,000; o, Michael Hanlon; a, Horenburger & Straub.

314-316 E 9th st, br store and tenem't; cost, $20,000; o, Albert Hochster; a, Kurtzer & Rohl.

318 E 9th st, br store and tenem't; cost, $20,000; o, August Ruff; a, Kurtzer & Rohl.

26 Monroe st, br store and tenem't; cost, $15,000; o, Salomon Jacobs; a, Nathan Langer.

360 Madison st, br store and tenem't; cost, $20,000; o, Abraham Glass; a, Meyer Jarmulowsky.

21 to 25 Ave D, n w cor 3d st, 2 br stores and flats; cost, $55,000 all; o, Wielandt & Roth; a, Horenburger & Straub.

S s 54th st, 125 w 8th ave, br flat; cost, $25,000; o, Mary E Dempsey; a, Neville & Bagge.

807 3d ave, br store and tenem't; cost, $20,000; o, Frank B Morehouse; a, Julius Kastner & Sons.

34 W 35th st, br bachelor hotel; cost, $35,000; o, Wm R H Martin; a, Ralph S Townsend.

N s 119th st, 91 e 5th ave, 4 br flats; cost, $92,000 all; o, Hy Rothschild; a, G F Pelham.

Park ave, s w cor 74th st, br flat; cost, $150,000; o, Leo Wise; a, Louis Korn.

S s 75th st, 80 w Lexington ave, br dwell'gs and stable; cost, $23,000; o, J H Schiff; a, De Lemos & Cordes.

E s West End ave, 50 s 100th st, br flat; cost, $75,000; o, Jas H Havens; a, Neville & Bagge.

44 W 120th st, br flat; cost, $48,000; o, James Everard; a, James W Cole.

S s 115th st, 100 w 7th ave, br flat; $75,000; o, Brogan & Meyer; a, Neville & Bagge.

S s 149th st, 250 w Amsterdam ave, 5 br dwell'gs; cost, $55,000 all; o, Gerard P Brouwer Aucher; a, Geo J Ebert.

N s 131st st, 125 w Park ave, 4 br flats; cost, $96,000 all; o, John A Picken; a, John Hauser.

Jackson ave, n e cor 163d st, 4 br flats; cost, $56,000 all; o, Mrs Ellen Mulholland; a, Lawrence & Ringrose.

Loring Place, n w cor 183d st, br dormitory; cost, $18,000; o, Psi Upsilon Fraternity; a, Henry Rutgers Marshall.

Webster ave, n e cor 174th st, 2 br flats; cost, $42,000 all; o, Frank P Sabetti; a, C A Millner.

St Ann's ave, s w cor 141st st, 4 br flats; cost, $83,000 all; o, Stephen J Eagan; a, Harry T Howell.

S s Southern Boulevard, 100 e Lincoln ave, br ice factory; cost, $400,000; o, Jacob Ruppert; a, J Kastner.

N s 144th st, 115 w Brook ave, 2 bldg's; cost, $40,000 all; o, Adolph Wexler; a, Harry T Howell.

ALTERATIONS.

11 East 65th st, extension; cost, $10,000; o, Mrs. Moore; a, Jardine, Kent & Jardine.

35 W 51st st, extension; cost, $16,000; o, W M V Hoffmann; a, Barney & Chapman.

689 5th ave, extension; cost, $25,000; o, Wm Rockefeller; a, Henry S Ihnen.

490-500 Cherry st, concrete foundation, with cast-iron bases, etc.; cost, $18,000; o, Crane Co; a, Robt Maynicke.

336 6th ave, extension; cost, $22,350; o, Mary J McCoy; a, Thos S Godwin.

MISCELLANEOUS.

Binghamton, N. Y.—Court st, store and flat; cost, $20,000; o, Waldron & Walker; a, A W Reynolds.

Toledo, O.—Michigan st; cost, $70,000; o, Y M C A; a, E O Fallis.

Waite ave, school bldg; cost, $40,000; a, Wachter & Hudson.

PROPOSALS OPEN.

Bids Close.		See Eng. Record.
	WATER-WORKS.	
Feb. 18.	Spring Lake, N. J	Jan. 28
	Adv., Eng. Record, Jan. 28, Feb. 4.	
Feb 20.	Elhart Lake, Wis	Jan. 28
Feb. 20.	Valves, etc., Victoria, B. C	Feb. 11
Feb. 20.	Moorhead, Minn	Feb. 11
Feb. 20.	Pipe, etc., Bloomington, Ind	Feb. 18
Feb. 21.	Honolulu, Hawaiian Is	Jan. 14
	Adv., Eng. Record, Jan. 14 to 28.	
Feb. 23.	Bermidji, Minn	Feb. 18
Feb. 24.	Pipe, etc., St. Paul, Minn	Feb. 18
Feb. 24.	Valves, etc., Cleveland, O	Feb. 4
Feb. 25.	Whitehall, Ill	Feb. 11
Feb. 27.	Windsor, N. Y	Feb. 18
	Adv., Eng. Record, Feb. 18.	
Feb. 27.	Well, Jamestown, N. D	Feb. 18
Mar. 1.	Oto, Ia	Jan. 21
Mar. 1.	Amsterdam, N. Y	Feb. 4
	Adv., Eng. Record, Feb. 4 to 18.	
Mar. 1.	Mt. Pleasant, Mich	Feb. 11
Mar. 3.	Keshena, Wis	Feb 11
Mar. 4.	Bonds, Cincinnati, O	Feb. 11
Mar. 6.	Jamesburg, N. J	Feb. 11
	Adv., Eng. Record, Feb. 11, 18.	
Mar. 7.	Pipe, etc., Everett, Mass	Feb. 11
	Adv., Eng. Record, Feb. 11.	
Mar. 7.	Allison, Ia	Feb. 18
Mar. 8.	Bonds, McConnellsville, O	Feb. 11
Mar. 9.	Atlanta, Ga	Feb. 18
Mar. 11.	Washington, D. C	Feb. 18
	Adv., Eng. Record, Feb. 18.	
Mar. 11.	Washington, D. C	Feb. 11
	Adv., Eng. Record, Feb 11.	
Mar. 15.	Belem, Para, Brazil	Nov. 26
Mar. 15.	Pipe, etc., Fayetteville, Ten	Feb. 11
	Adv., Eng. Record, Feb. 18.	
Apr. 3.	Winnepeg, Man	Feb. 4
	Adv., Eng. Record, Feb. 4 to 18.	
	SEWERAGE AND SEWAGE DISPOSAL.	
Feb. 20.	Bonds, Cleveland, O	Jan. 14
Feb. 20.	Toledo, O	Feb. 11
Feb. 20.	Albany, N. Y	Feb. 11
Feb. 21.	Bonds, Mt. Vernon, N. Y	Feb. 4
Feb. 23.	Fulton, N. Y	Feb. 11
	Adv., Eng. Record, Feb. 11.	
Feb. 24.	Cleveland, O	Feb. 18
Feb. 25.	Cleveland, O	Feb. 18
Feb. 28.	Bonds, Havana, Ill	Feb. 18
Feb. 28.	Steelton, Pa	Feb. 11
	Adv., Eng. Record, Feb. 11, 18.	
Mar. 1.	Mt. Pleasant, Mich	Feb. 11

Mar. 1. Cleveland, O.....Feb. 18
Mar. 2. Cleveland, O.....Feb. 18
Mar. 3. Keshena, Wis.....Feb. 11
Mar. 3. Cincinnati, O.....Feb. 11
Mar. 3. Cleveland, O.....Feb. 11
Mar. 6. Woonsocket, R. I.....Feb. 4
Adv., Eng. RECORD, Feb. 4, 11.
Mar. 7. Niles, O.....Feb. 11
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Mar. 9. Norfolk, Va.....Feb. 11
Adv., Eng. RECORD, Feb. 11, 18.
Mar. 10. Cleveland, O.....Feb. 18
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Adv., Eng. RECORD, Feb. 18.
Mar. 16. Cleveland, O.....Feb. 18

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Feb. 18. New York City.....Feb. 11
Adv., Eng. RECORD, Feb. 11.
Feb. 20. Abutments, Boston, Mass.....Feb. 11
Feb. 20. Rockford, Ill.....Jan. 28
Adv., Eng. RECORD, Jan. 28.
Feb. 21. Algoma, Wis.....Feb. 18
Feb. 23. Albany, N. Y.....Feb. 18
Feb. 24. Hamilton, O.....Feb. 4
Feb. 27. Monticello, Mo.....Feb. 4
Feb. 28. Bellefontaine, O.....Feb. 18
Mar. 1. Quebec, Que.....Jan. 7
Mar. 2. Shreveport, La.....Jan. 21
Mar. 4. Villagrove, Ill.....Feb. 18
Mar. 9. Shreveport, La.....Feb. 11
Mar. 10. Cleveland, O.....Feb. 18
Mar. 15. Chicago, Ill.....Jan. 21
Adv., Eng. RECORD, Jan. 21.
Apr. 1. Substructure, St. Joseph, Mo.....Jan. 7
Apr. 10. Chicago, Ill.....Feb. 18
Adv., Eng. RECORD, Feb. 18.
—— Spring Lake, N. J.....Jan. 7

PAVING AND ROADMAKING.

Feb. 20. Geneva, N. Y.....Jan. 28
Adv., Eng. RECORD, Jan. 28 to Feb. 18.
Feb. 20. Anderson, Ind.....Feb. 4
Feb. 21. Atlantic City, N. J.....Feb. 11
Feb. 22. Bedford, Ind.....Jan. 28
Feb. 23. Fulton, N. Y.....Feb. 11
Adv., Eng. RECORD, Feb. 11.
Feb. 23. Philadelphia, Pa.....Feb. 18
Feb. 23. Road roller, New York, N. Y.....Feb. 18
Feb. 24. Grand Rapids, Mich.....Feb. 18
Feb. 24. St. Louis, Mo.....Feb. 18
Feb. 25. Bellevue, Pa.....Feb. 18
Feb. 27. Yonkers, N. Y.....Dec. 3
Feb. 27. Portsmouth, Pa.....Feb. 4
Mar. 1. Bonds, Bridgeport, O.....Feb. 4
Mar. 1. Batavia, O.....Feb. 11
Mar. 1. Bonds, Zanesville, O.....Feb. 11
Mar. 1. Clinton, Ia.....Feb. 18
Mar. 1. Bonds, Sandusky, O.....Feb. 18
Mar. 1. Bonds, Scottsboro, Ala.....Feb. 18
Mar. 2. Cleveland, O.....Feb. 4
Mar. 3. Bedford, Ind.....Feb. 11
Mar. 4. Washington, D. C.....Feb. 4
Adv., Eng. RECORD, Feb. 4.
Mar. 4. Cleveland, O.....Feb. 11
Mar. 7. Joplin, Mo.....Feb. 4
Mar. 7. Cleveland, O.....Feb. 11
Mar. 11. Woodbury, N. J.....Feb. 11
Mar. 14. Cleveland, O.....Feb. 18
Mar. 16. Lebanon, Ind.....Feb. 18

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Feb. 20. Moorehead, Minn.....Feb. 11
Feb. 20. New York, N. Y.....Feb. 4
Feb. 20. Watertown, Wis.....Feb. 18
Feb. 20. South Bethlehem, Pa.....Feb. 18
Feb. 21. Conduits, etc., South Omaha, Neb. Feb. 18
Feb. 27. Vincennes, Ind.....Feb. 11
Adv., Eng. RECORD, Feb. 11, 18.
Feb. 28. Darlington, O. T.....Feb. 4
Mar. 1. Sault Ste. Marie, Mich.....Dec. 24
Mar. 1. Spartanburg, S. C.....Jan. 14
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Mar. 1. Baltimore, Md.....Feb. 18
Adv., Eng. RECORD, Feb. 18.
Mar. 6. Cambridge, O.....Feb. 18
Mar. 6. Portland, Me.....Feb. 4
Adv., Eng. RECORD, Feb. 4.
Mar. 8. Halifax, N. S.....Feb, 11
Adv., Eng. RECORD, Feb. 11, 18.
Mar. 31. Telephone, Shanghai, China.....Nov. 19
—— Pleasantville, O.....Dec. 24

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Feb. 21. Wreck, Boston, Mass.....Jan. 21
Feb. 21. Savannah, Ga.....Jan. 28
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Feb. 21. Conduits, etc., South Omaha, Neb. Feb. 18
Feb. 23. Kansas City, Mo.....Jan. 28
Adv., Eng. RECORD, Jan. 28, Feb. 4.
Mar. 1. New York City.....Feb. 4
Adv., ENG. RECORD, Feb. 4 to 18.
Mar. 3. Water, etc., Keshena, Wis.....Feb. 11
Mar. 3. Plattsburgh, N. Y.....Feb. 18
Mar. 4. San Francisco, Cal.....Feb. 11
Mar. 6. Portland, Me.....Feb. 4
Adv., Eng. RECORD, Feb. 4 to 18.
Mar. 7. Camden, N. J.....Feb. 11
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Mar. 8. Wharf, Rockpoint, Md.....Feb. 11
Mar. 8. New York, N. Y.....Feb. 11
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Mar. 10. New York City.....Feb. 11
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Mar. 10. Baltimore, Md.....Feb. 11
Adv., Eng. RECORD, Feb. 11, 18.
Mar. 10. New York City.....Feb. 18
Adv., Eng. RECORD, Feb. 18.
Mar. 14. Plumbing, New York, N. Y.....Feb. 18
Mar. 15. Rock Island, Ill.....Feb. 18
Adv., Eng. RECORD, Feb. 18.
Mar. 15. Baltimore, Md.....Feb. 18
Mar. 15. San Francisco, Cal.....Feb. 11
Apr 6. New Orleans, La.....Feb. 11
Adv., Eng. RECORD, Feb. 11, 18.

BUILDINGS.

Feb. 20. School bonds, Freemont, Neb.....Feb. 11
Feb. 20. Grain elevator, Bismark, N. D.....Feb. 18
Feb. 21. School, New York, N. Y.....Feb. 11
Feb. 21. Heating, Buffalo, Minn.....Feb. 11
Feb. 21. School, Columbus, O.....Feb. 11
Feb. 21. School bonds, Columbus, O.....Feb. 11
Feb. 21. Newport, R. I.....Feb. 11
Feb. 22. Plans, etc., Alexandria, La.....Feb. 4
Feb. 23. Detroit, Mich.....Feb. 11
Feb. 23. School, Flandreau, S. D.....Feb. 4
Feb. 25. School, Cleveland, O.....Feb. 4
Feb. 25. Douglass, Ga.....Dec. 31
Feb. 25. Ventilating, etc., East Cambridge, Mass.....Feb. 18
Feb. 25. Washington, D. C.....Feb. 18
Feb. 25. Heating, etc., Grinnell, Ia.....Feb. 18
Feb. 25. School, Minneapolis, Minn.....Feb. 18
Feb. 25. Birmingham, Ala.....Feb. 18
Feb. 25. Wilmington, N. C.....Feb. 18
Feb. 27. Heating, etc., school, Ponca, Neb.. Feb. 18
Feb. 27. School, New York, N. Y.....Feb. 18
Feb. 28. School, Ponca, Neb.....Feb. 18
Mar. 1. Arkadelphia, Ark.....Jan. 14
Mar. 1. Nacogdoches, Tex.....Feb. 11
Mar. 1. Mankato, Minn.....Feb. 18
Mar. 2. School, New York, N. Y.....Feb. 18
Mar. 6. School, Eau Claire, Wis.....Jan. 28
Mar. 8. Aberdeen, S. Dak.....Jan. 28
Mar. 10. Ventilating, etc., Cleveland, O.....Feb. 18
Mar. 11. School, Wheaton, Minn.....Feb. 18
Mar. 15. Plans, Wilkesbarre, Pa.....Jan. 28
Mar. 30. Iowa City, Ia.....Feb. 18
Apr. 3. Many, La.....Jan. 21
Apr. 14. Plans, Bradford, England.....Jan. 21

MISCELLANEOUS.

Feb. 20. Newark, N. J.....Jan. 21
Adv., Eng. RECORD, Jan. 21 to Feb. 4.
Feb. 20. Boston, Mass.....Feb. 4
Feb. 21. Boston, Mass.....Feb. 4
Adv., Eng. RECORD, Feb. 4, 11.
Feb. 21. Cement, etc., New York, N. Y.....Feb. 11
Feb. 23. River wall, etc., Philadelphia, Pa..Feb. 18
Feb. 25. Garbage disposal, Allenton, Pa.....Feb. 11
Mar. 1. Shaft, Rouse, Colo.....Feb. 18
Mar. 3. Garbage disposal, Atlanta, Ga.....Feb. 18
Mar. 4. Washington, D. C.....Feb. 11
Adv., Eng. RECORD, Feb. 11.
Mar. 7. Street cleaning, Cleveland O.....Feb. 4
Mar. 10. Garbage disposal, Brooklyn, N. Y. Feb. 18
Mar. 11. Washington, D. C.....Feb. 18
Adv., Eng. RECORD, Feb. 18.
Mar. 15. El. Ry., Shanghai, China.....Nov. 19

NEW SCHOOLS.

Philadelphia, Pa.—Frank Watson, 1208 Chestnut St., is said to be preparing plans for a 3-story brick parochial school for St. John's Roman Catholic Church.

Owatonna, Minn.—The School Board is stated to have decided to build an 8-room school.

Toledo, O.—Hudson & Wachter are stated to have been authorized to prepare plans for the new 12-room school on Waite Ave.

Dothan, Ala.—The House is stated to have passed a bill authorizing the issue of $15,000 bonds for a new school.

Washington, D. C.—Moulton, Starrett Co., of Chicago, are stated to have received the contract for erecting the Hearst school, at $169,516.

Marietta, O.—At the spring election the citizens will be asked to vote on expending $50,000 for new schools.

Marshall, Minn.—The plans of W. B. Dunnell, of Minneapolis, are stated to have been accepted for a $35,000 high school.

Ponca, Neb.—It is stated that bids are wanted Feb. 27 for heating and plumbing in a school. Sam Bittenbender, Clk. Bd. Educ.

New York, N. Y.—Bids are wanted March 2 for school No. 174. John E. Eustis, Chmn. Com. on Bldgs.

New York, N. Y.—The Board of Estimate and Apportionment on Feb. 15 authorized a bond issue of $7,573,000 for the purchase of school sites and the erection of new schools in the various boroughs.

Ponca, Neb.—It is stated that bids are wanted Feb. 28 for a school. Sam Bittenbender, Clk. Bd. Educ.

Wilmington, Del.—The lowest bid received Feb. 15 for the new high school is said to be that of A. S. Reed at $139,773.

Wheaton, Minn.—It is stated that bids are wanted March 11 for a school. J. K. Mork, Clk. Bd. Educ.

New York, N. Y.—Bids are wanted Feb 27 for school No. 119. John E. Eustis, Chmn. Com. on Bldgs.

Gloucester, Mass.—It is stated that competitive plans have been asked for a $30,000 school.

El Paso, Tex.—School bonds, to the amount of $30,000, and city hall bonds, to the amount of $10,000, have been sold.

Minneapolis, Minn.—Bids are wanted Feb. 25 for an addition to Irving school. W. K. Hicks, Chmn. Com. on Bldgs. & Repairs, Bd. Educ.

New York, N. Y.—The following bids were opened Feb. 14 by the Committee on Buildings of the Board of Education for public school No. 177: Thos. Cockerill & Son, 550 W. 41st St., $274,900; Murphy Brothers, 407 E. 101st St., $253,000; *P. J. Brennan, 1748 Washington Ave., $241,000; P. J. Carlin & Co., 289 4th Ave., $266,500; Herman Probst, 1180 B'way., $262,850; Mapes-Reeve Construction Co., 150 Nassau St., $269,800; P. Gallagher, 156 5th Ave., $269,188; John J. Hopper, 217 W. 125th St., $269,690; Luke A. Burke, 401 W. 59th St., $241,250; Mahony Bros., 52 New Bowery, $267,931; Harry McNally, 287 4th Ave., $257,507; John H. Parker Co., 256 B'way., $253,985; Collier-Weeks Co., 163 W. 23d St., $249,750; H. W. Weeks & Co., $254,400. Bidders all of New York city.

*Contract awarded.

STREET CLEANING AND GARBAGE DISPOSAL.

Boston, Mass.—See "Fires."

Atlanta, Ga.—Bids are wanted March 3 by the Secretary of the Board of Health for garbage disposal.

Brooklyn, N. Y.—Bids are wanted March 10 for disposal of garbage for the Boroughs of Queens and Richmond. James McCartney, Commr. Street Cleaning, New York, N. Y.

Sacramento, Cal.—Dr. Fay has been appointed to wait on the City Board of Trustees and urge some action looking to the erection of a crematory.

Cincinnati, O.—Thomas J. and James Strack have presented a communication to the Board of City Affairs asking for the contract for the removal of garbage.

Hazelton, Pa.—The Mayor, in his annual message, recommends the question of garbage disposal to the consideration of the Council.

Los Angeles, Cal.—The City Clerk has been directed to advertise for bids for the collection of garbage.

GOVERNMENT WORK.

Dubuque, Ia.—Plans are about completed for a $100,000 addition to the Government building.

South Omaha, Neb.—Bids are wanted Feb. 21 for a system of conduits and wiring for electric lighting in the U. S. Post Office. O. L. Spaulding, Asst. Secy. Treas. Dept., Washington, D. C.

Duluth, Minn.—According to press reports the contract for building the substructure for north pier of the Duluth Ship Canal has been awarded to Butler-Ryan Co., of St. Paul, for $160,833.

New York, N. Y.—Bids are wanted March 10 by the Superv. Archt., Treas. Dept., Washington, D. C., for the ornamental iron work of the main buildings at the U. S. Immigrant Station, Ellis Island, New York harbor, as advertised in "The Engineering Record."

New York, N. Y.—Bids are wanted March 14 for additional plumbing at Fort Hamilton. 1st. Lieut. E. F. McGlachlin, 5th Art'y., Q. M.

Baltimore, Md.—Bids are wanted March 15 for the building and for the metal work for Hooper Island lighthouse. Lieut.-Col. W. A. Jones, Corps Engrs., U. S. A.

Rock Island, Ill.—Bids are wanted March 15 at the U. S. Engineer's Office for about 60,000 cu. yds. of rip-rap rock and 107,000 cu. yds. of brush at various localities between St. Paul and mouth of Missouri river, as advertised in "The Engineering Record."

Plattsburgh, N. Y.—Bids are wanted March 2 for an ordnance storehouse. First Lieut. Charles Crawford, Q. M.

MISCELLANEOUS.

Pointe a la Hache, La.—I. L. Haspel Pres. Bd. of Commrs., Grand Prairie Levee District, writes that all bids opened Feb. 6 for the construction of 23 miles of levee have been rejected.

Cascade City, B. C.—See "Power Plants, Gas and Electricity."

Philadelphia, Pa.—See "Paving and Roadmaking."

Washington, D. C.—Bids are wanted March 11 for furnishing 20,000 bbls. of Portland cement, as advertised in "The Engineering Record."

Rouse, Colo.—Bids are wanted March 1 for sinking a two-compartment pumping shaft. Allan French, Supt. Colorado Fuel & Iron Co.

PROPOSALS.

Brick Pavement.

PEORIA, ILLS., February 14, 1899.

Sealed bids will be received by the Board of Local Improvements of the City of Peoria, Illinois, until two (2) o'clock p. m. of Monday, February 27th, 1899, for furnishing all labor and material for the construction on three streets in said city of about 21,6[illegible] sq. yds. of brick pavement and 2489 lineal feet of cement curbing, together with about 9249 cu. yds. of excavation, and setting 10,348 lineal feet of stone curbing, according to the specifications on file in the office of the Department of Public Works.

Proposals must be made out upon blanks furnished by said department, and be accompanied with an amount equal to 10 per cent. of the total amount of the bid in money, or certified check made payable to the order of M. W. Manning, President of the Board of Local Improvements.

For specifications, blank forms of proposal and any information, address the City Engineer. M. W. MANNING, President Board of Local Improvements.

A. D. THOMPSON, City Engineer.

Proposals continued on pages xi and xii.

THE ENGINEERING RECORD.
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TABLE OF LEADING ARTICLES.

The Engineering Record, conducted by Henry C. Meyer, is published every Saturday at 100 William Street, New York. Its opinions on technical subjects are either prepared or revised by specialists.
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EXPERIMENTS ON FULL-SIZE TIMBER ROOF TRUSSES.

In most parts of this country the consideration of timber trusses, whether for roof or bridge purposes, is assumed to be outside of the best work of the civil engineer. They are of comparatively simple construction, and the determination of the stresses in them is probably the simplest of all computation work. Hence it is often assumed that there are no problems in connection with them which are worthy of professional attention. Again, the fire-proof construction of buildings and the cheapness of steel trusses and girders at the present time, as well as the temporary character of all timber construction under atmospheric exposure, rule timber out of all heavy design in a large portion of engineering practice. Finally, the literature of American engineering is already rich in the results of tests of beams, columns, and specimens of all kinds of timbers used to any sensible extent in practice. Indeed, so far as the testing of timber pieces is concerned in connection with the common uses of the material, our records are of great value and fairly complete, although there always will be need of more extended investigations.

There is, however, a wide field of use of timber trusses in building construction of the lighter kind, and in many special lines of work, and there always will be. Such trusses are of short span, and carry comparatively light loads, and the fact that they are usually, or at least frequently, designed and built by carpenters or others not qualified to compute stresses or to arrange details so as best to meet the demands upon them, is an imperative reason why they should be the more thoroughly understood in all these ways that can contribute to economic design. They are always employed where economy is an essential requisite, as well as where certain safety should be attained.

As a matter of fact there are some details of such primitive structures as king-post and queen-post trusses, which would give trouble even to most engineers to design in a simple and economical way. This is due to the fact that some matters of shearing timber along the fibers, and the resistance to compression when the ends of the fibers bear directly against or obliquely across the ends of other fibers, have not yet been subjected to sufficient experimental investigation. It is probable that the full determination of such empirical matters can be made only by testing the complete structure in which all the tempering conditions are afforded precisely the same action as in a truss carrying its regular load. It is in this particular direction that empirical results are lacking, not only in connection with timber structures, but with those of iron and steel also. We know fairly well how single members act when tested to destruction, but we know comparatively little about their action or interaction at details, when assembled into the completed structure and so subjected to destructive test.

It is a matter of special interest, therefore, to notice the results of nine tests of full-size king-post and queen-post trusses by Major G. K. Scott-Moncrieff, R. E., an account of which is printed on page 284. Although the timber trusses tested had spans varying from 24 to 32 feet only, they were full-size, and the manner of loading was essentially that of a regular roof truss. Major Moncrieff, in these tests, has rendered a valuable service to the profession, not only by securing the results but also by attesting the necessity of experimenting with full-size structures in order to determine just how these structures will stand their actual duties no less than their destructive loads.

It is a matter of no surprise that the rule-of-thumb of even so good a constructor as Tredgold does not yield satisfactory results. Sound theory will aid any design, even that of a primitive timber truss. These tests show, among other things, the importance of good design of details, although there is nothing new in learning that failure frequently, and usually, begins in the details. The weakness of shearing in timber along the fibers is obviously to be guarded against in all such trusses, and the penetration of fibers on end is also a matter which ought always to receive careful attention. Another highly important feature of these tests is the difficulty experienced in keeping the trusses from buckling, because it emphasizes the efficiency of lateral bracing between roof trusses, which is not always as carefully designed as it should be. The results of these tests are commended to the careful consideration of all engineers and architects interested in timber structures.

THE POWER PLANTS OF CEMENT WORKS.

In view of the enormous capital that is now being invested in new plants for the manufacture of Portland cement to supply the steadily increasing demand for that article, it is pertinent to call attention to those details of the manufacture that concern the development and transmission of power, particularly as in some instances the power plant is not as economical a one, first cost and operating expenses being considered, as might be installed. This seems to be due to several reasons, one of which is the lack of good advice from engineers who are familiar with the best practice in steam engineering. Again, there is the disinclination on the part of owners to purchase the most economical machinery if it should happen to cost more in the beginning than less economical apparatus. At the present time, the available supply of cement is not sufficient to meet the demand, and it is said that this condition is likely to continue during the present season. Unfortunately this happy state of affairs will not always exist. Sooner or later competition is going to lower the price of cement, and manufacturers should realize, therefore, that those who are the best equipped for the economical manufacture of this article, are the ones who will survive when over-production occurs.

In the past, considerable attention has been given to the selection of the crushing and grinding machinery, and to its location, so that by the use of proper elevating and conveying and other labor-saving machinery, the labor item in the cost of manufacture would be reduced to a minimum. Careful study of some plants, however, shows that to accomplish this object the machinery has been so located as to involve the use of power transmission machinery that was costly in the first place, and, what is of far more consequence, costly as regards the expense of operation. Recent practice in cement works shows a vast improvement in this respect, but all new plants are not what they ought to be to secure the best results.

The demand for power in a cement works is apt to be pretty nearly constant throughout the working day, and in this respect it resembles the condition in a cotton mill, where the greatest efforts are made to reduce the cost of power to the lowest point possible. In the mill district, compound engines are almost universally installed, yet in some instances it is said that cement manufacturers have hesitated to pay the increased cost of the compound over the less-economical simple engine. The importance of the power question in a cement works may be gathered from the statement that on an average about one horse-power in engine capacity is installed for each barrel of cement that the plant is capable of turning out in a day. That is, for a plant of 1,000 barrels daily capacity, 1,000 horse-power would be required. When it is considered that one horse-power used ten hours during each working day costs, including interest on the plant, depreciation, fuel, labor, etc., from $20 per year up, it will be seen that this power question is worth looking into.

NEW JERSEY ROADS.

During 1898 about 85 miles of roads were built in New Jersey under the provisions of the Legislative act which makes a contribution from the State funds of one-third of the cost of the highways over which the State Commissioner of Public Works has control. This is a greater mileage than in any previous year; in 1895 about 46 miles were built, in 1896 about 50 miles, and in 1897 about 70 miles. The experience which has been gained during these years is reviewed in an interesting manner by Mr. Henry I. Budd, the commissioner, in his report for 1898, a document even more valuable than those of preceding years. Its most characteristic feature to the engineer is the strong tendency toward thin roads which it reveals. Observation and experience have demonstrated in New Jersey, it is stated, that the earth, properly drained, is as good a foundation as can be obtained for the superstructure of the road, and therefore it is unnecessary to place more metal on the surface than is required to resist the wear until the highways have to be surfaced again. After the roads have been worn down 2 or 3 inches it is necessary to recoat them, and Mr. Budd therefore concludes that it is only necessary for good highways to have a sufficient foundation to sustain these few inches. Hence the principal construction of the State has been reduced to roads 4, 6 and 8 inches thick. In localities where there are quantities of rock lying loose in the fields, the large stones are readily and cheaply formed into a Telford foundation on which 3 or 4 inches of broken stone is placed. Stone roads have been laid in some counties where gravel was originally designed to be used, because it has been found that the stone can be put in place at nearly as low a cost as the gravel, and the expense of maintenance of such roads is much less because they are not weakened by the weather. Gravel roads have been found to be firm on no soil but sand during wet and winter weather, while stone roads are at their best in those seasons when most needed by the farmers to cart their produce to market.

The maintenance of the State roads has been studied very carefully in recent years, and it has been learned that the application of coarse sand, or gravel and loam in which there is oxide of iron, will maintain the integrity of the surface by keeping the wear of the wagons

and horses' shoes from the stone. These coatings are also stated to prevent the powder binding the stone together from blowing away, and also retains in the metal the necessary amount of moisture to maintain the cementing property of trap dust. When this dust is dry it relaxes its hold, and the picking of the toes of the horses' shoes sometimes loosens the stone and produces what is known as raveling. Many miles of the stone roads on Long Island are covered with from ½ to 1 inch of sand for the same purpose.

Two of the New Jersey counties prefer gravel roads because of the abundance of beds of the material within their boundaries. These form, on the sand on which they are principally built, very creditable roads, the report states, which seemed to serve the purpose of these districts satisfactorily, but if the traffic were heavy the gravel would not answer the purpose. There seems to be no doubt but that they are developing portions of the State which were formerly given over to pine and scrub oaks. For example, a road 6¾ miles long and 14 feet wide has been built from Egg Harbor to Mays Landing. It is made of gravel 8 inches thick, and a large number of clearings and settlements have already been built along its lines, where fruit gardening is now carried on.

The roads now cost from 20 to 70 cents a square yard, and in wet places, where a Telford foundation is necessary, the cost reaches 73 cents. The majority of the highways in the southern part of the State, where there is a great deal of sand, cost from 50 to 60 cents a square yard. In the northern part they are using from 4 to 6 inches of stone, and the expense where the rock is obtained along the road ranges only from 20 to 45 cents a yard. A continuous gravel road 34 miles long, with a 7-mile branch, cost only $1,400 a mile. The low cost of the roads is remarkable, and if the charges for their maintenance and renewal do not prove to be excessive, there is no question but that Mr. Budd and his associates will have taught engineers an important lesson in economical highway construction.

Increased experience now enables the engineers on the State roads to estimate the cost of new work very closely. Careful cross-sectioning has been found absolutely necessary, but when it is done the amount of stone required for any road can be calculated with surprising accuracy. Moreover a careful examination of the formation through which the road runs enables the number of feet of drains to be determined with comparatively little error.

"The freeholders are also learning that it is not to the financial interest of the county to change their engineers each time the political complexion of the board changes; they have found they cannot afford to pay by expensive mistakes for the education of an engineer; so they are now mainly employing engineers without regard to their party affiliations, and in most of the cases giving them fixed salaries instead of percentages, thus destroying all temptation to increase the cost of the work. The frequent changes of engineers have in the past lost the counties thousands of dollars on account of the ignorance of new incumbents of the first principles of road building." In this connection "The Engineering Record" trusts that Mr. Budd will excuse the insertion at this place of a quotation from another report, that of the Sewage Commission of Connecticut, which reads as follows: "No chemical or bacteriological skill is necessary for the details of management of a sewage field, but there is needed a man who is absolutely faithful in carrying out the directions of the city engineer or selectmen, who is intelligent, and who has acquired experience in meeting all the vicissitudes of weather and knows the individual peculiarities of the beds. The commission has had occasion to observe the havoc wrought by a field superintendent without these qualifications, and to see a disposal field which had been working perfectly made inefficient and a menace to health because of a city election. A superintendent who was faithful and competent, but incapacitated from further work presumably because of his views on questions of national finance or legislative representation, was replaced by a man utterly without experience in managing a sewage field."

The New Jersey trolley roads are causing considerable trouble to the builders and managers of the highways, as in other parts of the country, and the report of Mr. Budd discusses the subject at some length. He says that where such roads are built in the middle of the highway the macadam should be constructed with two crowns, one on each side of the track, and the latter used for a drain, for he finds it impossible to keep a macadam surface in proper shape where there is a direct slope from the rail to the side ditch. Whether the trolley companies will allow their roads to be used as drains is another question. The report recommends refusing to grant franchises for the use of the highways by trolley lines when the companies are able to secure a private right-of-way, but it speaks also of the value of these roads in building up a district and discusses the subject much more temperately than do the reports of many highway officials.

THE NEW HIGH-SERVICE RESERVOIR, HAVERHILL, MASS.

In order to furnish an increased pressure of water, the the city of Haverhill has recently completed a new high-service reservoir, having an average depth of water of about 19 feet, and a capacity of 9,000,000 gallons. It is of irregular shape with earthen embankments, masonry core walls, concrete lining and stone paving. The site of the reservoir and embankments was cleared of soil, stones, trees, stumps, roots, turf and other vegetable matter. The best of this material was used in the embankments, and the most of the soil was used on the surface of the same. No materials containing roots, muck or stones more than 3 inches in diameter were used; the small stones were not allowed to form more than one per cent. of the material, and were not permitted to come in contact with each other. The embankments are 16½ feet wide on top, and of various heights, with an inner slope of 1½ to 1, and an outer slope of 2 to 1. They were started from a well prepared base, fitted for incorporation with the filling, and were built up in layers not exceeding 4 inches in thickness before rolling. Each layer was slightly concave in cross-section, but level longitudinally, and was carefully rolled with a heavy grooved roller and watered as required. At points which could not be reached with the roller, the layers were solidly rammed with heavy rammers. They were overfilled, but in no case more than 12 inches on the interior slopes, and then cut down to their true lines. Soil was placed on the top and slopes of the embankments as required, rolled with a hand roller, trimmed true to grade and sodded in places. The top of the embankment is 5 feet above the level of high water.

A core wall of rubble masonry was built in the embankments to a height level with the surface of high water. It was built against wooden forms on the inside face, with at least ¼ inch of mortar between the forms and the extreme points of the stones. No stones were laid so as to project entirely through the wall, and all voids between the stones were completely filled with cement mortar. It was built upon natural undisturbed earth, from which all vegetable and loose material had been removed, and during construction was carried up all around at about the same level at the same time, and carefully protected from the sun and rain. The face of the wall was plastered with a thin coat of neat cement mortar, and in places this coat was washed with neat cement grout. On the inner slope of the embankment is a 6-inch layer of broken stone or gravel. This stone was of a size to pass through a screen of 3-inch mesh, and be held by a screen of 1-inch mesh. The various sizes were well mixed, and when laid in place were well compacted by ramming. Over this was laid a dry pavement of sound, selected stone of good shape to make tight, firm work. These stones were not less than 10 inches in any dimension, nor less than 1 cubic foot in contents, and were taken from a ledge or from boulders large enough to make at least two pieces. They were laid with a firm bearing on the stone backing, thoroughly pinned and every precaution taken to make each stone secure in its place. The course at the foot of the slope has stone of the full depth of the surface paving, and the broken stone backing, and was laid in cement mortar with its top surface parallel with the slope of the embankment. The top course of this paving is of selected stone measuring 15 inches on the face. Over the bottom of the reservoir, on the inner slopes and under the embankments and core walls is a lining of concrete 6 inches thick. This was put on in one layer and carefully leveled and rammed. It was surfaced with cement mortar and smoothed off with trowels, using only mortar enough to make a fine smooth surface.

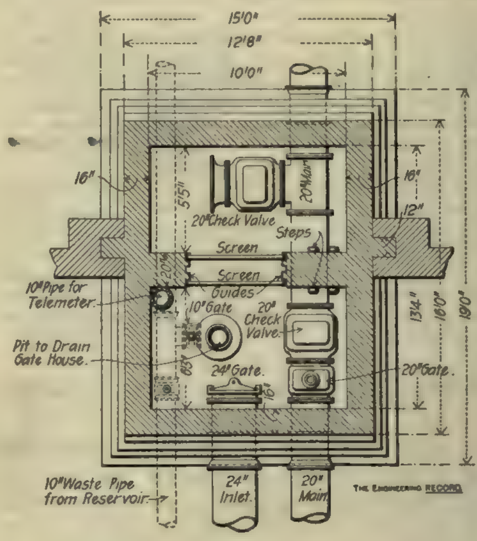


FIGURE 1.—PLAN OF GATE HOUSE.

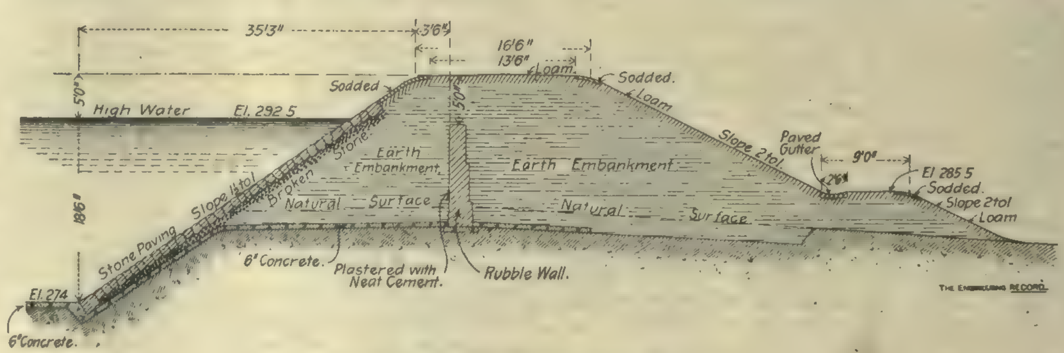


FIGURE 2.—SECTION OF EMBANKMENT.

The gate house is of brick with an under-

pinning of granite and a foundation of concrete 18 inches thick. The roof is of slate on a framing and covering of hard pine. Only the foundation and the brickwork to the surface of the embankment was included in the contract of the reservoir. Pipes, special castings, gates, valves, screens and screen guides were furnished by the city and set in place by the contractor. The 20-inch supply pipe is carried on brick piers across the reservoir to the opposite side from the gate house. The 24-inch outlet pipe is taken from the foot of the slope just in front of the gate house, and runs into it. The 20-inch pipe acts as a supply to the pipe system when the pumps are not working. It has a gate and check valve which prevents the water from running back into the main without first passing through the 24-inch pipe and gate chamber. When the pumps are not working the water runs through the 24-inch pipe into the gate chamber, where it passes through screens and then through a check valve, placed on an offset, into the 20-inch pipe. There is a vertical 10-inch pipe in the gate house for a telemeter. There is also a 10-inch waste pipe, with a branch to drain the gate house, which passes beneath the gate house and is embedded in concrete for its entire length. The 20-inch main is embedded in concrete between the gate house and the outer edge of the embankment. The concrete around each of these pipes is rectangular in cross-section, and is 6 inches thick above and below them, and 10 inches thick on the sides. It terminates in a cut-off wall 14 feet long, 4 feet 6 inches high, and 2 feet thick. There is also a similar cut-off wall on the 10-inch waste pipe under the toe of the inner slope.

Portland cement was used in the work and was furnished by the city. The sand used was clean, sharp and free from loam. The concrete was made with stone which would pass a screen of 2-inch mesh and be held on one with a ¾-inch mesh. The proportions used were 1 part of cement, 2½ to 3 parts of sand, and about 5 parts of stone. The quantity of stone varied somewhat, as much being used as the sand and cement would take and fill all of the voids. The concrete was deposited in 6-inch layers, in such a manner as not to separate the coarse from the fine material, and lightly rammed until the mortar flushed to the surface. All the rubble masonry was laid in cement mortar and well bonded with sound angular stones laid, with broken joints, on their natural beds. The stones were moistened before laying, and were completely surrounded with mortar, so as to be absolutely without voids.

Adjoining one side of the reservoir is a site for another, and under the embankment on this side the 6-inch layer of concrete was carried beyond the core wall, in order that the new reservoir may be built without weakening the embankment. For the same reason the core walls at the corners for the new reservoir were built out to the edge of the embankment. Figure 1 is a section showing the arrangement of the pipes and screens in the gate house. Figure 2 is a section of the embankment on the side adjoining the site of the future reservoir. Under the other embankments the concrete lining does not extend beyond the core wall. The cost of the reservoir was about $33,000. Mr. Freeman C. Coffin, M. Am. Soc. C. E., was the designer and engineer, and "The Engineering Record" is indebted to him for this information. In a recent letter he states that careful measurements were made after filling the reservoir, which is not connected with the service this winter. The first two weeks the surface fell 6 inches, the next week there was a loss of 1 inch, the next two weeks no loss. The loss the first two weeks is supposed to be largely due to a very large body of snow in the reservoir. The next week there were no storms; the last two weeks mentioned there was some rain.

THE PLANT OF THE MICHIGAN PORTLAND CEMENT COMPANY, COLDWATER, MICH.

[By Frederick H. Lewis, M. Am. Soc. C. E.]

In December of last year there was started at Coldwater, Mich., the new Portland cement works of the Michigan Portland Cement Company. This corporation has its general offices in Detroit, and is organized with a capital of $2,500,000, for the purpose of manufacturing Portland cement on a very large scale. The present plan has four kilns, with a capacity of 750 barrels per day, and contracts have been let for adding ten kilns to this plant, and for the construction of another plant at Quincy, a few miles away. When all the construction work is completed the company expects to operate 28 kilns, with a daily production of about 4,000 barrels of cement.

In these plants the raw materials will be blue clay and a soft amorphous marl, deposits of which occur frequently in the lakes and marshes of Michigan. Hence the raw materials will be handled in the wet way and introduced into the kilns as slurry, containing on an average 50 per cent. of water. The analyses of these raw materials are as follows:

Marl.		Clay.	
Carbonate of Lime	92.68	Silica	58 24
Carbonate of Magnesia	1.72	Iron Oxide	7.68
Dissoluble Silicates	1.65	Alumina	18 56
Sand	0.32	Calcium Oxide	9 61
Organic Matter plus Moisture	3.43	Magnesia Oxide	0.24
Sulphuric Acid	0.20	Loss of Ignition	10.04

The general method of manufacture at Coldwater is similar to that employed at Bronson, Mich., which was described quite fully in "The Engineering Record" of April 30, 1898. In detail, however, the method of manufacture differs somewhat, and it is thought these details are of sufficient interest to warrant a description. The works at Coldwater are located on the line of the Lake Shore & Michigan Southern Railway, and consist of a wet mill and kiln building, 75 x 225 feet in dimensions; a cement mill building, 75 x 150 feet; a power house, 75 x 100 feet, and an office and several outlying buildings. The buildings for manufacturing purposes are built of steel and concrete, and are of substantial construction. The structural work was furnished by the Champion Iron Company, of Kenton, Ohio.

FIGURE 1.—VIEW OF PUMP BARGE AND DREDGE.

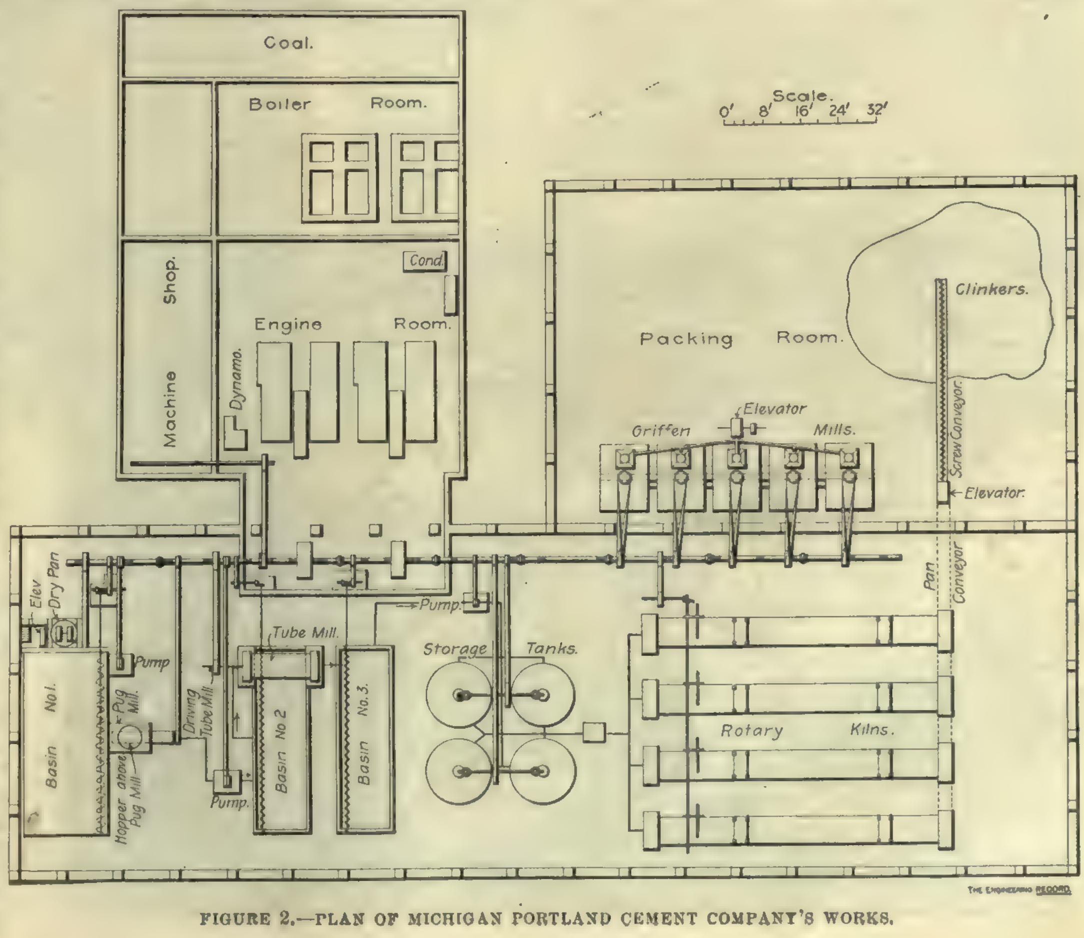


FIGURE 2.—PLAN OF MICHIGAN PORTLAND CEMENT COMPANY'S WORKS.

The marl deposit is found along the shores of a shallow lake several hundred acres in extent, about a fifth of a mile from the manufactory. It underlies a stratum of top soil a few feet in depth, beneath which the marl de-

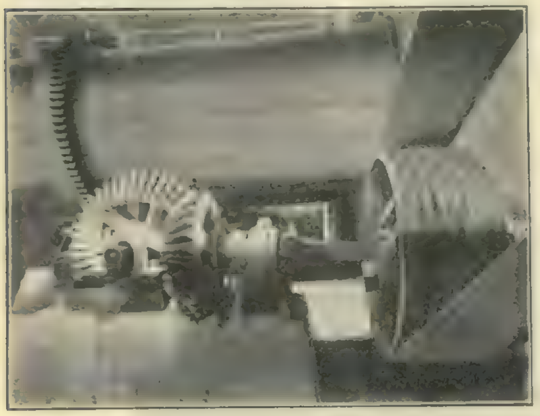


FIGURE 3.—DRIVING GEAR OF KILNS.

posit is found to an average depth of 20 feet. The clay is brought from an excellent deposit located about a mile from the works. Originally the marl was excavated by a dipper dredge which deposited it in the hold of a steam barge. This barge is driven by a paddle wheel in the stern similar to a western river boat, and is thus able to enter and back out of a narrow canal running from the lake to a point near the works, and excavated by the dredge. When loaded with marl the barge would steam to the end of the canal and pump the material from the hold through a pipe line to a receiving basin in the cement plant. The pipe line used for this purpose consists of a 6-inch Root spiral steel pipe some 200 yards long. On account of the difficulty of keeping the canal open in winter time and maintaining a sufficient amount of water in it, the pipe line has been carried northward on a trestle, so that it now reaches the point where the dredge is working, and avoids the necessity of having the barge pass to and fro to make connection to the pipe line. Under this plan the dredge and the barge may be operated continuously. Figure 1 is a view of the barge connected to the pipe line. The dredge is shown in the distance at work in the lake.

The soft wet marl from the pipe line is received at the cement plant in basin No. 1, which is shown on Figure 2, a plan of the works. The clay, which is comparatively dry, is unloaded in a dry pan shown just beyond this basin. After being ground by the edge runners, the clay is elevated to a platform above, and the mixture of the two raw materials takes place at this point. The marl after being strained from basin No. 1 is dumped into a tank of known volume. This tank discharges into a hopper above a pug mill, and to each charge of marl in the hopper a weighed portion of clay is added. The preliminary mixture of the raw materials then takes place in the pug mill into which the hopper discharges. The subsequent course of the slurry is readily traced in Figure 2. Discharging from the pug mill, it passes to basin No. 2, from which it is pumped into the tube mill. This mill and the pumps were furnished by the Bonnot Company, of Canton, O., which supplied all the apparatus for handling the raw materials. The mill grinds the wet marl very satisfactorily, discharging it into basin No. 3. From basin No. 3 it is pumped into the four steel storage tanks, which are provided with agitators. These tanks are 14 feet in diameter and 16 feet high, and afford sufficient supply to enable the chemist of the works to standardize the mixtures before they pass into the kilns. The delivery of the slurry to the kilns is by means of a pump. The kilns are 6 feet in diameter and 60 feet long, lined with special fire brick. The fuel used is crude petroleum from the Ohio oil fields. The conveying machinery taking the clinker to the mill is shown very clearly on the plans, as is also the arrangement of the Griffin mills for grinding the clinker. This conveying machinery was manufactured by the Jeffrey Manufacturing Company, of Columbus, Ohio. Figure 3 is a view of the rotary kilns showing the shafting and the gearing for turning them. Figure 4 is a view of the ends of the kilns and shows the main shaft.

The feature of generation and transmission of power has received more than ordinary attention on the part of the owners of the plant, the idea being to generate power as cheaply as possible and to reduce frictional losses to a minimum. The boiler plant consists of four horizontal return tubular boilers, equipped with Murphy stokers which are intended to burn cheap fuel without smoke and with a fairly good economy. The engines were furnished by the Bates Machine Company, of Joliet, Ill., and the manner of selecting them is interesting in that it was necessary to install a certain amount of power, arranged so that it could be largely increased when the works were enlarged. Provision was made, therefore, for the ultimate installation of two cross-compound condensing Bates-Corliss engines of about 500 horse-power each. As a total of 400 horse-power in two engines was required at first, the high-pressure side, the shaft and fly

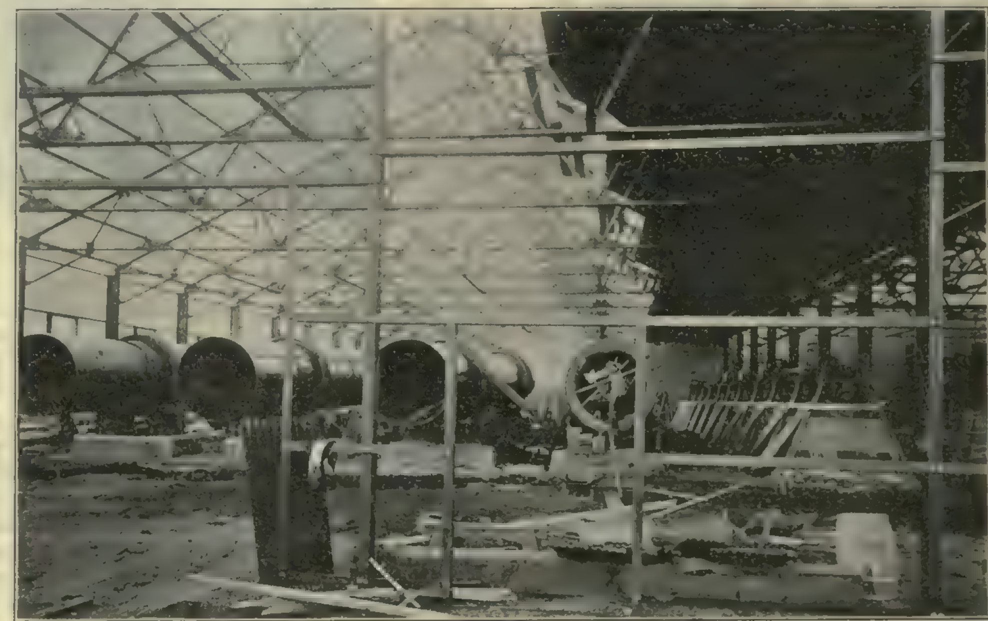


FIGURE 4.—INTERIOR VIEW OF THE KILN BUILDING.

wheel of the larger engines was installed, with small temporary high-pressure cylinder, the engines being run as simple condensing engines. As the works are now being enlarged the high-pressure cylinder is to be replaced by a larger one, and a low-pressure side added to each engine, increasing the power from 200 to 500 horse-power for each engine, and making, by compounding, a much more economical machine. The engine may be operated condensing or non-condensing as desired, a Stilwell-Bierce & Smith-Vaile jet condenser being provided. The condenser draws water from the canal, and discharges it out of doors at a convenient point. A complete pumping plant in duplicate is provided for drawing oil from the storage tanks some distance from the mills and supplying it to the rotary kilns. The engine room contains a Chandler & Taylor automatic engine directly connected to a 120 kilowatt General Electric dynamo supplying some 15 arc and 200 incandescent lights for the buildings.

The general arrangement of the power house and mill is particularly adapted, it will be seen, for the distribution of power with a minimum amount of frictional loss. The American system of rope driving is employed, and transmits power from each engine to the main line shaft, which runs from one end of the mill to the other. A view of the engine room and rope drive is shown in Figure 5. It will be noticed that the wall of the engine room indents the side of the main mill so as to keep the driven

FIGURE 5.—VIEW OF ENGINE ROOM, SHOWING ROPE DRIVE.

pulleys and their friction clutches and several of the large bearings separate from the mill building, where cement dust might be injurious to them. The pug mill, power pumps, rotaries, Griffin mills, etc., are mostly driven by quarter-turn belts from the main shaft, the driving belt in the main shaft being connected by means of friction clutches instead of fast and loose pulleys, as has been the general practice. All of the bearings supporting the main shaft are of the pedestal type, and are mounted upon heavy concrete foundations. The bearings themselves are of special dust-proof type. A ring of felt at either end prevents the dust from entering. These bearings and the entire power transmission equipment were furnished by the Dodge Manufacturing Company, Mishawaka, Ind.

The officers of the company are: William L. Holmes, president; John T. Holmes, secretary and treasurer. The general manager of the works is Mr. L. W. Hoch. Mr. R. D. Hasson is the superintendent, and Mr. Leigh Hunt his assistant. Mr. Oscar Gerlach is the chemist of the company. The writer is indebted to Mr. Hoch for the data and blue prints from which this description was prepared.

Some Interesting Submerged Concrete Laying was recently done at Boston for the foundation of a new 1,200-ton draw span. The foundation is 72 feet in mean diameter and 32 feet high, resting on piles. A plan of the pier and a description of the protection curb was published in "The Engineering Record" of July 30, 1898. The curb was not water-tight, and intended to retain the concrete in place and to protect it from washing or disturbance until set. The concrete inside it was deposited on the pile heads through an iron tube with a hopper top. The tube was held in a nearly vertical position, with its lower end resting on the top of the concrete already laid; then as it was filled with fresh concrete the bottom was slightly raised to permit the contents to flow out around the foot into the required position. Falsework piles were driven around the pier and carried on similar working platforms 6 or 8 feet wide, above high water level. In the center of the pier a group of piles nearly as high were banded together and carried a small platform. A heavy guyed mast 50 or 60 feet high was erected on this platform and carried a balanced horizontal boom about 80 feet long with equal arms crossing it about 20 feet above the bottom. Each arm of the boom was supported by an end and an intermediate adjustable iron guy rod from the top of the mast and by a vertical timber frame, or bent at the end resting on the annular platform. The boom was made of two timbers, one on each side of the mast with a space between in which traveled the lower part of a trolley running on the top of the boom. A set of tackle and a differential hoist were suspended from the trolley and supported the top of the concrete chute, which could be lifted out by the tackle or adjusted by the hoist. At the outer end and in the center of each boom a transverse beam was laid across the top, and from them were suspended two lines of horizontal platforms, one each side of the concrete chute. They were about 2 feet apart and crossed the pier diametrically at the level of the annular platform, on which their outer ends revolved with the boom. This diametrical platform served as a wheeling way on which the concrete was brought in barrows from the adjacent mixing platform and dumped into the hopper of the chute. By traversing the chute on the boom and by revolving the latter every part of the pier area was commanded.

THE UTILIZATION OF CITY REFUSE IN BOSTON, MASS.

In "The Engineering Record" of September 19, 1891, there was printed a description of the works at Chelsea, England, where the household refuse, paper, bottles and other rubbish are sorted and the useless portions burned. This plant has attracted considerable attention, and some interesting experiments were conducted at it by Bryan Donkin & Company, to determine the evaporative efficiency of the different classes of material, which were reviewed in the article mentioned. Several years ago the late Colonel Waring decided to construct a plant for the same purpose in New York. Under the old system, paper, rags, cans, packing boxes, fruit crates, excelsior, old shoes, bottles and such things, which the Italians who trimmed the city refuse scows did not wish to save, were dumped out at sea and carried back by the inflowing tide, eventually settling on the shores of the neighboring suburban towns, to the great disgust of the residents. The first New York plant was designed by Mr. A. W. Colwell, and built near the North River and Fifty-second Street. Colonel Waring described this plant in a report substantially as follows:

It consisted of an inclined wooden slat conveyor about 3 feet wide, running up at a slope of about 28 degrees. This carried the refuse to the top of a furnace having a common brick shell lined with firebrick and three grates, one above the other. The grates were of the water-tube class and the furnace was of the down-draft type. The spaces between the top layer of grate tubes were wider than those of the second layer, which in turn were wider than those of the bottom layer. The hot gases from the furnace passed through a horizontal boiler of about 80 horse-power, then through a fan exhauster, and finally through a dust separator to the smoke stack. The refuse was dumped from the carts on the bottom of the elevator and was sorted as it passed up the slope by workmen stationed along the side. These men picked out the news paper, manila paper, cotton rags, woolen rags, bottles, old shoes, rubber of all kinds, tin cans, barrels and the different kinds of metals. Each material was kept by itself and sold to various dealers, the paper and rags being baled in hand presses.

FIGURE 2.—BALING PRESSES UNDER CHUTES.

This plant was so successful that a larger one was erected in 1897 on Eighteenth Street near Avenue C. This had an increased picking area due to the use of a stitched canvas horizontal conveyor belt 80 feet long and 4 feet wide. By stationing men along each side a much more complete sorting of the refuse was secured, and the material which none of the men picked out was finally carried up on a conveyor belt and burned in a furnace of the same type as that first used, although somewhat larger. This plant was so successful that a still larger one was projected, and one of Colonel Waring's last official acts was to award a contract for its construction, which has not yet been carried out. The plans for this plant were prepared by Colonel W. F. Morse, of New York.

During this period and, in fact, since 1893, the City of Boston had been conducting an elaborate investigation of the different methods of disposing of all classes of municipal wastes. Finally in the spring of 1896 a commission comprising Dr. Durgin, president of the Board of Health; Mr. William Jackson, M. Am. Soc. C. E., city engineer; Mr. B. W. Wells, superintendent of streets, and Mr. P. O'Shea, superintendent of the sanitary division of the Street Department, recommended the disposal of the city garbage

FIGURE 3.—TOP OF DESTRUCTOR, SHOWING BOILER AND ENGINES.

FIGURE 1.—THE SORTING ROOM AND CONVEYOR.

by either reduction or cremation, the amount to be handled being estimated at approximately 200 tons per day. After some delay a contract for this work was closed with the New England Sanitary Product Company, by which this corporation takes the garbage from the city dump in its own scows to a plant 6 miles distant, on a point of land projecting into the harbor, and there treats it by the well-known Arnold process used in Philadelphia and New York. The company is paid $47,700 a year, and its plant is reported to have been operating successfully up to the time of its destruction by fire a few weeks ago.

The ashes and street sweepings collected in the city during 1897 amounted to 417,901 cartloads of 44 cubic feet each. Sixty-three per cent. of this was used for filling low ground, 26 per cent. was sent to sea at a cost of 15 cents per cartload, and the remainder was taken away by contractors without cost to the city.

FIGURE 4.—REFUSE DESTRUCTOR AND CHUTE.

In addition to these two classes of waste materials, there remains the combustible refuse, and about a year ago the city advertised for bids for the disposal by cremation of such parts of it as were worthless. The work was to be done on a wharf adjacent to a dump leased by the city, and the quantity to be handled was estimated at about 500 cubic yards a day. Four bids were received, but all rejected. In September of the same year, 1898, Mayor Quincy requested Colonel Morse to design a plant which he would guarantee to remove the valuable parts of the refuse and destroy without nuisance those which were worthless. Subsequently a contract was made with the City Refuse Utilization Company to build the plant from these plans on the city's ground and operate it for ten years, the city having an option to purchase the works upon appraisal at the end of five years. The company is paid $5,500 a year for operating it, in addition to receiving all the valuable portions of the refuse. This plant has been built, and was put in operation January 23, 1899.

The buildings comprise a main central house, 162 feet long and 40 feet wide, and, on each side, a storage shed of the same length and 20 feet wide. The main house is supported on steel columns, and has a clear story to afford light and ventilation. The walls are of brick and the interior is divided by a brick cross-wall into two rooms, a small one for the furnace and a large one for the men who sort the refuse. Through the center of the latter room there is an endless steel belt 4 feet wide and 150 feet long, shown in Figure 1, which is carried on chain rollers supported on a steel frame. This conveyor is of the apron type, extensively used for handling clay, ores, broken stone, sand, chemicals and similar materials, and was made by the Jeffrey Manufacturing Company of Columbus, Ohio. The first 25 feet of this belt is at the ground level, then it rises and runs for about 90 feet at a height of 2½ feet above the floor, and finally runs up through an opening in the rear wall, which is not shown very distinctly in the illustration, into the adjoining room, where it passes over the top of the furnace to a bin placed behind the rear wall of the building. On each side of the level track shown in Figure 1 are placed sorting bins and hoppers, into which the men throw various classes of paper, rags, cardboard and other articles as they are carried along in front of them on the conveyor. Each of the hoppers has a chute running through the floor to the basement of the building, where it terminates in a baling press, as shown in Figure 2. In these presses the rags and paper are compressed and baled like cotton.

The carts which collect the refuse are weighed on scales and then dump their loads on the floor, as shown at the left of Figure 1. This pile is shoveled on the conveyor in suitable quantities to be handled. The sorters save six different classes of paper and cardboard, four of rags, and also clothing, carpets, leather, rubber, bottles, iron of all kinds, tin cans, wood and a great variety of miscellaneous articles.

Across the end of the building in the furnace room is a Morse-Boulger refuse destructor, 56 feet long, 13 feet high and 10 feet wide, shown in a general way in Figures 3 and 4. The top of the furnace has two feeding holes covered with solid fire clay slabs, which slide back and forth, as shown in Figure 3. The refuse is fed into one hole or the other through a chute shown in Figure 4, which is pivoted so that it can be swung from one hole to the other, and receives the refuse either directly from the conveyor passing over its upper end into the receiving bin, or else from the bin. The latter has a capacity of 200 cubic yards, and is intended merely to store refuse for use as fuel before the conveyor is put in operation. The destructor differs in many respects from any furnace heretofore built in this country, and is designed for the rapid destruction of the peculiar class of material to be handled, and also for furnishing heat for a boiler placed behind the furnace, as shown in Figure 3. There are passages to admit large amounts of heated air into the interior of the furnace, and in addition to a main firebox of 4 cubic yards capacity in the front of the crematory there is a secondary firebox or smoke consumer at the other end. Special combustion chambers and cross-walls of perforated firebrick are provided to insure as thorough combustion as possible, and to deliver the hot gases to the boiler unmixed with ashes or light material. Provision is made for the rapid removal of ashes and the admission of special currents of air at various points, and the stoking is conducted with the aid of steam in a manner economical of labor. The stack is of steel, lined with firebrick, 125 feet high and bolted to a base 14 feet high. The boiler connections with the stack and with the furnace are controlled by dampers in such a way that the boiler may be operated by its own firebox or entirely by heat from the burning refuse. The furnace may also be operated independently of the boilers when desired. The boiler furnishes steam for a horizontal engine, shown rather indistinctly in Figure 3, which operates the conveying machinery, and also furnishes steam for a Westinghouse engine driving a dynamo, which furnishes current for the electric lights about the plant.

As before mentioned, the plant is owned by the City Refuse Utilization Company, of which Mr. Herbert Tate, of New York, is president. The designs and plans were furnished by Colonel W. F. Morse, sanitary engineer, who was assisted in the architectural details by Mr. H. B. Hooker, and it was built under the superintendence of Messrs. Morse & Boulger, of New York, by Messrs. Jones & Meehan, of Boston.

THE STANDARD BUILDING, NEW YORK CITY.

The Standard Building, 24 and 26 Broadway, New York, was originally 87 feet wide, about 206 feet deep, running through the block to New Street, and nine stories, or 150 feet, high above the pavement on the Broadway side. The walls of the building were of stone, and the iron floor beams were supported by the walls and interior cast-iron columns. The foundations consisted of about 1,800 piles driven in fine wet sand and capped with granite, concrete, and timber grillage. The building was well constructed and in good condition in 1895, when the owners determined to enlarge it. They secured on the north side an adjacent lot about 27 feet wide and of the same depth as the old one, thus giving the total area frontages of 114 feet on Broadway and New Street and a depth of 206 feet. It was desired to utilize all the available space and incorporate the old building in a new structure occupying the whole of the site except what is required for two open courts, and having a total height above the pavement on Broadway of 232 feet, or 16 stories and an attic. As the grade of New Street is lower than that of Broadway, the height of that front is 17 stories. One story, however, that between the ninth and tenth, is not available for office purposes. The present building consists of the old structure combined with a new one of modern steel-cage fire-proof construction enclosing the old building on top and on one side, and designed so as to conform with the architecture of the old front and make the new face entirely continuous and homogeneous. The south side of the new structure adjacent to the old building is supported on 12 steel pneumatic caisson foundations sunk to the solid rock, and these, together with the original pile foundations of the old part, carry the entire present building. A careful examination of the old foundations indicated that their total bearing capacity was ample to carry the old structure, and that part of the new one which has been superimposed above it. The piles were divided into different groups and the bearing capacity of each was calculated. Some of them showed an excess and some a deficiency for the loads which it was assumed would reach them if directly transmitted, and special provision was therefore made for the distribution of the weight above the ninth story so as to transmit it in the required proportion to the different elements of the new and the old foundations.

A description of the caisson foundations and the method of constructing them was published in "The Engineering Record" of July 11, 1896, while the work was in progress. The old building weighed approximately 40,000,000 pounds, and that portion of the new structure that has been extended above it weighs about 12,000,000 pounds, nearly 10,000,000 pounds of which is carried to the pile foundations, while the remainder is transmitted to the new caisson foundations. Up to the top of the ninth story the old building was practically undisturbed except by the reinforcement of two old interior columns and the addition of four new ones. All of them rest on steel beams which distribute their loads on the wooden grillages.

The new work consists of the steel caissons and the superstructure. The bottom width of the latter, 27 feet, is increased at the top of the ninth story to 114 feet, overhanging the entire width of the old building, and forming from that level up a single uniform construction nearly rectangular in plan, 114x206 feet in extreme dimensions, and about 84 feet in height, including six full stories and two short ones. Each of the steel caissons is surmounted by a brick pier on which are set two circular cast steel pedestals from 7 to 10 feet in diameter and from 14 to 18 feet apart on centers. Each pair of pedestals supports a triple or quadruple plate-girder cantilever which overhangs their centers, and in some cases the ends of the caisson,

sufficiently to carry at its extremities the columns in the planes of the walls, thus providing for eccentric loads and securing definite balanced reactions. These cantilevers and two

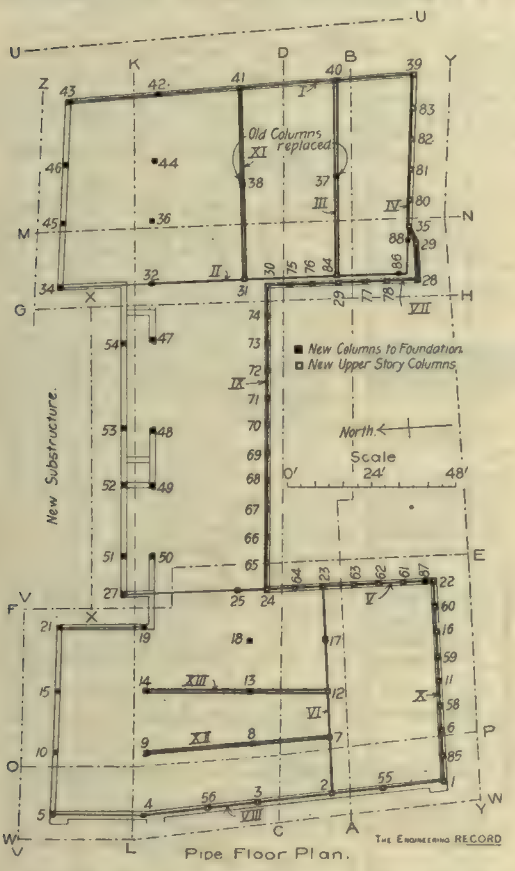


FIGURE 5.—PLAN OF GIRDERS OVER OLD BUILDING.

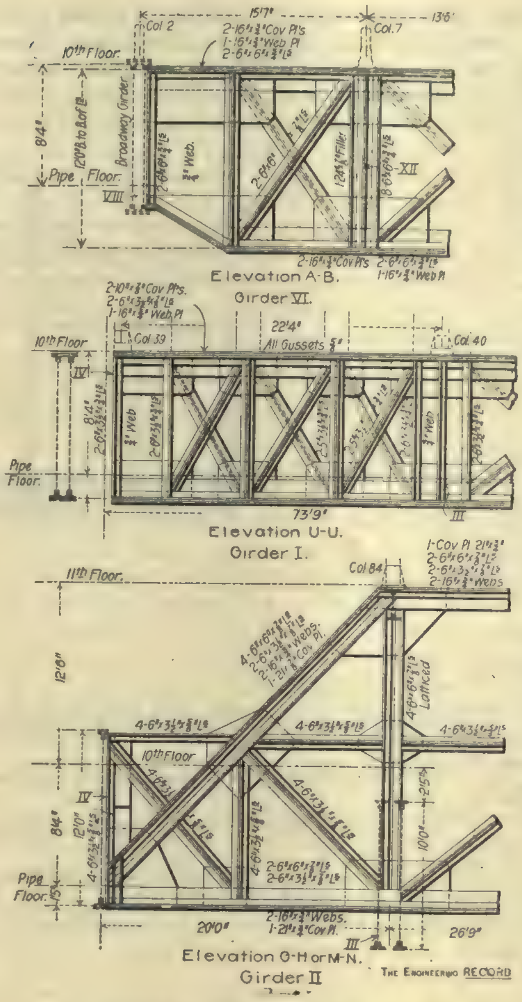


FIGURE 6.—DETAILS OF GIRDERS.

small surface grillages carry the entire framework of the northern part of the building, which consists of riveted steel columns and rolled and riveted beams. One of the caisson pedestals is shown in plan and end elevation in Figure 1. The corresponding side elevation is shown in Figure 2, which gives a side elevation and transverse section of cantilever L, which is typical of all the foundation cantilevers. A general foundation plan and diagram of the first tier or cellar floor beams of the new substructure is shown in Figure 3. Here the walls and the old building are omitted and the lot boundaries are indicated by a line broken with one dot. The caissons are shown by heavy dotted lines, and the pedestals and cantilevers by full heavy lines. The floor beams of the first or cellar tier and the wall girders are indicated by double lines. The columns in cross-section are shown by conventional solid black areas, and their types of cross section are indicated by the enlarged diagram. Columns Nos. 5, 10, 15, 21, 34, 45, 46 and 43 are similar. Columns 20, 28, 26, 33, 14, 19, 27, 51, 52, 53, 54, 36, 44 and B are similar. Columns 4, 9, 32 and 42 are similar. Columns 47, 48, 49 and 50 are of cast-iron, with hollow rectangular cross section. The columns enumerated in each group vary in dimensions, in reinforcement plates and in the size, but not in the arrangement of the shapes. Columns 47 and 48 are set directly on a group of grillage beams which distribute their load over an extended area of the old foundation walls and have web connections for the new cellar floor beams. Column 49 is carried by a compound cantilever composed of six 24-inch rolled beams 22 feet long, with an overhang of 13 feet, which are anchored by column 50 and supported from a grillage of 6-inch

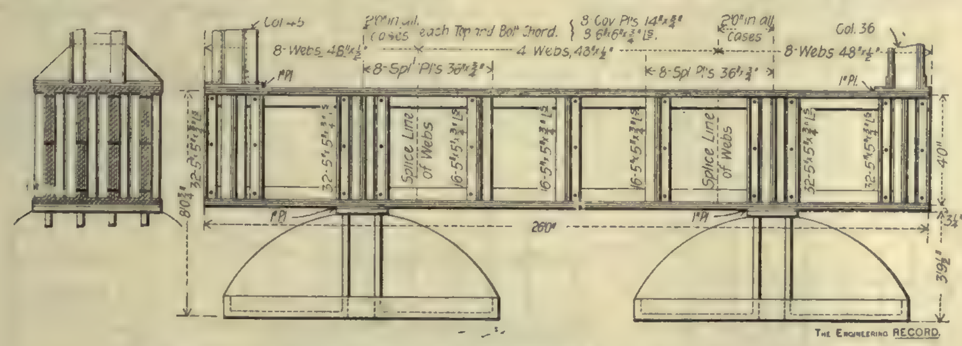
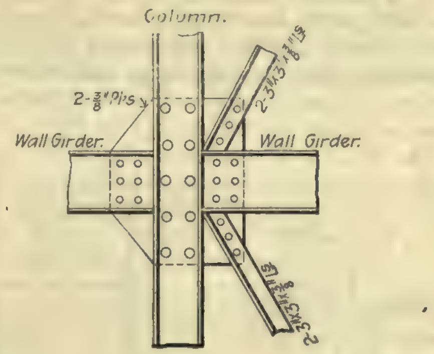


FIGURE 2.—TRANSVERSE SECTION AND SIDE ELEVATION OF CANTILEVER L.



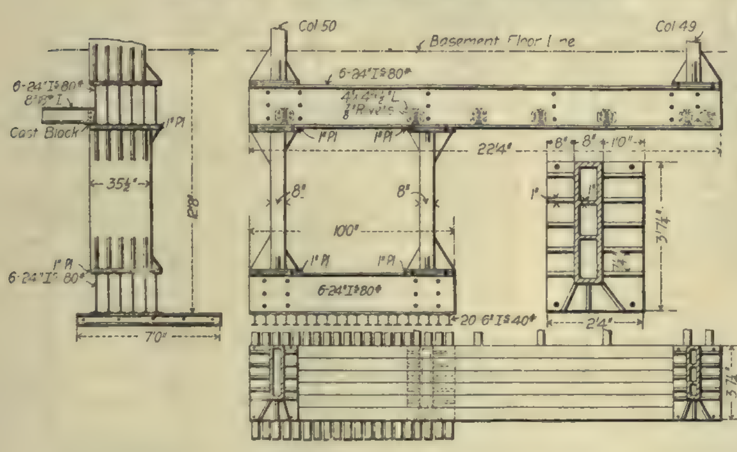


FIGURE 4.—FOUNDATIONS FOR COLUMNS 49 AND 50.

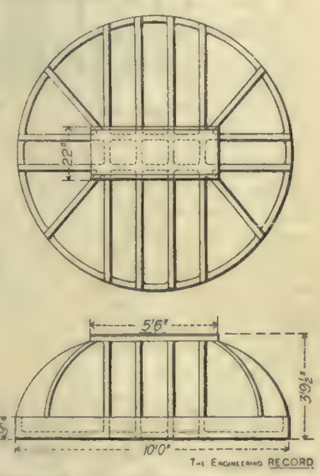


FIGURE 1.—PEDESTAL.

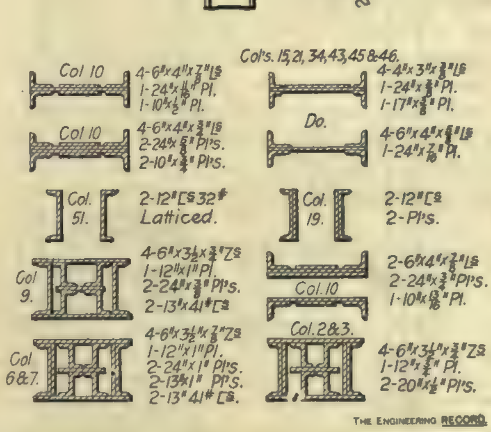


FIGURE 15.—DETAILS OF TYPICAL COLUMNS.

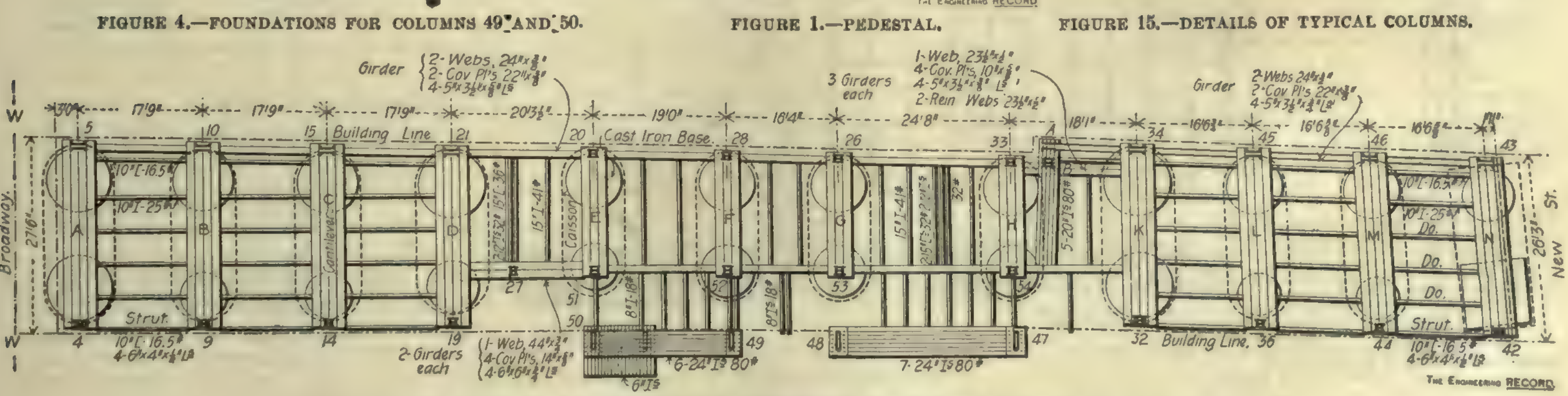


FIGURE 3.—FOUNDATION AND CELLAR FLOOR BEAM PLAN.

STRUCTURAL FEATURES OF THE ENLARGED STANDARD BUILDING, NEW YORK.

MESSRS. KIMBALL & THOMPSON, ARCHITECTS; MR. C. O. BROWN, CONSULTING ENGINEER.

beams laid on the surface of the sand, as shown in the enlarged drawing, Figure 4.

In the first tier the floor beams in the ends of the building are carried directly from the cantilevers and are placed longitudinally, while in the center part of the building the lengths and spacing of the cantilevers are such as to make it more desirable to have the floor beams set transversely and carried by longitudinal girders attached to the ends of the cantilevers. Rolled beams 10 and 15 inches deep are generally used. The first, second and basement floors cover the whole area of the extension and correspond in general dimensions to the cellar floor. Between columns 21 and 34 the arrangement of floor beams is irregular to provide for elevator shafts, etc. Elsewhere there are transverse 15-inch I-beams set 5 feet apart and supported by longitudinal girders between the wall columns. Above the second story an open court about 18x96 feet is formed in the middle of the north side of the building, and above that point, except adjacent to the court, the successive tiers of floor beams are 15-inch 41-pound I-beams about 25 feet long, set 5 feet apart and carrying hollow brick flat arches on their lower flanges. These beams are supported at both ends by longitudinal wall girders attached to the columns. The south girders are each single 15-inch 41-pound I-beams, and the north ones are riveted plate girders with an 8x⅜-inch web and four 4x4x⅜-inch chord angles.

At the top of the ninth story the roof of the old building was removed and the outside walls capped with steel latticed girders arrranged so as to distribute a portion of the load of the succeeding new upper stories uniformly throughout the length of the old footings. These wall girders are shown in diagram in Figure 5, where they are marked respectively I, IV, VII, IX, V, X, VIII. Girder I is supported wholly on the new street walls up to column 42 of the new structure and thence to column 43 which is carried by the caisson foundations. The effect is thus virtually to make it a beam solidly built into a rigid framework for 27 feet at one end and having concentrated loads and a continuous support of possibly varying reaction for the remaining 87 feet of its length. Girder IV is supported by the old wall and a new wall column, No. 88, which is carried down to the pile foundation and supports a cantilever arm 10 feet long at the west end. Girders VII and IX are supported entirely by the old walls. Girder V is supported at one end by the new interior

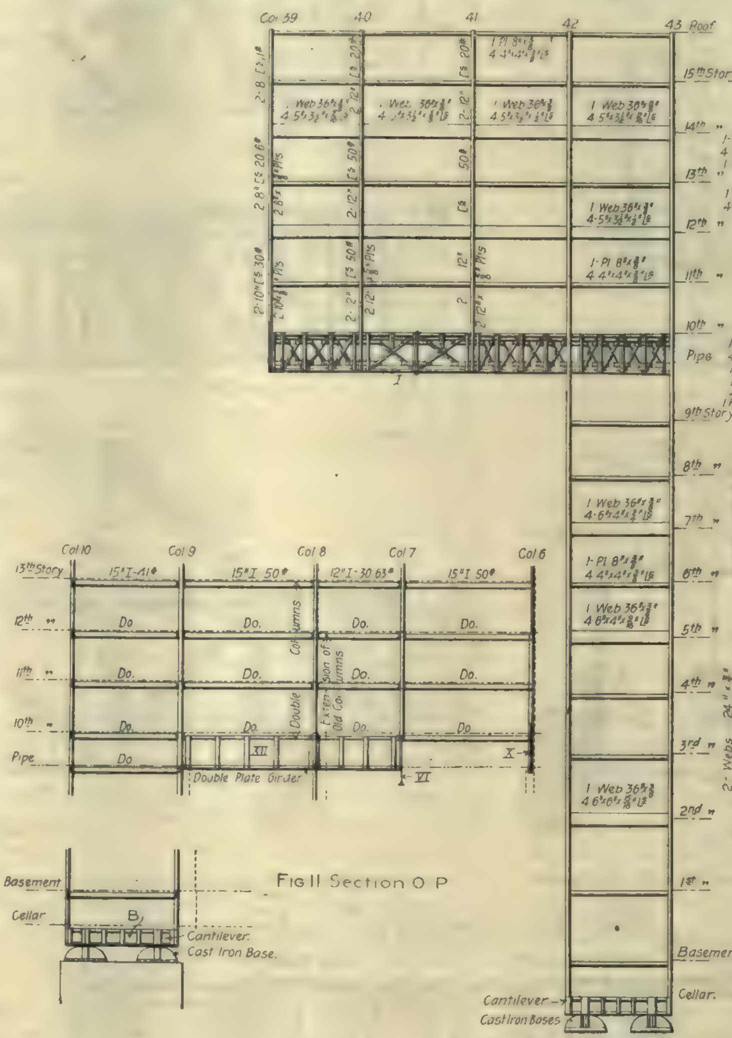


FIG. 7 Elevation U-U.

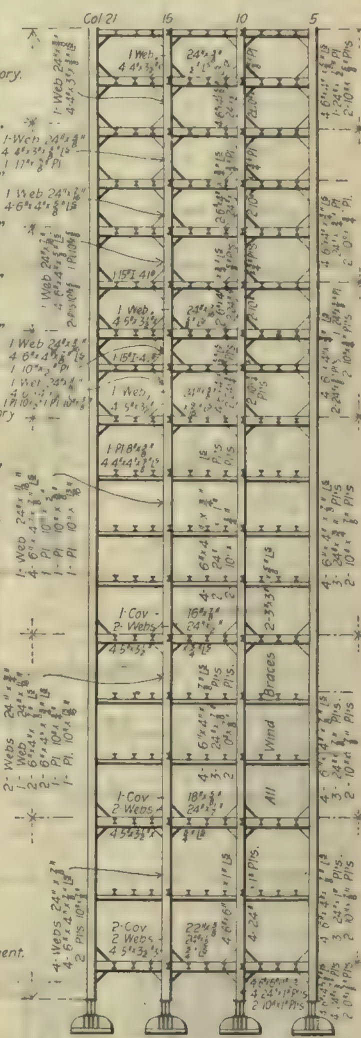
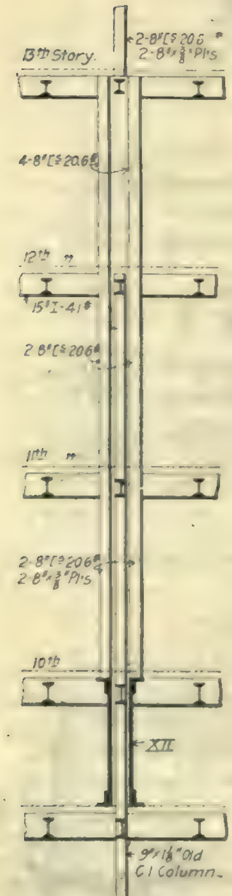


FIG. 8 Elevation V-V

FIG. 11 Section O P



Detail of Columns 8 and 13

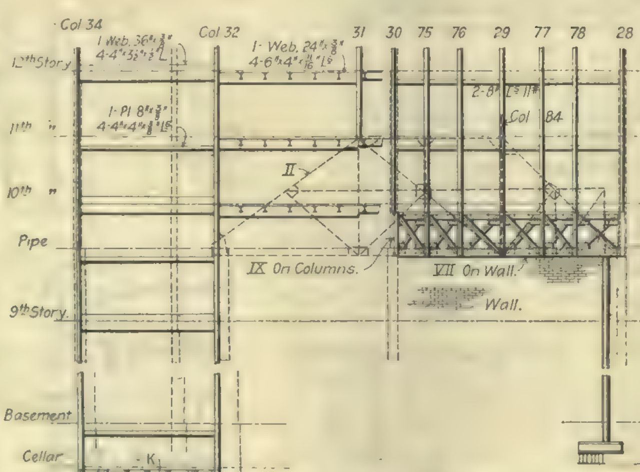


FIG. 9 Section G-H.

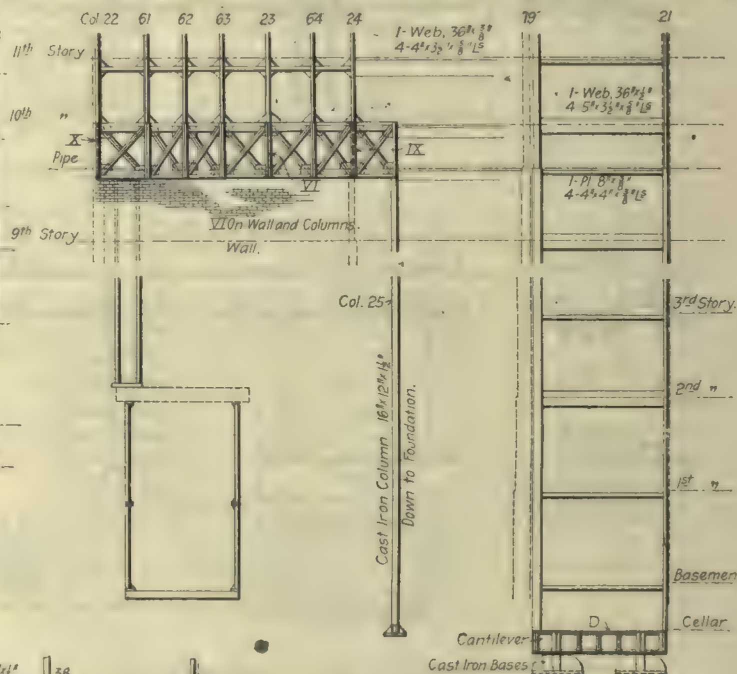


FIG. 10 Section E-F.

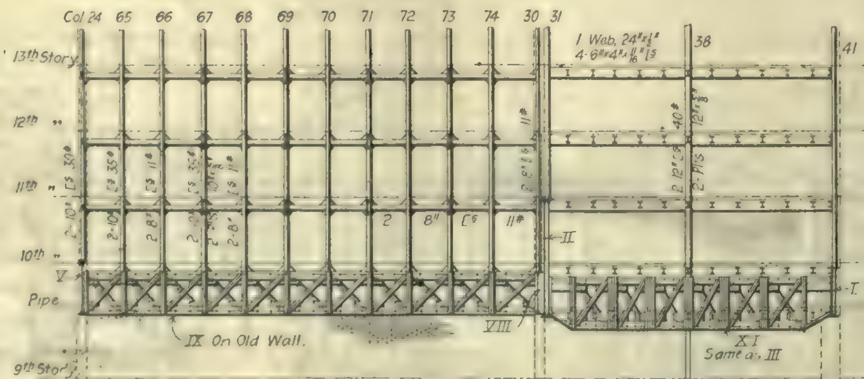


FIG. 13 Section C-D.

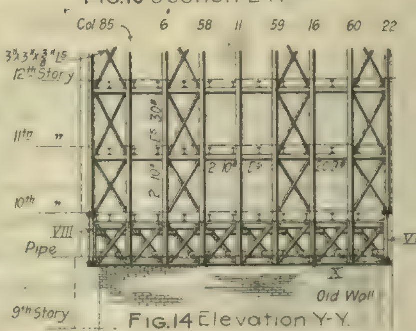


FIG. 14 Elevation Y-Y.

SECTIONS ON THE LINES INDICATED IN FIGURE 5, SHOWING TYPICAL FEATURES OF FRAMEWORK.

THE RECONSTRUCTION OF THE STANDARD BUILDING, NEW YORK CITY

MESSRS. KIMBALL & THOMPSON, ARCHITECTS; MR. C. O. BROWN, CONSULTING ENGINEER.

column, No. 25, and at the other end by the new wall column, No. 87, which are carried down to the old foundation and relieve the wall on which the girder also rests from undue loading. Girder X is supported entirely on the old wall, and girder VIII rests on the old wall throughout its entire length and is also connected at one end to column 4. These girders all rest upon old walls, and act mainly as distributing girders for the concentrated loads above them, and to prevent local overloading of the masonry and foundations. Where the walls are too weak to carry the necessary strains to the foundations they are reinforced by the wall columns 87 and 88, and a portion of the loads at the north ends of the Broadway and New Street walls is carried direct to the columns of the new foundations.

The old foundations of the interior columns at both ends of the buildings were considered adequate to receive an increased load, but not sufficient to carry the whole excess imposed by the superstructure above the roof of the original building. In order to load the piles up to their assigned limit and transfer the remainders of the loads at these points to the new foundations and to other parts of the old foundations where there was sufficient excess of capacity, an auxiliary system of equalizing girders was added to the distributing wall girders and so proportioned and connected that the different portions of the loads were divided and transmitted as required to the different columns or bearings in accordance with a simple system of moments. Equalizing girders III, XI, XII and XIII were made double so as to permit the interior columns 37, 38, 8 and 13 to pass freely through them between the separated halves without any connections to the girders. These old columns were extended to carry all the loads up to and including the eleventh and twelfth floors. Above these levels the loads were carried by new single columns, independent of the lower sections, and supported from the equalizing girders by double columns set one on each side of the extension of the old column. Of the loads thus imposed on girders III and XI by the east interior columns 37 and 38 one-half goes to the wall girder I and the other half to the truss II. This truss is 20 feet deep, extending up to the eleventh story, and is supported by a caisson column, No. 32, and by a new cast-iron wall column, No. 86, which stands on the pile foundation. Similarly the lower sections of the west interior columns 8 and 13 are carried direct to the old foundations, and the upper sections are supported by the girders XII and XIII. Each of these girders is supported at one end by a caisson column and at the other end by the cross girder VI, which also carries the interior columns 12 and 7 and 17, and is supported entirely by the wall girders V and VIII.

All of the girders shown in Figure 5, except girder II, have their top chords in the same horizontal plane, and are rigidly riveted together with web connections at all intersections, and as their depths vary from 8 to 12 feet the construction affords great stiffness and insures sufficient distribution of load to develop the full strength of the walls and foundations. The girders were completely shop riveted and are composed chiefly of heavy steel angles and plates, as indicated in Figure 6, which shows characteristic portions of typical girders. Girder VI is similar to girder III. Girder I is similar to girders IV, VIII, VII, IX and X, except that the last three are single instead of double. In Figure 5 the columns which extend down to the foundation are shown in solid black, and those which commence at the tenth floor are indicated by an open rectangle. In this figure only the equalizing and distributing girders are shown; all other girders and floor beams are omitted to avoid confusion. This floor is known as the pipe floor and has the same arrangement of beams and girders as the tenth floor.

In each of the 19 rectangles formed by the intersecting rows of columns over the old building is a pair of 5x¾-inch horizontal lateral diagonals. These bars are laid flat on top of the floor beams and are riveted at the ends to angle clips on the columns. In most cases their reactions are taken up by the beams and girders, but between four pairs of columns there is no beam where the bars connect, and at each of these places a strut is provided made of four 6x6x½-inch angles riveted back to back.

Figures 7 to 13, inclusive, are elevations corresponding to the sections indicated in Figure 5, and show the arrangement of columns, foundations and wall braces and the location and operation of the equalizing and distributing girders. Figures 7 and 8 are complete elevations of face and side walls of the new framework, and show typical materials and connections. Figures 9, 10, 11 and 12 are similar partial elevations from which the upper and intermediate portions have been omitted to save space, and because the members are duplicates of those shown in the adjacent panels. Elevation ZZ, Figure 5, is similar to Figure 8, and elevation XX, Figure 5, is nearly similar to the elevation of the panels between columns 32, 36, 44 and 42, Figure 12. In Figure 9, truss II, is shown behind truss VII, and is indicated by a dotted line to distinguish it from girder VII. Besides carrying the west ends of girders III and XI this truss supports the interior column No. 31 and the wall columns 86 and 84, the last being indicated by a dotted line behind column 29. Girders IV, III and XI being on the opposite side of this truss from the section plane are not in section, and are not shown in this view. On the same block is shown a detail of columns 8 and 13, which carry the twelfth floor loads and those below them down to the old pile foundations direct, while the upper floor loads on the same vertical line are carried to the equalizing girders. The elevation of the other side of column 8, a complete section of part of the upper stories, is shown in Figure 13, where the column panels correspond to those above them. Elevation WW, in Figure 5, is similar to elevation UU, Figure 7, except that columns 4 and 5 are not connected below the ninth floor. Elevation AB is similar to elevation CD, Figure 13, except that it does not show girder IX and the framework above it. Section MN is similar to section OP, Figure 11, except that the double plate girders III and XI are in cross section and columns 37 and 38 are like columns 8 and 13 in Figure 13. Figure 14 is an elevation at YY of the south side of the upper part of the west wing, showing the diagonal members in the wall panels, and is similar to the elevation of the north wing at YY.

Above the ninth story the floor beams in the east and west parts are set 5 feet apart and run north and south, being supported by east and west interior column beams and girders and in the north wall by plate girders with 24-inch webs and 5x3½-inch chord angles. Between the light courts, in the narrow portion of the building, the column girders are about 16 feet apart, east and west, and are each composed of a 24-inch web and four 6x4-inch angles supporting 12-inch 30-pound floor beams 5 feet apart, which carry the floor arches with their axes east and west. The tenth floor only is entirely covered with a solid steel plate construction formed of oblique Z bars 6 inches high united by top and bottom horizontal plates all riveted together to form troughs, covering the whole area, and giving great rigidity. The troughs are filled with concrete and have a wooden wearing surface on top. The sway bracing in the south wall is connected to the columns by steel rivets, as shown in Figure 15, which also gives some typical column sections. Between the ninth and tenth stories the space of about 9 feet, which is occupied by the equalizing girders, forms a mezzanine story, which does not appear in the face of the building, where a solid horizontal belt molding like a cornice is substituted for windows between the old and new stories. This space, called the pipe chamber, is only lighted artificially and is reserved for the distribution of horizontal pipe lines, electric conduits, the location of intermediate water tanks, etc.

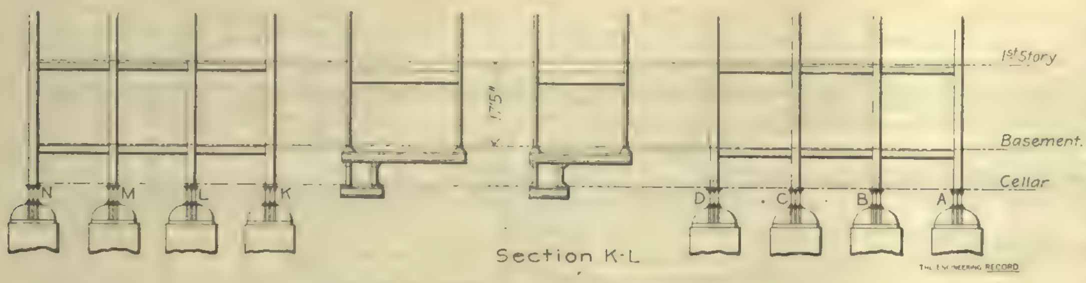


FIGURE 12.—SECTION ON LINE K-L IN FIGURE 5.

Work on the foundations for the north part of the building was commenced in the summer of 1895, and carried to the top of the ninth story before the new superstructure above the old building was begun. The work of erecting, adjusting and connecting the equalizing and distributing girders was slow and tedious, and the skeleton framework was completed during September, 1897. The new construction was finished ready for tenants in April, 1898, and was built without materially disturbing any of the tenants who completely occupied the old building while the work was in progress. Messrs. Kimball & Thompson were the architects and Mr. C. O. Brown, M. Am. Soc. C. E., was the consulting engineer for the steel work, which was manufactured and erected by J. B. & J. M. Cornell. Sooysmith & Company were the contractors for the caisson foundations.

THE NEW VAUXHALL BRIDGE, LONDON.

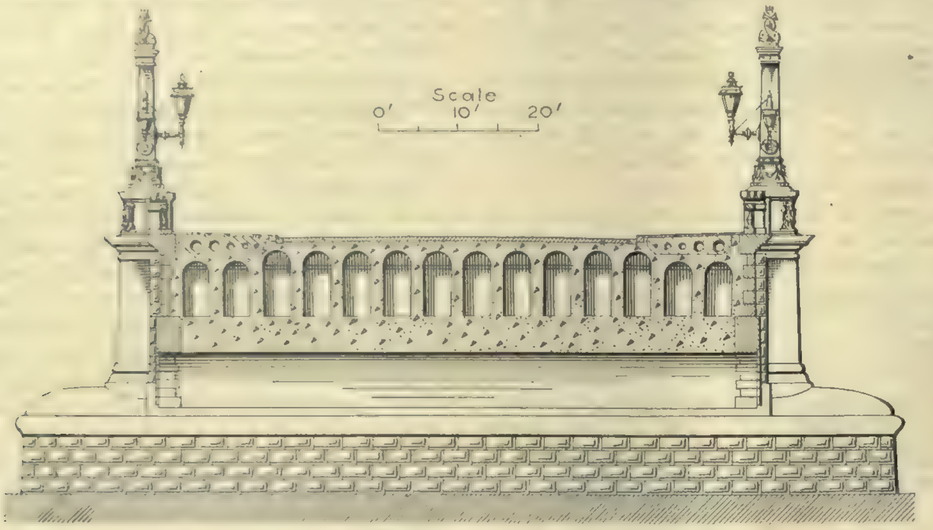
One of the famous bridges of London, the cast-iron structure across the Thames at Vauxhall, is now being demolished, preparatory to constructing a bridge with a number of masonry spans, each with three hinges. Both the old and the new spans are of much interest, as will be seen from the following account and the accompanying illustrations, condensed from the "Builder":

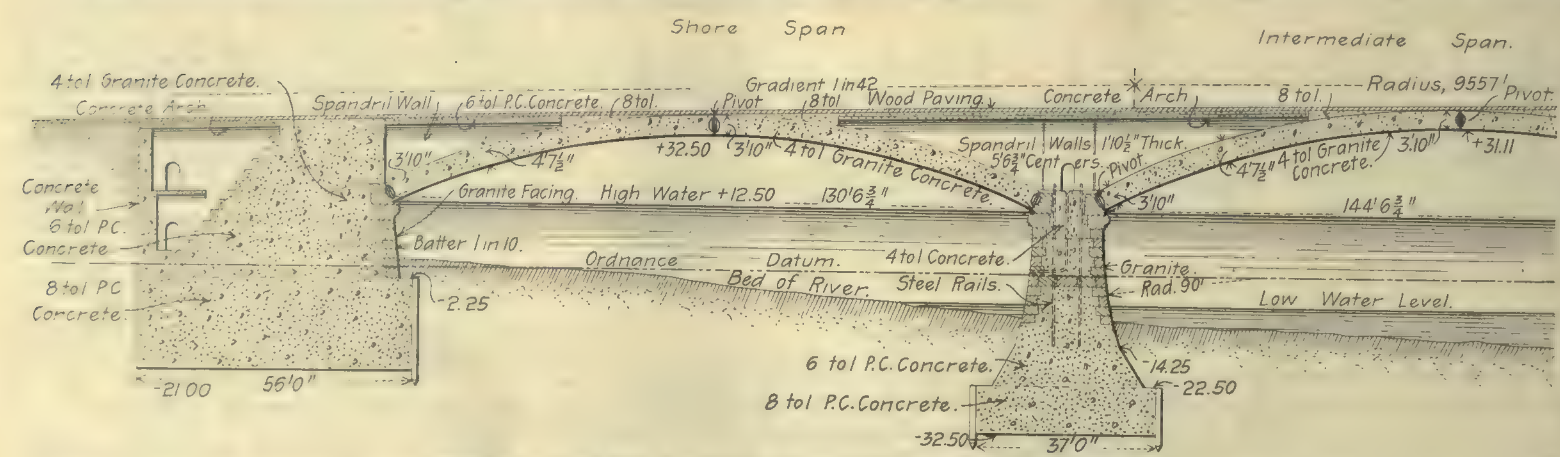
The old bridge was commenced in the year 1811, and opened to traffic in 1816, and is composed of two abutments, eight piers, and nine arches. The abutments are supported on a grid of piles, the tops of which are about 5 to 7 feet below the surface of the foreshore. In the case of the piers no piles were used, but only a grid composed of 16-inch thick timbers, laid on the top of the ballast or clay, upon the top of which the masonry and brickwork were built. No information exists as to whether the piers were built within coffer-dams or not; but, from the high state of the water in the river at the period when the bridge was built, caused by old London Bridge, it is believed that coffer-dams must have been used.

The piers and abutments are composed of blue stone facings, backed up and filled in with brickwork, and all set in lias lime mortar; the piers, above the springing level of the ribs, are hollow, with occasional cross walls, and the tops arched over to carry the roadway. All the brickwork, so far as it has been broken into, is good work, and it is assumed that the same will be the case throughout. The engineer, when

designing the bridge, kept the springing line of the ribs at the same gradient as the roadway, and by this means one set of patterns only was required for the ribs; the effect of this being that the piers are all at different heights, instead of the same, as is the case in all later bridges constructed across the River Thames. The ribs, bracing, floorplates, cornice, parapet, etc., are all made of the best cold-blast cast-iron. The ribs are made in three segments, and to them are cast the spandrel pillars, etc., so that great rigidity was obtained in a light structure. The ribs were braced together by means of lattice bracing at regular spaces, and leaded in and thoroughly well bolted together; the plates carrying the roadway were laid on the top of the upper member of the spandrel pillars, and held in position by means of long through bolts and muff couplings. The spans of the arches are 78 feet throughout, and the maximum headway at the center span is 26 feet above high water. Each span consists of ten ribs, which bear at their springings on cast-iron skewbacks built into the brick and stonework, no holding-down bolts being used. From the construction of the ribs it has been found during demolition that very little horizontal thrust could have been exerted, as when the center portion of the rib was removed the rusting up of the springing ends in the skewbacks was sufficient to keep the free portion in position, which weighed about 5 tons. The original cost of building the existing bridge was about $1,200,000, and it was purchased by the late Metropolitan Board of Works in 1879 for a sum of $350,000, and thrown open to the public free of all tolls.

The accompanying cuts give a good idea of the construction of the new bridge. The rock-faced voussoirs, introduced to give boldness of effect, will project from 6 to 8 inches beyond the spandrel face. The lower columns of the piers project beyond the face for about five-eighths of their diameter, so as to throw a good shadow on to the flat portion of the pier. The upper columns are intended for ornament and also to carry the lamps which will be used for navigation purposes and for lighting the bridge, and the tops will be surmounted with bronzes.





SECTIONS OF THE NEW VAUXHALL THREE-HINGE CONCRETE ARCH BRIDGE.

The abutments are carried above the level of the footway, and it is intended that statuary of some description shall be placed thereon, but not necessarily that shown on the elevation. The width of the new bridge between the parapets will be 80 feet, composed of a carriageway 50 feet wide between the curbs, and with two 15-foot footways. The bridge throughout will be constructed of Portland cement concrete of varying strengths, according to the work that it has to do. All exposed surfaces of the abutments, piers and bridge, except the under side of the arches, will be faced with the whitest granite obtainable.

The arches throughout will be in two pieces pivoted at the center and the springing; by adopting this means of construction a considerable amount of material is saved in the haunches and springing, as the curves of pressure are compelled to pass through the pivots. The neutral axes and equilibrium curves of the arches are in the same line, so that the compression is equal over the arch at any point of its cross sectional area. The maximum compression does not exceed 17 tons per square foot on the concrete, due to dead load only; the live load, which bears a very small ratio to the dead load, has not been taken into account in calculating the stresses on the arch, but is taken into account for the loads on the foundations.

The tests made with the 4-to-1 Portland cement granite concrete for two months' old material to be used in the arches crushed at an average of 238 tons per square foot, so that allowing 17 tons per square foot as the compression in the arch, this will give a factor of safety of 14 to 1, which must be considered as very high. As concrete takes about two and a half to three years to attain its maximum strength, it is assumed that the ultimate crushing strength ought to be as high as 400 tons to the square foot.

The bridge is from the design of Sir A. R. Binnie, chief engineer to the London County Council, and will be carried out under the immediate superintendence of Mr. E. P. Wells, of the Engineer's Department of the Council, acting as resident engineer.

CEMENT SPECIFICATIONS AND CEMENT TESTING.

For a number of years engineers have been the leading contributors to the literature of cement testing and cement specifications, at least so far as this country is concerned. Occasionally a manufacturer of cement stated his side of the subject, but the producers of the material who have done so have been very few. Hence it is of interest to enumerate the main features in a paper read by Mr. Robert W. Lesley, Assoc. Am. Soc. C. E., before the Engineers' Club of Philadelphia a few weeks ago. Mr. Lesley's long experience as a manufacturer of cement and his intimate acquaintance with all the specifications which have been involved in the last quarter century for this material, render his statements on the subject of particular value. Through the courtesy of the Club, "The Engineering Record" is premitted to print at this time the following abstract of this interesting paper in advance of its publication in full in the Club's "Proceedings."

In the introductory portion of the address Mr. Lesley pointed out that the testing of cement, like that of all building material, has been progressing along the lines of accuracy, system and definiteness, characteristic of the improvements in methods of construction. There is a fundamental difference, however, between testing cement and testing other materials. All except cement can be tested in their original condition, like sand, or as finished products, like steel or iron. The representative of the architect or engineer can make his tests at the sand bank and at the steel works, or at the place where the material is to be actually used. No act of the engineer, manufacturer or consumer can alter the raw product or the finished metal in any way at any of these places. But with cement the condition is very different. No engineer or architect would accept a barrel of cement upon tests made with the powder alone, on its weight per cubic foot, the specific gravity, the fineness or the chemical composition. Such tests, which can be made at the mills or the place of use, must be supplemented according to all specifications by tests for tensile or compressive strength. To make them the material must be formed into briquettes, which are put in testing machines of one sort or another. The making of these briquettes involves an operation after the completion of the manufacture of the cement, and involves a process of treating the manufactured product by either the engineer or the testing expert to obtain results to meet the required specification. The manufacturer may test the finished product by mixing it with water and sand into briquettes which are found to satisfy the requirements of the specifications as to strength. The material may be sent in a sealed car to its destination and there be tested by a person desiring to produce the fairest of results, though possibly unfamiliar with its peculiarities or with methods of testing and all the little details which enter into the proper handling of such a material. The briquettes he produces

are not the manufactured product of the cement maker, but his own. This product is made up of the cement which leaves the mill, the water used in gauging the briquette, the sand used by the tester, all influenced by the personal equation of the tester and his laboratory.

The first question in the use of cement which confronts the manufacturer as well as the engineer is what specifications are to be used. The engineer will be guided by the character of the work he has to do, the amount of time allowed him to do it, the permanence or temporary nature of the undertaking, and the experience of other engineers who have done similar work. This specification is put in print and goes to the manufacturer. He may be making a cement of uniform character, which he may consider to meet the specification and be perfectly safe and satisfactory. He may, on the other hand, discover that the specification contains elements which, under the condition governing the use of the material, would involve danger and failure, injurious alike to the engineer and manufacturer. In some cases these matters can be reconciled between the manufacturer and the engineer; in other cases the manufacturer is forced to decline to supply the cement.

For some six or eight years Mr. Lesley has been gathering and classifying specifications, and a study of the mass of materials so accumulated shows the difficulties under which the manufacturer labors and the necessity of some thorough understanding as to the methods under which cement is to be tested.

In a general way it may be said that in the test for fineness of Portland cement the engineers of the United States Army specify that 95½ per cent. must pass a 2,500-mesh sieve, 84 per cent. a 10,000-mesh sieve and 70 per cent. a 40,000-mesh. In work for the Light House Board 95 per cent. must, on an average, pass a 2,500-mesh sieve. The average of a number of specifications by the civil engineer corps of the Navy requires 90 per cent. to pass a 6,400-mesh sieve and 97 per cent. a 3,600-mesh sieve. The average of a number of specifications for government work in the District of Clumbia calls for a fineness equivalent to 95 per cent. through a 2,500-mesh sieve and 85 per cent. through a 10,000-mesh sieve. The average requirements of recent specifications in Easton, Williamsport, Wilmington, Waltham, New York, Pittsburg, Brooklyn, Baltimore and Philadelphia were 97 per cent. through a 2,500-mesh sieve, 89 per cent. through 10,000-mesh and 69 per cent. through 40,000-mesh. The average requirements of six of the leading street and steam railways were 95½ per cent. through a 2,500-mesh sieve and 80 per cent. through an 8,000-mesh sieve. For a number of important recent bridges it was required that 97 per cent. of the cement should pass a sieve with 2,500 meshes and 88 per cent. one with 10,000 meshes. The average of 71 specifications was 96 per cent. must pass a 2,500-mesh sieve, 85 per cent. a 10,000-mesh and 69 per cent. a 40,000-mesh.

The tensile requirements for recent works executed under the direction of the Corps of Engineers of the United States Army average, for neat tests, 131 pounds at the end of 24 hours, 402 pounds at the end of 7 days and 547 pounds at the end of 28 days. Specifications for a number of structures built by the Light House Board average 383 and 600 pounds for 7 and 28 days respectively. The average of recent specifications for the Navy is 462 pounds at the end of seven days. The average of a number of city specifications is 161, 388 and 538 pounds for 1, 7 and 28 days respectively. The average requirement of a number of railways is 115, 319 and 483 pounds for 1, 7 and 28 days respectively. The average of 91 American specifications is 134, 384 and 528 pounds for 1, 7 and 28 days respectively.

In briquettes made of 3 parts sand to 1 of cement the average requirements of the engineers of the Army have been 119 and 189 pounds for 7 and 28-day tests. The average in the case of the Light House Board is 85 pounds at the end of seven days. The average for a number of cities is 134 and 201 pounds for 7 and 28 days. The average of 52 specifications is 118 and 189 pounds for 7 and 28-day tests.

It will be noticed that all these requirements are given as averages. The fluctuations from these figures on one side or another are very great, and it is these variations which cause the trouble of the manufacturer. For example, the three-to-one briquettes seven days old are required by the specification of the engineers of the Army to have a strength varying anywhere from 90 to 140 pounds and the 28-day tests must show a strength of from 125 to 200 pounds.

In specifications for natural cement drawn by the Corps of Engineers of the Army the fineness is required to average about 91 per cent. on a 2,500-mesh sieve, 85 per cent. on a 6,400-mesh and 72½ per cent. on one with 10,000 meshes. The average of 38 American specifications is 92 per cent. on a 2,500-mesh sieve, 85 per cent. on one with 6,400 meshes and 79 per cent. on one with 10,000 meshes. The tensile requirements of the same corps run from 40 to 70 pounds per square inch in 1 day, 90 to 125 pounds at 7 days and 100 to 200 pounds at the end of 28 days. The same requirements in the case of cities range from 50 to 100 pounds for 1-day tests, 100 to 200 pounds for 7-day tests and 150 to 300 pounds for 28-day tests. In briquettes mixed with two parts of sand to one of natural cement the Corps of Engineers has issued specifications requiring 7-day tests to show anywhere from 25 to 50 pounds strength, and 28-day tests to show from 65 to 200 pounds strength.

It is evident from this brief review of Mr. Lesley's collection of specifications that the engineer who wishes to compile a specification from the requirements which have been laid down by his predecessors engaged on similar work, or the manufacturer who wishes to produce a material satisfactory to a large number of users, is confronted by a difficult problem. Precedent is strong with the engineering profession, and reputable manufacturers have pride in the high quality of their product. While the work of an engineer under a specification may run for two or three years, yet the cement manufacturer is in business for a life time and he cannot afford to sacrifice permanence in the quality of the output to meet fluctuating specifications. The manufacturer, under existing conditions, must not only comply with the specifications as they are carried out by his own testing experts, but he must also know the conditions under which the expert of the user will test the cement, the water that will be employed in gauging, and the personal equation of the laboratory in which the work will be done. In spite of all the good intentions of the testers it is found that the results they obtain do not agree. Mr. Lesley gives a number of reasons for these differences, some of which are enumerated herewith. They are the result of his experience and that of others interested in testing cement, and many of them are fully summarized in John Newman's well-known book on concrete.

1. The nature of the slab on which the briquettes are made, whether it is impervious or porous.

2. The method of removing the briquette from the mold.

3. The area of the breaking section of the briquette.

4. The form of the briquette and the ratio of the periphery to the area of the breaking section.

5. The length of time elapsing between the testing and setting of briquette.

6. The position of the strain as regards the breaking section of the briquette.

7. The nature of the strain, whether it is slowly or rapidly applied.

8. The time occupied in applying the strain and in making the test.

9. The form of clip for holding the briquette.

10. Whether the clip is hung on pivots to prevent cross strain.

11. The equal or unequal bearing of the clips on the briquettes.

12. Whether the molds are perfectly clean and dry or wet before the cement is deposited.

13. Whether the mold is of iron, brass or wood, and placed on an iron plate with damp blotting paper interposed to prevent adhesion.

14. The age of Portland cement after grinding.

15. Whether the cement has been properly air-slaked.

16. Whether a skilled operator, accustomed to testing and making the briquettes, is employed.

17. The amount of residue after the cement has been sifted.

18. Whether the mold was filled at one operation and all air bubbles removed.

19. The method of filling the mold.

20. Whether the briquettes are made by the same operator on the same day and under the same conditions.

21. The time occupied in gauging the cement and filling the mold.

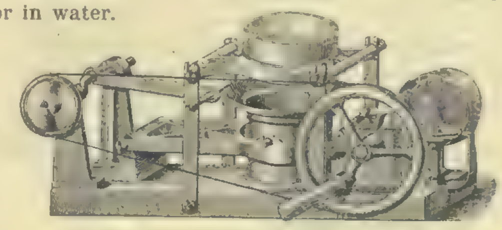
22. Whether the mold was shaken or tapped to make the briquette more dense, or filled and firmly pressed by a trowel.

23. The amount of water used in mixing.

24. The character of the water used in mixing. The soluble constituents in it may interfere with the setting; therefore it should be of the same character as that to be mixed with the concrete.

25. The temperature of the water.

26. Whether the briquettes are kept damp by wet cloths or in a damp atmosphere or kept dry or in water.



TETMAJER SCREENING APPARATUS.

27. The temperature of the setting room.

28. The temperature of the testing room.

29. Whether the cement is hand or machine mixed.

30. Whether the materials are mixed when dry several times before being mixed in a damp state.

31. The method of gauging the dry cement.

32. The season of the year when the test is made, unless the testing room is kept at a uniform temperature.

33. The exposure of a briquette to sunlight while setting.

34. The sudden exposure of briquettes without covering to a current of air.

35. Unskillful handling of the testing machines and snapping of briquettes where the machine is operated by hand.

36. Too sudden tightening of briquettes in placing them in the clips.

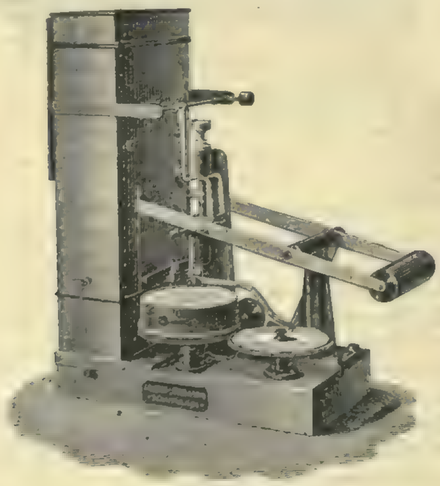
Mr. Lesley presented, to show the influence of these minor details of manipulation, a table prepared by Prof. J. Madison Porter, of Lafayette College, of the results of tensile tests of briquettes made of 1 part of cement and 3 parts of sand by a number of different testing laboratories, all using the same cement and working in accordance with the recommendations of the American Society of Civil Engineers. The tensile strength of these briquettes had a variation in the results of each laboratory of from 8 to 45 pounds. Moreover, the average results of all the tests in each laboratory ranged from 75 to 247 pounds. "It can be readily seen," Mr. Lesley states, "that the engineer and the tester under him, intending to do all that conscience and right would dictate, might possibly go astray, and that the cement man, on the other hand, making the article

which goes to the engineer for final test, may have in the same way to bear some fault that may not be directly traceable to the manufactured product as it leaves the mill."

In making tests for the fineness of cement Mr. Lesley considers that the best apparatus is that devised by Professor Tetmajer. It can be operated by either hand or power, and the fineness is determined by the residue left on the screen after a stated number of revolutions of the wheel. Debray of Paris has a machine of somewhat similar construction.

The reason for the difference in the results of tests for the time of setting is easily understood, according to Mr. Lesley, after an examination of the form of Vicat's needles used in most laboratories. These are of two sizes and are held by the operator on the pat or briquette; the time of setting is determined by noticing the moment when one of the needles ceases to penetrate the material, and the possible chance of error is readily seen to be great. John Grant improved this needle in 1859, and still later Debray introduced a better form in the testing laboratory of the Corps of Bridges and Highways in Paris. This last apparatus closely resembles that of Professor Tetmajer in use in the laboratory of the Zurich Polytechnicum. It makes automatically a diagram which shows the interval of time from the moment water is applied to the cement to the beginning of the final hardening.

The apparatus for testing the tensile strength of cement was said to date in a general way from the construction of the London drainage works under John Grant. His machine has been developed into the Riehle and Olsen apparatus. General Gillmore devised another type of machine in which prisms of cement to be broken were placed on two supports and weighted by means of shot flowing into a pan suspended from a registering dial. The machine used by Dr. Michaelis in Germany is a development of the Gillmore type, and the Fairbanks machine is another.



TETMAJER NEEDLE APPARATUS.

The difficulties following the manipulation of cement and the filling of molds by hand led to the design of machines for this purpose. That shown in the accompanying illustration is used in the Royal Testing Laboratory at Charlottenburg, near Berlin. Others of a similar type operated by hand or power are used in a number of laboratories, and an apparatus of the same general nature has been made in this country.

In concluding the paper Mr. Lesley advocates a method of testing which is comparatively novel. After pointing out the great difference between the facilities and methods of work in the laboratories belonging to the firms making a specialty of testing materials and the temporary testing rooms on the site of the works where the cement is being used, he says: "In the making of specifications or in the laying down of methods of making tests and modes of manipulation, it is almost impossible to make set suggestions which will apply equally to laboratories of both classes and to testing under the varying conditions which exist in the two kinds of laboratories. For this reason it is gratifying to find that of late years there is gradually coming into the minds of the engineers and consumers of cement, a distinction between the well-equipped, well-established, well-managed, scientifically constructed, scientifically appointed laboratory and the ordinary testing room on work all over the country. This distinction is very strongly drawn in a recent specification of the Russian Government and also in a recent specification of the Master Builders' Association of Philadelphia. The requirements of testing in these two specifications are distinctly modified as between the laboratory on the work and the laboratory of the trained expert, and this to my mind seems proper and right, a move in the right direction, and one which engineer, consumer and cement manufacturer should co-operate in extending. It may be argued with propriety, in view of the fact there exist these well equipped laboratories managed by leading experts, that the laboratory on the work is a back number and has no further cause for existence; that all cement should be tested in these better-equipped laboratories, and that the testing room on public work at the place of construction should exist no longer. This argument would apply with great force were it possible to ship the cement to the scientific laboratory and have it tested there, or were it possible for the scientific laboratory to locate itself on the large works being done in the wildernesses of our country, but these conditions do not and cannot exist under the present scope of engineering work. Consequently the testing of cement on its arrival at the place of consumption in the laboratory under the direct supervision of the engineer whose reputation is at stake in the work, will and must go on for the reason that any other course would involve delay in the work, and would in some way deprive the engineer of the direct supervision of the manufacture of this new article, the cement briquette, which in its form of mortar is to be the binding material of his work. Consequently there seems to be but one answer to the question of how cement shall be tested, and that is, there shall be distinct differences made between the specification for cement to be tested in the ordinary laboratory on public work and cement to be tested in the scientific laboratory of the skilled expert. The main object of the engineer who is using the material on the work is to know that the cement he is receiving is of the quality for which he contracted. It would seem proper that at the beginning of any large piece of work the services of the trained expert of the well-equipped laboratory should be called in to determine whether the cement offered is of a fixed standard, and at the same time a sample of the same cement should be tested in the laboratory of the engineer on the work to determine what results it gives under the conditions of that particular laboratory with that particular tester. When these two facts have been determined subsequent tests of the cement should be made on the work by the assistant of the engineer in the laboratory on the work and the manufacturer should be held to deliver at all times a cement similar to the first sample submitted for test. It should further be provided that in the event of a difference arising at any time between the manufacturer and the engineer as to the quality or methods of test in the laboratory on the work then the services of the skilled expert should be called in to determine if the cement is equal to that first tested by him. In other words, the engineer who is responsible for the work should, practically under his own roof and with his own employees, control the testing of the material which is to enter into the work for which he is responsible, but at all times there should be left an appeal to a scientific laboratory which should act as judge between the manufacturer and the engineer."

THE STRENGTH OF TIMBER TRUSSES.

On another page of this issue will be found a statement of the value of such tests of full-size timber trusses as those made by Major G. K. Scott-Moncrieff, R. E., and recently described in the "Journal" of the Royal Institute of British Architects. His paper is too long to reproduce in full, but the following abstract covers its most important features:

The ordinary timber truss for the support of roofs of moderate span—say up to 40 feet—is not, theoretically, an economical structure. If, however, requirements of practice necessitated modification of theory, there would be every reason why the present method of design should be continued. The object of the experiments here described was to ascertain whether trusses, as constructed according to the dimensions generally accepted in English practice, had any advantage, from a practical point of view, over others designed more strictly in accordance with theory and more economical of material. The dimensions usually accepted are those laid down by Tredgold, who wrote his great work on carpentry in the early part of this century. In 1844 this book was officially adopted as the text-book to be used by the engineer department of the British army, and it has been accepted ever since as the standard authority on the subject. The chapter on roofs in that book, after stating the objects of a roof, begins by observing "that in practice roofs are generally made too heavy, and that he will do a most acceptable service to his profession who will show how to retrench and execute the same roof with the smallest quantity of timber; he will by this take an unnecessary load off the walls, and a large and useless expense from the owner." Tredgold's tables are based upon the supposition that (1) the trusses are 10 feet apart, (2) the roof covering is slate, (3) the pitch about 27 degrees, (4) the timber yellow fir. He states that the scantlings are the smallest that ought to be used for good Riga or Memel timber.

Before being perfectly certain, however, that trusses based upon theoretical principles could be more economically made than those designed by Tredgold, it was necessary to subject specimen trusses of both kinds to tests. It was further necessary to have these tests carried out on full-size trusses, as models might give unfair results. In order to secure the best results in the theoretical truss, it was necessary so to design it that, at the various joints, the axes of the various members should intersect on the central fibers of other members, and thus insure concentric stress. To this end the design of the joints was reconsidered. Figure 1 shows ordinary joint and Figure 2 the modified form of the joint at heel of principal. In this case the stress on the strap is a minimum, owing to its horizontal position. The bolt passes through a chock of wood between the halves of the tiebeam, and this chock is housed for a short depth in these halves at either side to prevent slipping. Figure 3 shows the arrangement at the foot of the king-post.

The first experiments were carried out on trusses resting on two brick pillars about 2 feet square and 6 feet high. In the brickwork near the ground was built an ordinary I-rolled steel beam. On the truss, at points corresponding to the positions of the purlins, were suspended Duckham's patent weighing-machines, which had a block and tackle suspended from them, with a corresponding block hooked on to a screw coupling fastened to the I-beam. The tackle was hauled up as tight as it would go, and extra pressure was put on by screwing up the coupling. This method was unsatisfactory, because it was found that if any load or fastening slipped the man working the screw coupling was exposed to considerable danger, and also the Duckham weighing machines were not very sensitive. It became necessary to devise some other plan.

A scheme was at first worked out whereby the pressure would be produced by two sets of treble blocks worked by windlasses, and the amount of the pressures registered by helical springs; but there were practical difficulties which caused this plan to be superseded by another, which, although it had disadvantages, was practicable, and gave interesting results. By this scheme an ordinary 7-inch steam gauge was connected with a shallow cylinder in which worked a ram or piston 50 square inches in area. As the steam gauge registered the pressure per square inch, any readings indicated on the dial would be one-fiftieth of the actual pressure on the cylinder. Each of these cylinders was carefully tested by a system of levers. It was found to give very accurate results. The actual pressure brought to bear upon the cylinders was produced by hydraulic jacks, worked by men pulling a rope attached to the handle of the jack. During the tests no workmen came near the apparatus, so that if anything gave way nobody could be hurt. No accidents occurred.

The amount of pressure required is considerable. If we consider each truss to be spaced at 10 feet, in accordance with Tredgold's data, and the weight of the roof covering, including occasional loads, to be 40 pounds per square foot, we have 400 pounds per foot run of slant length, whatever the span may be. In a 28-foot span the slant length of the common rafters is about 32 feet (the rise being 7 feet), so that the load amounts to 12,800 pounds. Of this, half, approximately, will be borne by the purlins, and half will rest on the pole plates. None will be borne vertically at the ridge, as usually constructed. Each purlin, therefore, will have to bear 3,200 pounds; and as the roof must be designed with a reasonable margin of safety, it was clearly necessary that the testing apparatus on each purlin should be able to stand 12,000 or 13,000 pounds.

The truss, then, was laid on its side, as shown in Figure 4. A rolled steel beam was used for taking the pressures, and steel straps or sling bars 4 inches by ⅝ inch total, or 3 inches by ⅝ inch net section, connected the ends of the truss with the steel beam. The hydraulic jacks and rams were introduced at the positions of the purlins. It will be observed that the sling bars have slots cut in them, so as to be available for different sizes of trusses. A packing piece of steel was introduced at the place where the wall plate would ordinarily come, but there was no substitute for the pole plate. This fact placed the tested truss at a slight disadvantage, in respect of rigidity, with the ordinary truss in a building, because, as tested, its rigidity was that of a supported beam, whereas really the effect of the pole plate and its superincumbent load is to fix the ends, or at all events to make them nearly fixed, and, of course, greatly to reduce the deflection.

The first test on this system was carried out on a king-post truss made after the usual pattern, but with principal rafter and tiebeam of the same scantling. This truss was 29 feet span, the principals and tiebeam being both 5x4 inches, and struts 4x4 inches, the heel straps 1¼x¼ inch, with plates 3x4 inches below, and 2¾x4 inches above. These heel straps were made at right angles to the principals. The end of the tiebeam projected for about 9 inches beyond the heel of the principal.

The object of this test was to ascertain whether the tiebeam of a truss, if of the same scantling as the principal, would be likely to fail, and if so, where. When the pressure reached 12,000 pounds on each side the end of the tiebeam sheared off, as shown in Figure 5. At the same time, on the other side, the plates, both above and below, crushed into the timber. There was no indication of any other failure in the truss. The pressure on the plates was very great, amounting to nearly 5,000 pounds to the square inch ($12{,}000 \times \text{cosec } 27° \times \cot 27° \div 2\frac{3}{4} \times 4 = 4{,}974$), which is more than the ordinary crushing resistance of fir, transversely to the grain. Apparently on one side the straps were doing all the work of resisting the thrust, and transmitting it to the tiebeam; while on the other side the strap was not so tight, and the joint in the timber had to take at least part of the stress, which amounted to about 24,000 pounds. The area to resist shearing was 4 inches by 9 inches = 36 square inches, hence the stress intensity was $24{,}000 \div 36 = 668$ pounds. The ultimate resistance of fir to shearing along the grain is 500 pounds per square inch; so that, if the straps were at all loose (as in practice they might easily be), failure in this particular way would be almost inevitable. The actual maximum weight which the truss would have to bear in a roof would be about 6,600 pounds over each purlin, so it may be said to have been tested to about twice its maximum load. All that could be said to have been proved by this test was that it showed in such a truss the scantlings of the various members were quite sufficiently proportioned, but the joint was weak. Tredgold's joint, with a large bolt, would have held, no doubt.

The next test tried was the same truss (span 29 feet), except that, instead of the solid tiebeam, planks 5x1½ inches were substituted, with a horizontal strap, 1-inch bolts, and end blocks. The latter were not of the semi-circular shape shown in Figure 2, but of the angular shape shown in Figure 6, with wedges of hard wood tightening up the whole. This was very speedily proved to be a failure. At about 7,500 pounds on each side the pressure bent the straps and split the wedges. This showed the necessity of some modification of the form of block, and the semi-circular form then introduced has since been used with most satisfactory results.

The third trial was a truss of 28 feet span, with 6x3½-inch principals, 4x2¾-inch struts, 11½x6-inch tiebeam, 6x4-inch king-post—in fact, exactly as given in Tredgold's tables. This truss showed signs of weakness at 6,000 pounds on each purlin. At this pressure the struts buckled and crushed the fibers at the foot of the king-post. When the pressure reached 7,500 pounds on each side one of the principals, which had bent into a sinuous curve, split at a tight knot, and no further resistance was afforded.

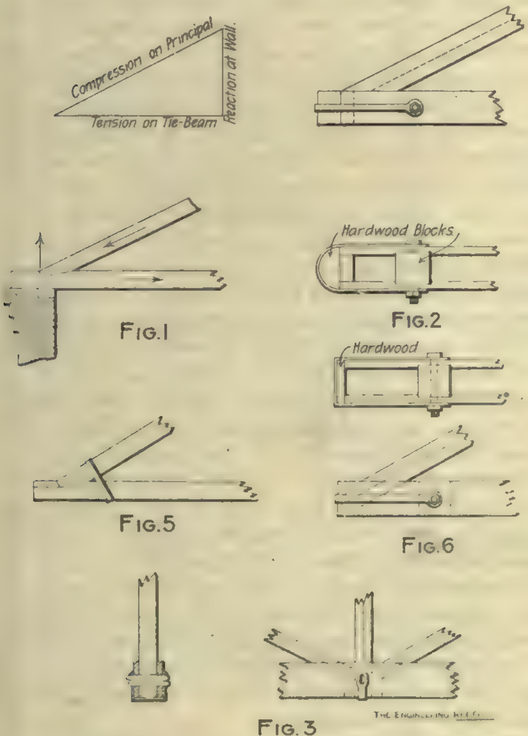
This truss showed great stiffness as a whole, on account of the heavy tiebeam, but the fact of the failure having occurred so early in the operation prevented the observation of the deflection at the same pressure as some others which have been experimented on. The fact of its having failed at a tight knot is worth noting, for it shows that the old idea that tight knots are not injurious is quite a fallacy. This has been confirmed by several similar observations.

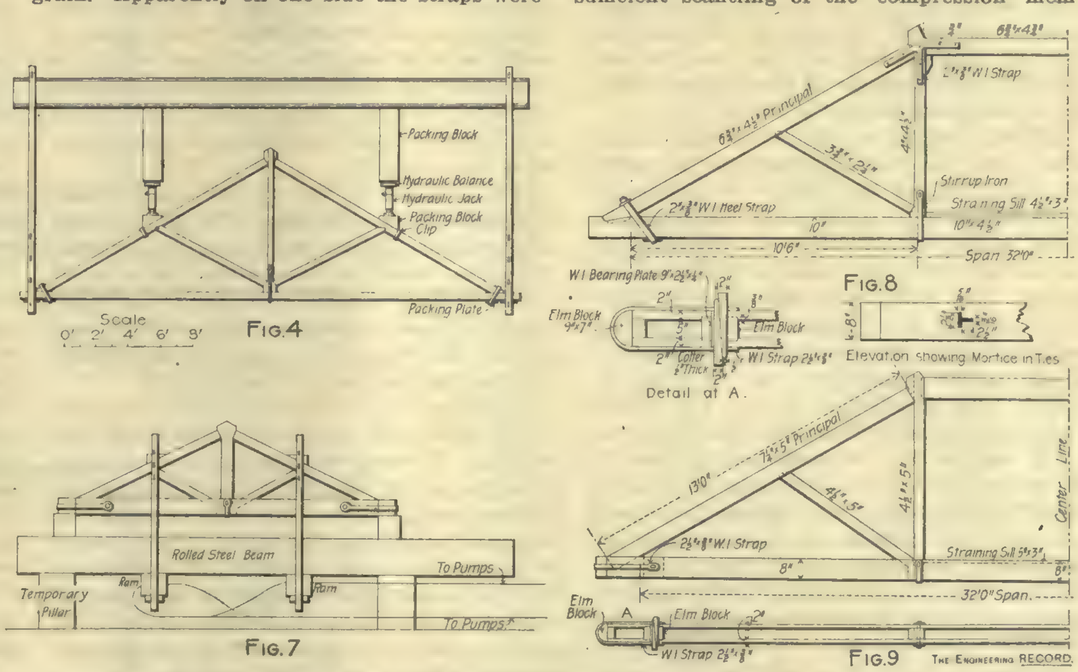
This test was also important in showing that the weakness of the truss lay in the insufficient scantling of the compression members, and in their unscientific proportions—viz.: 6x3½ inches and 4½x2¾ inches. These struts buckled in the direction of their least dimension.

The fourth truss was of 28 feet span, principal rafters 5x6 inches, struts 5x4 inches, tiebeam double, each plank 8x2 inches, king-post 5x2 inches. This truss was for the same span as the former one, but the dimensions were calculated according to theoretical principles. The strap at the foot of the principal was horizontal, 2 inches broad, with 2-inch bolt. A bolt 1⅞ inches was hardly strong enough.

This truss, when loaded with 9,000 pounds on each side, showed some signs of weakness, the principal beginning to buckle, but it did not actually fail until, at pressures between 11,000 and 12,000 pounds, the hydraulic jacks began to leak so much that no further pressure could be attained. At this pressure the total deflection of the truss was considerable—viz.: 1.75 inch; but it recovered its original form as soon as the loads were removed.

Comparing this truss with the one previously tested, we see that there was a considerable saving in cost as well as increase of strength. It would be, perhaps, unfair to base any general deduction from the comparison; but it may be said that, so far as we have gone, theory had





DIAGRAMS OF TIMBER TESTS BY MAJOR SCOTT-MONCRIEFF.

given better results than practice. Truss No. 3 had failed under a load equivalent to 75 pounds per square foot of roof, while truss No. 4 had borne without failure a weight corresponding to a uniform load of 137 to 140 pounds per square foot.

At this stage of the experiments it was thought advisable to make some alterations in the methods employed. The fact of the hydraulic jacks leaking at high pressures was very unsatisfactory, and it was considered also very disadvantageous to have the truss lying on its side, a position which might suffice for purposes of comparison, but which would not give such true results as to the actual bearing power of the truss as would be the case if the truss were in a vertical position.

Special hydraulic rams were cast, and connected by means of ordinary lead gas piping with pumps in an adjacent building, in which were also fixed on each system of pipes the 7-inch gauges, as before. It was therefore possible to work the pumps at some distance from the truss, watching the effect from a window. The trusses were placed vertical, as they would be in a building. The rolled steel beam against which the rams worked was raised on props a few feet above ground, the truss was supported on blocks which rested on the steel beam, and the steel straps, as before, passed over the truss and under the hydraulic rams. The difference between this method and the former one was that in this the steel straps pulled at the truss, whereas in the other the hydraulic jacks pushed at the truss, in both cases exercising pressure at those places where the purlins would ordinarily come.

The first truss to be experimented on in this manner was the last experimented on, which had then withstood any attempt to destroy it. At 10,800 pounds the truss began perceptibly to buckle, and at 17,850 pounds the principal on one side gave way by combined crushing and bending. The whole truss had distorted laterally to a very great extent, which would no doubt have been considerably diminished if it had been stiffened, as in the case of a roof in actual use, by lateral purlins, etc. The weight of the two hydraulic rams and sling bars was 1,288 pounds, so the total weight on the truss at the time of failure was 19,138 pounds, or about 9,500 on each purlin. This amounts to a direct thrust of 21,600 pounds on each principal, or 1,080 pounds per square inch. The truss was calculated to bear a safe load of 600 pounds per square inch. The failure was found to have taken place at small knots. The truss had been lying exposed to wintry weather for some months, and the timber had shrunk a little at the foot of the principals, and this had made the joint there somewhat loose.

The total weight at which this truss had failed —19,138 pounds— was, it will be observed, considerably less than the weight it had withstood on a previous trial, when it had borne upwards of 22,000 pounds without failure. The reason apparently was that the shrinkage of the joints had made local pressure more severely felt on some parts of the structure, with the accompanying disadvantages of eccentric loading. This pointed to the necessity of so designing the joint as to be able to tighten it up at will.

The next trusses experimented upon were 24 feet span. One of these was of Tredgold's dimensions: Principals 5x4 inches, struts 4x2½ inches, king-post 5x3½ inches, tiebeam 10½x5 inches.

Under a total pressure of about 15,600 pounds the principal rafter showed signs of splitting. At 20,000 pounds the lateral deflection as a whole was about 4 inches. At 22,000 pounds the truss absolutely failed by cracking along the principals, beginning at a knot just above the junction of the struts. The vertical deflection was 2½ inches. The weight per square foot at which this truss failed was about 84.

The next truss was also 24 feet span, but considerably lighter, the scantlings being as follows: Principals, 4x4 inches; struts, 4x3 inches; king-post, 4x3 inches; tiebeam double, 8x1½ inches. At 15,000 pounds there was no sign of weakness, but at 20,000 pounds the lower end of the principal pushed the heel strap into an inclined position. The weight per square foot of roof surface which the truss could bear is 75 pounds. The resistance per square inch of the principal rafter works out to 1,403 pounds, whereas in the last case the same resistance is 1,240 pounds. The difference is no doubt due to the eccentricity of loading in the older pattern. Failure was caused, however, by the same defect as noted previously in this pattern of truss—i. e., being unable to tighten up the joint at the junction of principal and tiebeam. This led to a modified design of this joint, shown in Figure 9, where a gib and cotter joint is given horizontally, bearing against a vertical plate which supplies the necessary bearing area to resist the pull.

The next test was with a queen-post truss 32 feet span, of the type proposed by Tredgold, with scantlings as follows: Principals, 6¾x4¼ inches; struts, 3¾x2¼ inches; tiebeam, 10x4½ inches; queen-posts, 4x4½ inches; straining beam, 6¾x4¾ inches; straining sill, 4½x3 inches. See Figure 8.

The great difficulty in this test, and in that of a truss of similar span designed with a double tiebeam, was to prevent lateral deflection, or buckling of the truss as a whole. Endeavor was made to keep the structure as stiff as possible by means of stays formed of blocks and tackle, on both sides; but even this was not thoroughly efficacious, and the trusses were not, in either case, tested to actual destruction, although they were both crippled.

At a pressure on the whole truss of 24,780 pounds the fibers at the ends of the struts began to be crushed, and the queen-posts showed signs of shearing along the grain at the places where the struts were tenoned into them. At 31,920 pounds the joint at the foot of the principal was crippled, the fibers of the timber being crushed, and the strap strained and bent.

The truss as a whole was now so distorted that it was hardly feasible to continue any further test. The truss was taken down and a new strap put in at the heel of the principal, inclined as much as possible to the horizontal. It was again tested, but the strain it had already been subjected to had evidently had an injurious effect on its elasticity, for after the pressure had reached 37,680 pounds it buckled laterally to such an extent that it slipped off its bearings, without, however, any actual fracture.

The ninth truss, shown in Figure 9, was for the same span as the eighth, but it had a double tiebeam, stouter principals and other compression members, and less ironwork. This truss was tested twice, and exhibited even more than the former one the tendency to twist laterally, owing, doubtless, to the absence of iron at the joints. There was no failure of any of the joints or of any of the members, and it is probable that if it could have been kept true in a lateral direction it would have exhibited very great strength. At about 30,000 pounds, however, the lateral twisting caused the temporary props on which the whole was resting to be overturned, and in the fall the truss was so damaged that it was not considered worth while to test it again.

The experiments are by no means conclusive, but they show, so far as they have gone, that it is possible to introduce considerable economy into the design of trusses made of timber, and that the subject of the best design has not yet been fully exhausted in trade practice.

HEATING AND LIGHTING OF THE UNIVERSITY BLOCK, SYRACUSE, N. Y.

An eleven-story building was erected in 1897 in the business center of Syracuse, N. Y., by Syracuse University. It is known as "The University Block," and while built chiefly for office purposes, is given up in part to the law school of the university. The block faces Vanderbilt Square, on a rectangular lot extending from Warren Street to Bank Alley, a distance of 132 feet, and runs back 107 feet along the two streets to a building on the rear. The exterior of the building is of renaissance architecture, in light granite and warm-gray terra-cotta and brick. It is of steel-frame construction, and fireproof throughout.

The main entrance, which is considered the architectural feature of the building, is in the center of its Vanderbilt Square front. It is 28 feet wide, and runs back 58 feet to the elevators. On each side marble stairways ascend to the first floor, and above a marble wainscot, 12 feet high, a marble and white terra-cotta arcade, rising to a height of three stories, supports a leaded-glass roof.

The ground floor of the building, which is on a level with the sidewalk, is divided up for stores, and nearly two-thirds of the basement is rentable for similar purposes. The first floor contains two banking rooms with a number of small offices, and rooms for the College of Law in the rear of the building, including a library room and lecture hall. The banking rooms and the lecture hall extend through two stories to the third floor, and over the smaller rooms of the first floor is a second or mezzanine story. The seven floors next above are devoted to offices, the typical plan being given in Figure 1. The subdivision into rooms is varied, of course, to meet the desires of tenants, and hence no partitions are shown. As will be seen, the building is naturally divisible into two distinct parts by the indentation of two courts, one in the front, rising from the glass roof to the main entrance, and one in the rear over the skylight in the central part of the lecture-hall ceiling. Each section of a floor has its own central corridor, connected at about the middle with the elevator hall, and the depth of room from corridor to the outside wall is such that there is no rentable floor area much over 20 feet from the windows. The entire top floor is occupied by The Citizens' Club, and the roof space is fitted up for a roof garden, one-half being reserved for the club renting the rooms on the top floor, while the other half is open to the public. The building is quite thoroughly equipped with the conveniences of modern office buildings. Among the features may be named the general distribution of wash basins with both hot and cold water-supply, and the cold water furnished during the summer months from a refrigerating machine in the basement.

The building is heated and lighted from its own plant, occupying about one-third of the basement. Heating is done by steam, in the greater part of the building by direct radiation, but for a portion of the lower part by an indirect hot-blast apparatus; the lighting is electrical throughout. The parts of the building warmed with a supply of fresh air are the basement and the lecture hall, but provision has been made in the size of the heating coils and the capacity of the blower, to deliver at some time in the future into the stores on the ground floor, and into the banking rooms on the floor above, sufficient heated air to provide for half of the required heat. The fresh air is brought into the building at the rear court, immediately over the glass roof of the lecture hall, entering at each side into a room set apart as an air inlet. An iron-wire screen of 1-inch mesh is placed over the inlet opening, and two fire doors opening inwards are hung on either side. In addition to this, a hood of galvanized iron is fixed to the inlet to prevent rain and snow from beating in. Within the room a fine brass-wire screen with meshes of about ⅛ of an inch, is stretched diagonally across the room from wall to wall on a framework of angle and channel iron. The screen is provided with a door, and as the air-room opens from the third-floor corridor, this arrangement permits of readily carry-

ing away the debris which has not been arrested by the coarser screen at the inlet.

Each of the rooms opens at the side into a brick shaft, dropping to the basement. One of the shafts carries air through a brick duct in the basement to heating coils and blower for the rentable rooms; the other leads directly to a chamber at its base, from which the air is exhausted into a fan direct driven from an electric motor, and is discharged into the various rooms of the building plant. The two shafts are located alongside of the cylinder shafts of the elevator machinery, as may be seen in Figure 2, a part plan of the basement. The air through the first mentioned shaft is first filtered through a large bag of cotton cloth, tapering to a point from the full area of the shaft at the third floor to the level of the basement ceiling. The bag is suspended by rings from numerous hooks spaced about the wall of the shaft, and may be easily removed for cleaning, for which purpose a reserve bag is kept on hand. From this shaft the air is led by the brick duct mentioned, and shown in the figure, through a tempering coil, built in three sections with a total heating surfaced of about 400 square feet, and provided

trolled by thermostats operated by compressed air.

The fresh air for the basement rooms, as will be seen, passes through registers in the sides of the ducts; that for the lecture hall above rises through two flues shown on the plan. Each of the flues connects with a duct in a suspended ceiling of the second story, and the air is led to grill-work registers over the two lecture-hall entrances. The doorways open from the corridor and face each other at the inner wall of the room. The velocity of air is calculated as 800 feet per minute in the main ducts, as 500 feet per minute in the connections to registers, but it is not permitted to be greater than 400 feet per minute through the register openings.

The supply to the building plant, as has already been mentioned, is drawn through a separate shaft to a chamber in the basement, and passes into a fan. The fan discharges into a system of circular ducts suspended from the ceiling, which turn downward at the outlets, directing the fresh but unheated air toward the floor.

Air is carried from the building partly through pipe shafts used also as vent shafts, part-

into one of the elevator-cylinder shafts. Above the roof the vent shafts are all covered with ventilating covers.

Within the building provision has been made for an internal circulation. A return-air passage is built in the basement, as shown in the figure, and forms a means of exit for the cooler air from the main entrance corridor. The air from this quarter is drawn down into the basement, and is led to the fresh-air duct already mentioned, passing through heating coils and blower, and back into the rooms. The return passage is used during the night and extremely cold days.

The building plant comprises four main rooms. In one are located the boilers, in another are the pumps, and accessory machinery, the third is devoted to the engine and dynamo plant, and the fourth is the blower room. The rooms are 11 feet high, with the exception of the boiler room, which sets 4 feet lower, and are floored with brick in the boiler room, slate in the engine and dynamo room, and with iron in the two others. In the pump room some floor space, which would otherwise be needed, is saved by placing a number of the tanks below the iron floor in excavations made to receive them.

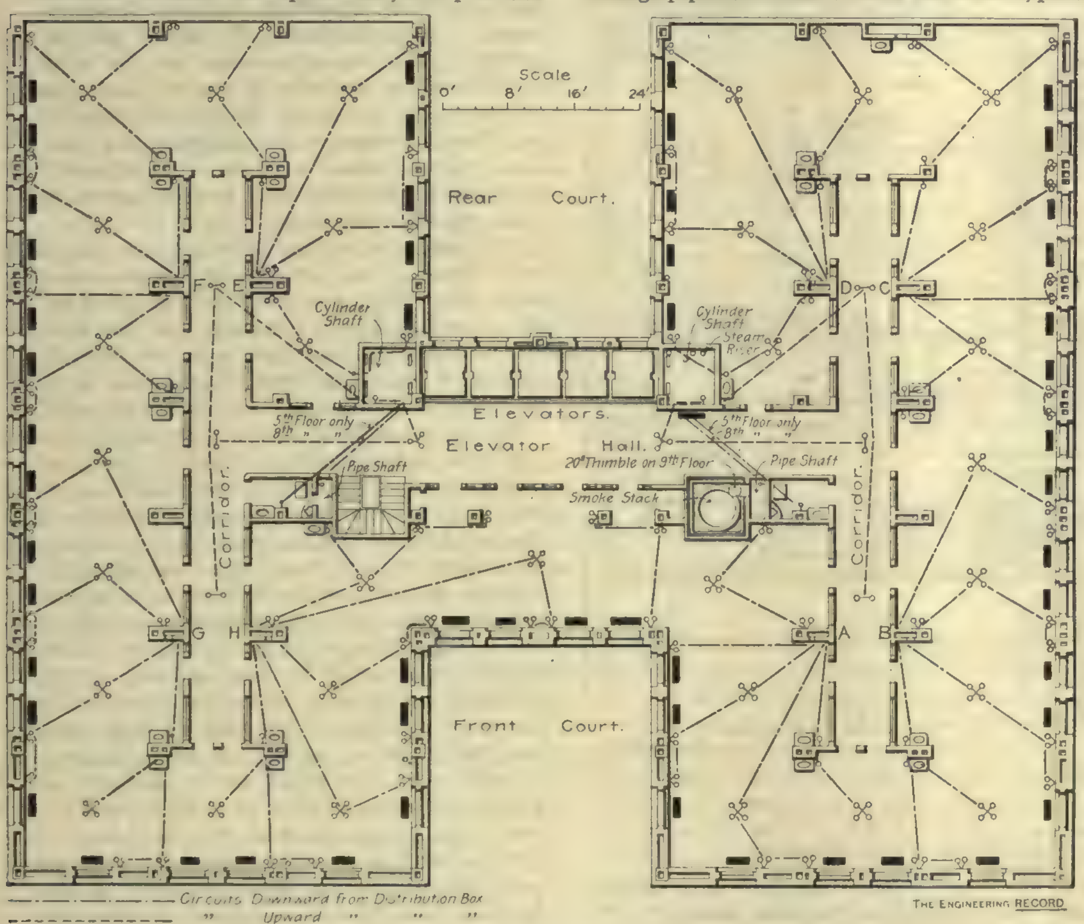


FIGURE 1.—TYPICAL FLOOR PLAN.

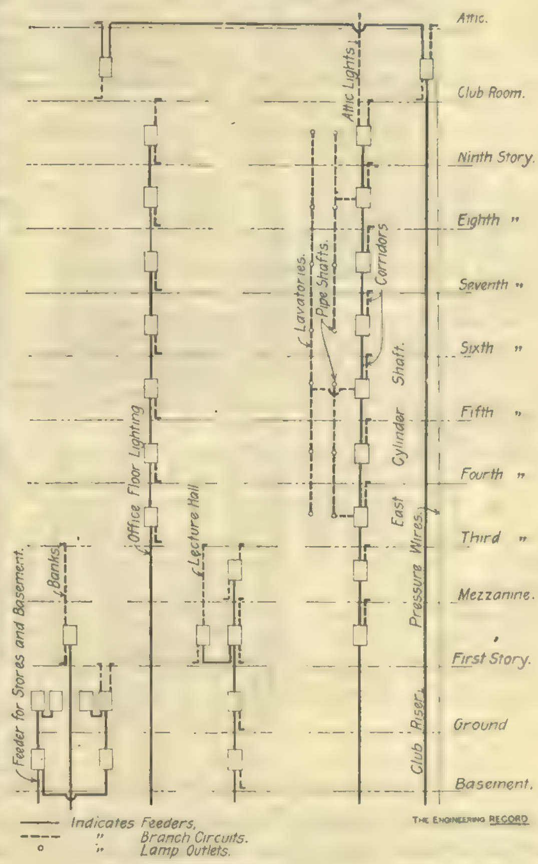


FIGURE 3.—RISER DIAGRAM.

with a by-pass underneath. It is then taken by the blower, which is of the Sturtevant steel housed type, 110 inches high, and is discharged through the main heating coils into a system of ceiling ducts. The blower is direct driven at a speed of 200 revolutions per minute by a Sturtevant automatic cut-off engine, and is designed to deliver at this speed about 12,000 cubic feet of air per minute. This is considered sufficient to change the air in the basement rooms once every fifteen minutes, and in stores and banking rooms, every half hour. The lecture hall is supplied with 4,000 cubic feet of air per minute, and having a seating capacity of 200 people, is thus given a per capita supply per minute of 20 cubic feet. The heating coils are grouped in six sections, with a total of about 1,850 square feet of heating surface, and are also provided with a by-pass. The ducts leading from the stack have a connection with the by-pass, and a swinging damper is placed at the junction of the connections from the heating coils and from the by-pass to regulate the temperature of the air by the proportions of hot and cold air mixed. The dampers are con-

ly through the cylinder shafts belonging to the elevating apparatus, and in other special ways. Vent registers are placed in the interior wall of the basement rooms, in pairs at floor and ceiling. Ducts carry the air from these to the cylinder shafts and to the space surrounding the smoke stack from the boiler, a short elbow in the latter case directing the vitiated air upwards. The lecture hall is provided with four vent registers, opening directly into two flues in the rear wall, backing against the adjoining building. Two of the registers are in the wainscot, and the other directly above them, just below the ceiling cornice. The rest of the air carried from the building passes through the slop-sink and toilet rooms into adjacent pipe-shafts rising through the building. The location of the slop-sink rooms, and contiguous shafts is shown in Figure 1. One of the shafts discharges into the space surrounding the smoke stack at the ninth-story ceiling. The club rooms on the tenth floor are also equipped with vent registers. These open into separate flues, connecting with a system of ducts in the attic, by which the air is brought

Three Babcock & Wilcox water-tube boilers generate all the steam used in the building, supplying a header suspended from the ceiling in front of them. A steam main from one end carries steam for the pumps, and the electric light engines, passing through the pump room on its way to the engine room. From the other end of the header a steam line is carried to the heating coils and blower engine, the branches to the coils being fitted with pressure-reducing valves. The exhaust from the pumps and engines is sent through a feed-water heater, provided with a by-pass and protected with a grease extractor, which is so connected that the exhaust steam must first pass through it. Beyond the heater the exhaust steam may pass either through the heating system or through an exhaust pipe weighted with a back-pressure valve. The distribution of steam for heating is on the one-pipe downward system. All the low-pressure steam thus rises through the building in a single pipe, 10 inches in diameter, and at the attic may pass into a system of nearly horizontal branches, which connect with dropping lines of pipe in the outside walls for the supply

of the direct radiators. The riser is in one of the elevator-cylinder shafts, as indicated in Figure 1, and is supported by a blank pipe of the same size resting on a stone foundation below the basement floor.

The feeding lines in the outside walls drop to the basement, where they connect with a system of returns. They are anchored at about the fifth story and expansion is allowed for by the long horizontal connections in both attic and basement. Radiator connections are made with the dropping pipes at every floor, and the steam, as it condenses, drains back into them and reaches the returns by gravity. Each radiator is also provided with an automatic air-valve, which is connected by a system of air pipes to the vacuum-producing ejector of the Paul system of vacuum heating. All the condensation from the heating system is brought into a governor tank in the pump room, from which it is delivered to the boilers by a boiler-feed pump. Exhaust-steam pipes leading from the engines are dripped to a blow-off tank, with an overflow pipe discharging the grease-laden

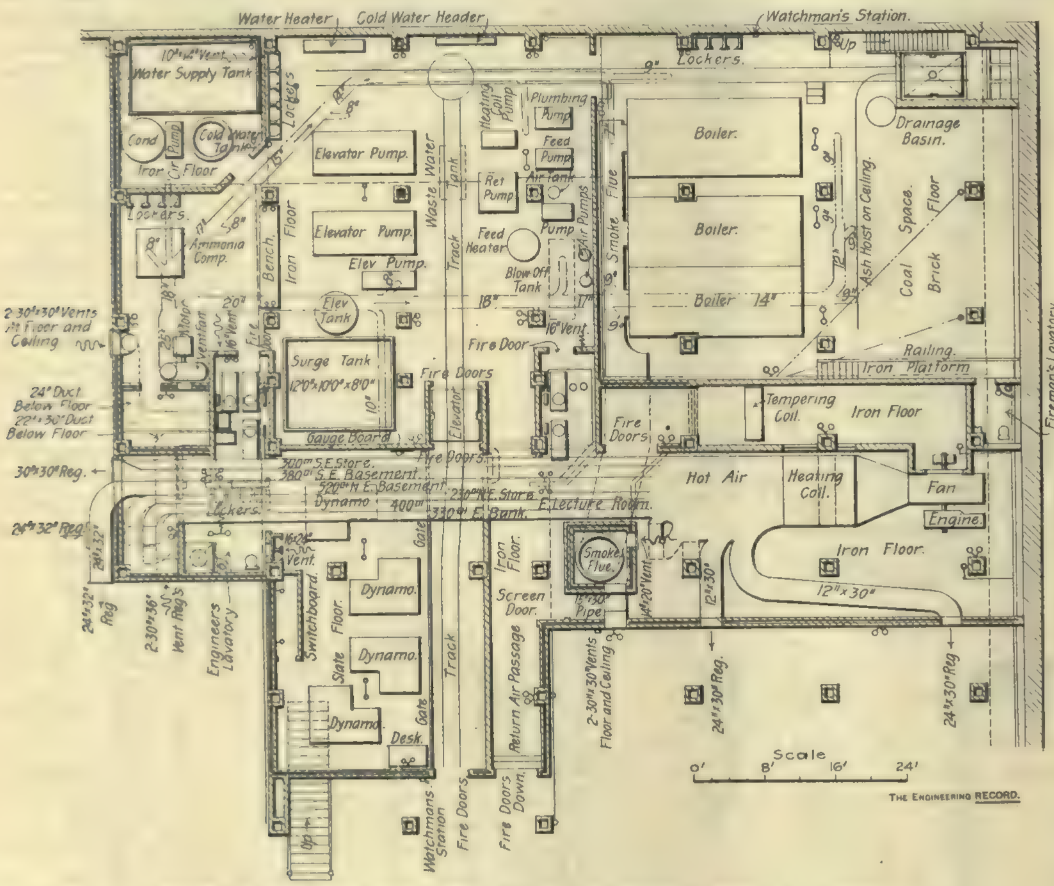


FIGURE 2.—PLAN OF MECHANICAL PLANT, UNIVERSITY BLOCK, SYRACUSE.

water into the sewer. Water from the high-pressure lines is trapped into a waste-water tank, having connections with the governor tank. Besides these, a coil return pump is used to take care of the condensation in the heating coils.

The main heating coils may receive the exhaust from the blower engine, in addition to a supply of low-pressure steam from the main plant; they may at any time also take live steam through a pressure-reducing valve. The arrangement permits of sending the exhaust of the blower engine to the exhaust riser. All the exposed piping in the building, where it is intended that as little condensation as possible shall take place, is covered with John's asbestos fire-felt.

The building is wired for lighting on the two-wire system, for 118-volt 16 candle-power lamps. Four 50-kilowatt General Electric generators, direct connected to 11 x 14-inch automatic cut-off engines built by the Straight-line Engine Company, of Syracuse, N. Y., are located in the engine room, as shown in Figure 2. The engines accept steam at 100 pounds pressure, and run at a speed of 280 revolutions per minute. Feeders from the generators are carried under the basement to the switchboard in iron conduits, and each of the machines is provided with an equalizing conductor similarly protected and brought to the switchboard for mutually connecting together when two or more generators are required to furnish power. The switchboard is of black enameled slate with a compact arrangement of instruments upon its face. There are four generator switches with corresponding circuit breakers, ammeters and field-regulating rheostats. There are two bus bars on the rear of the board connected to the dynamos through the separate switches and circuit breakers. The various feeders to the different light centers are taken from the bus bars through switches on the face of the board, named according to the part of the building which they supply. There are on the switchboard besides the instruments already enumerated, a large voltmeter for indicating the pressure of the bus bars, a second voltmeter for indicating separately the pressure of any generator terminal, the voltage at a distant part of the building, or the difference of potential between either bus bar and the ground, and the usual potential indicator with switches and pilot lamps for tracing grounds. The switchboard stands about 3 feet from the wall and the enclosure behind it, through which the various feeders leave the board, may be entered at either end by a door of flat brass twisted wire. All the feeders are rubber-covered copper wire, and are encased throughout their length, except for the greater part of the rising lines, in iron conduits, made by the Interior Conduit & Insulation Company, and having an insulation lining and a covering of asphaltum on the outside.

In general, it may be said that each floor of the building is lighted in sections, each such section on every floor being supplied from a single pair of rising feeders, connected with the bus bars as explained. There are eight centers of distribution for the office lighting, four in each side of the building, two in each end of the two divisions, one for the rooms each side of the corridor at these points; letters A to H in Figure 1 show the location of these risers. The feeders pass under the basement floor from the switchboard to a point immediately below their respective centers, and rise within brick shafts close to the brickwork surrounding the steel columns. The iron-armored conduits do not extend more than a few feet above the first floor. On every office floor, this is, from the third to the ninth, inclusive, the feeders pass through distribution boxes set flush with the corridor hall about 4 feet 6 inches above the floor. Branch circuits with fuse connections are tapped from the feeders bars in these boxes and pass in conduits to their respective outlets. The boxes are of cast-iron, encased in the brick-work, and have slate backs, upon which the electrical connections are made. There are in general no switches in the boxes, and the brass covers are fastened with screws, as it is not expected that there will be many occasions for opening them. A diagram of the rising mains and the location of distribution boxes is shown in Figure 3. The branch conductors for the office lighting are carried down from the box and over the floor beams underneath the floor, connecting with outlets in the ceilings of rooms below, and extending to the walls of the offices where they rise to side outlets, about 6 feet above the floor. It will thus be seen that the lamps in the side outlets are lighted on circuits made with the same distribution box as circuits including lamps in the ceiling of rooms below. This method is not fraught with any inconvenience in management, as the lights are controlled in the separate rooms; on the other hand, it will be seen that it results in a saving in the length of branch circuits, obviously of considerable amount in the aggregate in a building of its size. The branch circuits for the ceiling lights of the ninth floor, however, are made from the ninth-floor box.

The club rooms on the tenth floor are lighted on a separate riser, the branch circuits being taken from two boxes, one fed from the other. From the main box on the tenth floor two wires are run down the shaft back to one of the voltmeters on the switchboard, to determine whenever desired, the pressure at this distant point.

The nature and purposes of the rooms below the third floor demand a greater number of special circuits. Each of the two banks on the first floor is wired on a separate circuit from the switchboard, and the lecture hall is lighted by a third feeder. Four other circuits supply sections of the basement and stores, with distribution boxes on both basement and ground floors. The diagram already referred to shows also the distribution for these systems. There is a doubling of boxes on each of the floors of the store lighting circuit, thus keeping down the size of the box as well as the multiplicity of connection, otherwise a result. Each box of a pair is on opposite sides of a column, and the two columns are adjacent.

Three other circuits are wired for the display lighting of the store windows on the ground floor. Feeder mains lead from the switchboard to outside columns, and rise to two distribution boxes, 2 feet above the basement floor, from which branches are taken to outlets in the store windows. The three circuits from the switchboard allow for about 50 lamps per window.

The corridors are lighted from two mains, carried up the cylinder shafts. On each floor a distributing box is located, from which connections to ceiling branches for corridor lights are made. A diagram of these circuits is also shown in Figure 3. These feeders also supply circuits in the pipe shafts and slop-sink rooms, as shown. The entrance hall is lighted from a separate main, and includes two electroliers of 25 lights each, supplied on three branch circuits each.

The building was erected from the plans of Messrs. Green & Wicks, architects, of Buffalo, N. Y., by Messrs. A. Friederich Sons, of Rochester, N. Y., the general contractors. The heating and lighting installations were made from the plans of the architects, by Mr. Edward Joy, of Syracuse, N. Y., and the New York Electric Equipment Company, of New York City, respectively.

TEST OF AN AMERICAN STOKER.

A copy of a report of a test made by Mr. George H. Barrus has been received from the American Stoker Company, Washington Life Building, New York City. The test was made to determine whether an increase of 10 per cent. in the evaporation per pound of coal was produced by the application of stokers, and comprised two evaporative trials on a plant of four Corliss vertical boilers, at the Tremont and Suffolk Mills, Lowell, Mass. The tests are interesting, in view of the creditable performance of the stokers and the care taken to determine the amount of steam used to drive the stokers and furnish an air blast necessary for their proper working.

The boilers are the standard Corliss fire-box type, covered with magnesia. Each has a shell 84 inches in diameter, 268 2¼-inch tubes 13 feet long, and a 78-inch fire-box 60 inches high. The boilers contained 132.7 square feet of grate surface, 5,848 square feet of water heating, and 2,095 square feet of steam heating surface. The grates in three of the hand-fired furnaces contained 5 16-inch air spaces, aggregating in area about 40 per cent. of the entire grate surface, and those in one of the hand-fired furnaces contained ½-inch openings, aggregating about 50 per cent. of the total grate surface. Air blast for the boilers was furnished by a No. 10 "Monogram" Sturtevant fan driven by a Sturtevant automatic engine. The steam used by the fan engine and by the four motors driving the mechanical stokers was measured by means of a calibrated orifice introduced in the main supply pipe. A gauge showed the pressure on either side of the orifice, so that the quantity of steam flowing through could be measured from the difference in pressures. It was found that 317.5 pounds of steam were used per hour to operate the stokers and supply the blast. This quantity was but 1.5 per cent. of the total evaporation of the boilers.

The tests were complete evaporative trials and their general features were conducted in the manner usually followed by Mr. Barrus. The water was weighed and supplied to the boilers through an independent pipe. During the test with hand firing the furnaces were fed by the regular mill hands under the direction of Mr. F. W. Tinker, chief engineer of the mills. The fires were from 12 to 15 inches thick during the test and were carefully watched. During the stoker tests the firing was done by the regular hands under the direction of a representative of the American Stoker Company. The fires were carried from 15 to 20 inches thick at the center, and from 10 inches to 12 inches thick on the sides over the dead plates. The maximum blast was 3.6 inches water pressure and the minimum 1.8 inches. Both tests were over 12 hours' duration and the firing was interrupted during the noon hour.

On the stoker tests a flue gas analysis was made by means of the Orsat apparatus and was found to consist as follows, the percentages being by volume: Carbonic acid, 11.65 per cent.; oxygen, 7.9 per cent.; carbonic oxide, 0.15 per cent.; nitrogen, by difference, 80.3 per cent.

From these quantities the supply of air per pound of carbon is found to be 20.3 pounds, and the quantity of dry gas, 21.3 pounds. Assuming that the percentage of carbon in the combustible was 89 per cent. and the hydrogen 4 per cent., the heat balance for the stoker tests shows that 80.5 per cent. of the heat was absorbed in useful evaporation, 11.3 per cent. lost by hot gas, 2.8 per cent. lost by the evaporation of moisture in the coal and the moisture formed by burning of hydrogen, 0.8 per cent. lost by unconsumed CO, while 4.6 per cent. was lost by radiation, carbon and smoke, hydrocarbons and unaccounted for.

The evaporation per pound of dry coal on the hand-firing test was 10.17 pounds of water from and at 212 degrees. Allowing for the steam used in driving the stoker and furnishing the blast, the evaporation per pound of dry coal on the stoker test was 11.79 pounds of water from and at 212 degrees. This quantity represents an increase of 15.9 per cent. over the evaporation on the test with hand firing, thus fulfilling the guarantee by a wide margin. The power developed by the boilers, Mr. Barrus states, was greater on both tests than the rating of the builders. The following are the principal data and results of the tests:

Kind of coal	New River	
Moisture in coal, per cent	3.5	0.7
Firing	Hand	Stoker
Duration, hrs.	10.	10.6
Ashes, etc., per cent	5.9	6.5
Coal per hour per sq. ft. of grate, lbs.	20.7	....
H.P., A. S. M. E., basis of 30 lbs.	811.2	749.4
Equiv. evap. per sq. ft. heating surf. per hr., lbs.	4.2	3.9
Average boiler press., lbs.	110.5	107.9
Average temp. of feed-water, deg.	66.3	44.4
Average temp. of gases in main flue, deg.	451.	409.
Average suction, ins.	0.42	0.2
Degrees superheat	47.	34.
B. T. U. per lb. dry coal	....	14,543
B. T. U. per lb. combustible	....	15,357
Evap. per lb. dry coal, uncorrected for superheat., lbs.	8.363	9.716
Equiv. evap. per lb. dry coal, corrected, lbs.	10.173	11.97
Equiv. evap. per lb. combustible, corrected, lbs.	10.822	12,797
Effic. based on combustible, per cent.	....	80.5
Equiv. evap. per lb. dry coal, stoker test, less steam chargeable to stoker, lbs.	....	11.790
Increased evap. per lb dry coal, per cent.	....	15.9

NOTES.

Daring Repairs Inside a Water Main were recently made at the water-works in Kansas City, Mo. The threads of a valve seat in a 30-inch main had become broken, and in order to make the repairs without removing the valve, it was necessary for some one to go into the pipe. To leave the main closed for a day meant to leave part of the city without protection from fire. A machinist, Charles Lunstedt, volunteered to do the work. He entered the main through a 24-inch pipe and put in a new seat in about three hours. It was a cold job, as the temperature of the water had been running about 36 to 38 degrees, but hot irons were placed inside the pipe to remove the chill as much as possible. Air was let into the pipe through a pit around the valve.

The Ventilation of Sewers has been investigated by Mr. J. T. Earnshaw, borough surveyor of Ashton-under-Lyne, England. He finds that in nineteen towns of an average population of 68,600, where the sewers are ventilated only by openings at the street level, the local engineers in fourteen instances consider the ventilation satisfactory, and in the remaining cases are doubtful as to the value of this system. In forty towns of an average population of 95,900, where street openings and shafts in the streets or against high buildings are used, the ventilation is satisfactory to the surveyors in eighteen instances, and unsatisfactory in the others. In nine towns, with an average population of 104,200, with street openings, special shafts against buildings, and connections to factory chimneys, the results are satisfactory in but six cases. In eight towns of an average population of 41,300, with the sewers ventilated by street openings, shafts against buildings and Holman gas destroyers, the results are satisfactory in five cases. In two towns of about 44,300 population each, with the ventilation depending on special shafts only, the surveyors of each place consider the results satisfactory.

The Recent New York Navy-Yard Fire, which resulted in the loss of perhaps a million dollars, led a correspondent of "The Engineering Record" to send the following note: "Some thirty years ago, when the foundations of the large machine shop, which was destroyed, had been completed and its erection was about to be continued, the then newly appointed Civil Engineer of the yard pointed out the great danger from fire which would attend the use of wooden floors, beams and girders in a building of that size and importance, divided by no fireproof walls, and where the floors would soon become saturated with oil. He recommended the substitution of iron beams and brick arches, a method of construction which had been adopted not long before in the construction of the Receiving Stores. He was sharply rebuked by the line officer then at the head of the Bureau of Yards and Docks for venturing to question the wisdom of plans that had been approved by the Department, and his sympathy with Uncle Sam for the loss of his machine shop is, in consequence, somewhat tempered by the way in which the wisdom of his disregarded warning has just been vindicated. It would have been much money in many ways in our Uncle's pocket if he had put a competent civil engineer at the head of that Bureau long before he did. He may congratulate himself that he has one there now, and thank the 'Record' for its most efficient help in securing a change."

A Broken-Stone Road with a concrete foundation is described by Mr. W. H. Maxwell in the "Surveyor." It is in the present Hornsey District, England, and runs through a deep cutting. The first road was made by laying large quantities of gravel and sand on the natural clay soil and covering them with a thick coat of broken flint and gravel. This experiment was unsuccessful, and the road went from bad to worse. Finally Sir John Macneill built four longitudinal drains along the subgrade, and connected them every 30 yards by main cross drains leading to the side ditches, and also by smaller drains every 10 yards. This elaborate drainage was necessary because of the large quantity of water flowing down the slopes of the cutting, which was in a clay soil. On this foundation a natural cement concrete was spread for a width of 18 feet and a depth of 6 inches. A few minutes after it was laid the upper surface was indented by means of a wooden timber, so as to have triangular cross furrows every 4 inches, to hold the broken stone and shed the water toward the side ditches. The broken stone laid on this concrete was about 6 inches thick. The road was built about 1830 and is still in use. The engineer in charge of it, Mr. E. J. Lovegrove, says: "Speaking of the road generally, it is a difficult one to keep in repair, having regard to the peculiar class of traffic and also to the fact that there is a considerable amount of movement in the road itself."

TRADE PUBLICATIONS.

The Stewart Heater Company, Buffalo, N. Y., is distributing a small calendar having unusually clear date sheets, one for each six days.

Joseph G. Pollard, 141 Raymond Street, Brooklyn, has issued a 24-page catalogue of contractors' tools and supplies. These include forges, drills, vises, plows, scrapers, sewer braces, pipe laying tools, special tools for paving, and similar supplies.

Electrically driven fans for ventilating and pressure work are described in Bulletin H, issued by the B. F. Sturtevant Company, Boston, Mass. Pressure fans are shown directly connected to motors of the open and enclosed types and ventilating blowers driven by polar and multipolar motors are also illustrated.

Mr. Charles L. Heisler, of Erie, Pa., the designer of the Heisler locomotives for mountain service on curves of very short radius and heavy grades, has prepared a circular describing a steam roller which he has lately designed. In many respects it departs from the familiar types, and the description of its peculiarities in the pamphlet in question will interest all who have occasion to use machinery of this class.

The Hilles & Jones Company, Wilmington, Del., in its Catalogue P describes and illus-

trates a large line of punches, shears, riveters, plate-planing machines and bending rolls, driven by belt or direct-connected steam or electric motors. The pamphlet is not a general catalogue, but while it illustrates merely a few representative machines, it will be useful to all who are interested in methods of working plates, bars and structural shapes.

The Climax Road Machine Company, Marathon, N. Y., is distributing an attractively printed catalogue of its well-known line of double and single lever rock crushers, elevators, screens, distributing wagons, road rollers and reversible road machines. The pamphlet contains a number of interesting views of crushing plants which will be of value to engineers who have occasion to put up machinery of this sort, while the information it gives concerning the construction of company's products should be kept in the working library of all builders of good roads.

The Bucyrus Company, South Milwaukee, Wis., has had printed an attractive book describing the steam shovels, sewer excavating machines, dipper, elevator and hydraulic dredges, centrifugal pumps, locomotive and wrecking cranes, and placer mining machines, which it manufactures. The standard sizes of its steam shovels range from a 12-ton apparatus with a half-yard dipper to one weighing 75 tons and provided with a dipper of 3½ cubic yards capacity. The buckets of its dipper dredges are even larger, one for the dredge of Breymann Brothers having a capacity of 8 yards. These shovels and dredges, as well as the other products of the company, are illustrated in the book, which contains a large amount of valuable information for all interested in the subject.

PERSONAL AND OBITUARY NOTES.

Mr. C. M. Oliver has been appointed superintendent of the Wheeling, W. Va., water-works.

Mr. Henry Souther has opened a chemical and physical laboratory for public and private tests at 438 Asylum Street, Hartford, Conn.

Mr. Albert J. Cox of the Iowa Engineering Company, Clinton, Ia., sailed for Cuba February 18 to investigate a number of engineering enterprises.

Messrs. Leonard M. Cox, Ernest P. Goodrich and Alfred C. Lewerenz have been nominated by President McKinley as civil engineers in the Navy Department.

Mr. Albert H. Porter, M. Am. Soc. C. E., whose brilliant work in connection with the development of the Niagara power plant attracted much attention a few years ago, has been appointed assistant superintendent of the New York State Canals, Western Division.

Captain George Russell Talcott, U. S. engineer on the James River improvements at Richmond, Va., died suddenly of heart disease on February 18. He was a son of the distinguished engineer, Captain Andrew Talcott, and was himself connected with either railway or government engineering works during a period of nearly forty years.

Mr. John A. McMurtrie, who died at Denver on February 16, was born in Mauch Chunk, Pa., in January, 1848. He began surveying work in 1864, and in 1869 was appointed transitman on the Lehigh & Susquehanna road. Afterward he was a division engineer on the St. Joseph & Denver City and the Kansas Pacific lines, and finally joined the engineering staff of the Denver & Rio Grande Railroad, of which he was chief engineer from 1878 to 1884. During this time about 1,500 miles of road were built under extremely difficult conditions, and the experience gained on this work, coupled with his natural gifts, enabled him to carry out the extensive contracts on which he was subsequently engaged.

CONTRACTING NEWS

OF SPECIAL INTEREST TO
CONTRACTORS, BUILDERS, ENGINEERS, AND MANUFACTURERS
OF ENGINEERING AND BUILDING SUPPLIES.

For Proposals see pages 296, xi and xii.

WATER.

Canby, Minn.—At a special election held Feb. 17, it was voted to issue $12,000 bonds for the new water system.

Waterbury, Conn.—City Engineer Cairns has been instructed to contract with the Warren Foundry and Machine Co., of New York City, for pipe needed during the present year, at $19.70 per gross ton.

Red Lake Falls, Minn.—Press reports state that the Council is considering the construction of a system of water works. Cost $12,000.

Clayton, N. Y.—Press reports state that the contract for water and sewerage systems has been given to A. F. Nims, of Philadelphia. Total amount of contract, $46,000.

Willis Point, Tex.—Local press reports state that a franchise has been granted to Chicago parties for a system of water works and electric lights.

Utica, N. Y.—The Common Council, on Feb. 17, approved the bill, to be sent to the Legislature, providing for a system of municipal water works.

Sheffield, Mass.—W. H. Dresser, Supt. of the Sheffield Water Co., writes that in the spring it is proposed to lay about three miles of pipe to the village of Ashley Falls.

Clinton, Ind.—Mayor C. M. White writes that a petition is being circulated among the citizens, calling for an election to vote on the purchase of water works.

Springfield, Tenn.—See Power Plants, Gas and Electricity.

Columbia, S. C.—A bill has passed the Legislature authorizing the Catawba River Co., when organized, to construct a dam across Catawba River at or near Indian Hook Shoals.

Evanston, Ill.—The City Council has appropriated $1,000 for preliminaries in regard to the construction of a new intake for the water works.

Gaffney, S. C.—L. Baker, ex-city clk., writes that bids will probably be asked about May 1, or as soon as water is secured from artesian well now drilling, for the construction of a system of water works, to cost $18,000. Frederic Minshall, Engr. in Charge, Orangeburg, S. C.

Woburn, Mass.—Wm. W. Wade, Water Registrar, writes that nothing definite has as yet been done in regard to the purchase of a pumping engine. The City Council has petitioned the Legislature for authority to issue $25,000 bonds for construction purposes.

Portland, Ore.—Press reports state that the Council has under consideration two plans for the extension of the water system.

Waverly, Ia.—It is stated C. P. Miller & Co., of Chicago, secured the contract for an artesian well 12-in. in diameter at the top and 6-in. at the bottom, and 1,600 feet deep, at $1.90 per ft.

Mexico, Mex.—Press reports state $500,000 bonds have been offered for sale, bonds to be used for the purpose of enlarging the system of water works and sewerage of the city of Guadalajara. Mason, Lewis & Co., of Boston, may be addressed for particulars.

Porter, Minn.—It is stated that the proposition will be voted upon to issue $12,000 water works bonds.

Waterloo, Wis.—Press reports state that additional pumping machinery is to be purchased.

Wykoff, Minn.—According to press reports a mass meeting was recently held in favor of water works construction.

St. Ansgar, Ia.—It is stated that the Council has under consideration the matter of bonding for a system of water works.

Mobile, Ala.—The Senate has passed the bill authorizing Mobile to issue bonds for water works and sewers.

Ute, Ia.—At a special election recently held it was voted to build water works.

Williamsport, Md.—At the municipal election, held March 6, a vote will be taken on the proposition to levy an additional tax for water works and lighting.

Golden, Colo.—At a special election, to be held Feb. 28, a vote will be taken on the question of securing a gravity system of water works, the supply to be taken from Beaver Brook, and the creation of a bonded indebtedness of not to exceed $45,000 to pay for same.

Mountain Lake, Minn.—The Council will, according to press reports, be petitioned to submit the question of water works construction to vote at the March election.

Melrose, Mass.—James W. Riley, Supt. of Water Works, writes that it is proposed to lay a quantity of cast-iron pipe.

San Francisco, Cal.—The Sunset District Improvement Club has petitioned the Board of Supervisors to order the completion of the main intercepting sewer, at an approximate cost of $250,000.

Salem, Mass.—The Committee on Water Works has reported to the Council that 40 miles of cement pipe must be replaced with iron pipe, at a cost of $800,000.

Morton, Minn.—The Council will probably submit the matter of constructing water works to the voters at the spring election.

Denton, Tex.—According to local press reports, an additional 13,000 feet of water mains and 16 hydrants will be put in by the local water company.

Visalia, Cal.—The Westinghouse Electric Co., Pittsburg, is stated to have received a contract from the Mt. Whitney Power Co., of Visalia, for the construction of three 600 h. p. alternating current generators, two direct circuit generators, four 500 h. p. step-up transformers, five step-down transformers and eighteen electric motors from ½ h. p. to 30 h. p. The machinery will be used for the equipment of a system of irrigation which is in course of construction on the Pacific slope. Amount of contract about $300,000.

Sausalito, Cal.—The municipal ownership of the water works is being considered by the Town Trustees.

Redlands, Cal.—The stockholders of the Redlands Water Co. have voted to appropriate $40,000 for the use of the directors in developing the sources of the water supply.

Wellington, Kan.—The proposition to issue $100,000 bonds for the purchase or construction of water works will be submitted to a vote of the people.

Cleveland, O.—Bids are wanted March 16 for furnishing 4 water cylinders and otherwise repairing and rebuilding Worthington pumping engine No. 4 at Division St. pumping station. Geo. R. Warden, Dir. Pub. Wks.

Chicago, Ill.—Bids are wanted March 1 for laying water service pipes. L. E. McGann, Pres. Bd. Local Improvements.

Hornellsville, N. Y.—It is proposed to have an amendment to the charter passed by the Legislature to allow the city to purchase or construct water works.

Florence, Colo.—Hiram Phillips, C. E., St. Louis, Mo., writes that Florence will soon be in the market for about 500 water meters.

Victor, Colo.—Congress has passed a bill which grants the city certain lands for reservoirs.

Rochester, N. Y.—Chief Engineer Kuichling estimates that $50,000 will be required to pay for the water main extensions which have been petitioned.

Flushing, N. Y.—President of the Borough, Bowley, is having prepared a new ordinance for the extension of water mains.

Albany, Ind.—It is stated that the Town Council is receiving plans and specifications for water works and electric light plants.

Kansas City, Mo.—The Board of Public Works has been asked by Superintendent Longwell and Engineer Kiersted of the water department to indorse the proposition to build a second 30-in. main at a cost of $70,000 to supply the Turkey Creek reservoir from Kaw Point.

Rochelle, Ga.—It is proposed to hold an election in the near future to vote on the issue of bonds to the amount of $6,000 for boring an artesian well and building a school.

Sibley, Ia.—H. Newell, City Clk., writes that on March 27 a vote will be taken on the proposition to construct water works.

Blooming Prairie, Minn.—H. O. Anderson, Village Recorder, writes that at the coming election a vote will be taken on the proposition to bond for the construction of water works.

St. Louis, Mo.—Bids are wanted March 21 for furnishing detailed designs, plans, etc., and for constructing 3 vertical triple expansion crank and flywheel condensing pumping engines at high service pumping station No. 1, Bissell's Point. Emory S. Foster, Secy. Bd. Pub. Improvements.

Windsor, N. Y.—Bids are wanted March 6 for $20,000 bonds. M. A. Tompkins, Village Clk. It is stated that plans for the water works are being prepared by J. F. Wilmer, C. E., of Buffalo.

Elkhart Lake, Wis.—The following bids for the construction of water works and an elevated tank were opened Feb. 20 by G. A. Kraemer, Village Clk.: Sanitary Construction Co., Green Bay, Wis., *$5,000; Jackson & Moss, Des Moines, Ia., steel elevated tank only, $1,725.
*Contract awarded.

Cuyahoga Falls, O.—C. A. Weidner, City Clk., states that the vote taken Feb. 18 on the proposition to issue $60,000 bonds for water works failed to carry. Another election will probably be called.

Lakeport, Cal.—It is stated that bids are wanted April 11 for water-works. Bids are wanted April 10 for $15,400 bonds. H. V. Keeling, Town Clk.

Cleveland, O.—Superintendent Kingsley of the Water Works Dept. has prepared plans for increasing and improving the pipe line system in connection with the fireboats. Estimated cost, about $20,000.

Lansingburgh, N. Y.—The water-works bill, empowering the Commissioners to acquire additional land and riparian rights looking toward an extension of the water-works system, has been signed by the Governor.

Berlin, Ont.—It is stated that bids are wanted March 1 for sinking pipe wells. W. M. Davis, Supt. Water Wks.

Wappingers Falls, N. Y.—The proposition to issue $50,000 bonds for water-works construction will be voted upon at the election to be held March 14.

Tuskegee, Ala.—The following bids were opened Feb. 15 for the construction of a system of water works, as advertised in "The Engineering Record," Alber & Byrne, Engineers, Birmingham: Moore & McCreary, Atlanta, Ga., $17,284; Maxwell & Co., Birmingham, Ala. (without air lift), $16,738; P. H. Porter, Louisville, Ky., $18,534; Guild & Co., Chattanooga, Tenn., $19,475; J. B. Neely, Chattanooga, Tenn., $19,990. The contract was awarded to Moore & McCreary at the following figures: 334.5 tons 8-in., 6-in. and 4-in. cast iron pipes at $23 per ton; 5 tons of specials at $50; 35 hydrants at $20.75 each; 3 8-in. gate valves at $13.60; 2 gate valves at $9.50; 10 gate valves at $5.50; 15 valve boxes at $2.25; laying 3,840 ft. of 8-in. pipe, at 8¼ cts.; laying 3,550 ft. of 6-in. pipe at 7 9/10 cts.; laying 17,750 ft. of 4-in. pipe, 6 9/10 cts.; 2 Duplex pumps, 12, 7, 12-in., $1,070; 1 Duplex pump, 4½, 3, 4-in., $60; 1 vertical heater, $85; foundations and setting the above, 75; air lift, including foundations, $1,000; 2 tubular boilers, 54-in. x 14 ft., $1,124; 1 standpipe, 12x 100 ft., including foundation, $2,355; 1 pumping basin, 35 x 12 ft., $425; power house, 64 x 25 ft., corrugated steel, $450; sinking well, 8-in. casing, $4 per ft.

The letting of the electric light plant was deferred for thirty days, the bids received to be retained, and the contract to be awarded on the same.

Galveston, Tex.—Mayor S. H. Brashear, in his annual message, recommends that steps be taken at once to establish a municipal water-works system.

Stayner, Ont.—It is stated that bids are wanted March 1 for water-works. John Galt, Engr., Canada Life Bldg., Toronto, Ont.

SEWERAGE AND SEWAGE DISPOSAL.

Pittsburg, Pa.—Bids are wanted March 1 for sewer pipe, cement, castings, stone, block, crushed and irregular, electrical supplies, etc., for one year. Edw. M. Bigelow, Dir. Dept. Pub. Wks.

Virginia City, Nev.—Bids are wanted March 6 for keeping in repair all streets, sewers, culverts and crossing in Virginia City and Gold Hill and roads and culverts in Storey County. W. G. Douglass, Co. Clk.

Clayton, N. Y.—See "Water."

San Diego, Cal.—Press reports state that City Engineer Capps has prepared plans and specifications for sewerage system for portion of city south of N St. and west of 32d. Estimated cost, $108,229.

Mexico, Mex.—See "Water."

Sullivan, Ill.—The city will, according to reports, vote April 18, on the question of issuing $20,000 bonds for sewers and for building a stand pipe and a city hall.

Clarksburg, W. Va.—We are informed that C. O. Finley is the engineer in charge of constructing a $30,000 sewer system.

Mt. Vernon, N. Y.—A bill has been introduced in the Legislature for the appointment of three commissioners, who are to construct an outlet sewer, cost not to exceed $200,000. The sewer will be built through the town of Pelham to Long Island Sound.

Philadelphia, Pa.—The Board of Surveyors has approved plans for main sewers in Cottman St. and in Ripka, Pechin and Hermitage Sts.

Denver, Colo.—Local press reports state that J. J. Fleetford, the lowest bidder, having failed to furnish the required bond, the Board of Public Works has voted to award the contract for the Capital Hill storm sewer to the J. M. O'Rourke Construction Co., of Denver. See our issue of Jan. 28 for list of bids received.

Wilkesbarre, Pa.—A resolution has passed the City Council, authorizing the Sewer Committee to advertise for bids for sewers in several streets.

Seattle, Wash.—Local press reports state that the contract for the construction of sewers in several streets has been awarded to F. McLelland for $9,935. Other bids were as follows: Stirrat & Goetz, $10,174.50; T. Ryan, $11,015.60; Smart & Co., $11,537; J. W. Fitts, $11,749.40.

Conneaut O.—The Village Council has passed a resolution declaring it necessary to construct a sewer in Sewer District No. 3. J. L. Risley, Village Clk.

Valdosta, Ga.—It is stated that the Board of Aldermen has under consideration the construction of a sewerage system. Probable cost, $20,000.

Pawtucket, R. I.—A bill is before the State Legislature authorizing the city to borrow $150,000 for sewer purposes.

Grass Valley, Cal.—W. D. Harris, City Clk., writes that $40,000 sewerage bonds have been sold to Dennison, Prior & Co., of Cleveland, O.

Martinsville, Ind.—C. G. H. Goss, City Engr., writes that the City Council has ordered plans and specifications prepared for a system of sanitary sewers.

Columbus, O.—The following bids for constructing a Concrete Masonry Dam were opened Feb. 16 by Julian Griggs, Ch. Engr Dept. Pub. Imp.

Bidders.	Residence.	Dry Earth Excavation 5,000 C. Y.	Wet Earth Excavation. 3,500 C. Y.	Rock Excavation. 1,200 C. Y.	Concrete Masonry, City furnish Cement. 19,000 C. Y.	Total.
Hoffman & Innis	Columbus, O.	.30	1.00	.80	2.00	43,960
Willard & Cornwell	Louisville, Ky.	.24	1 25	1.25	1 95	44,125
Ryland & Kanmacher	Columbus, O.	.30	1.00	1 00	2 00	44,200
F. M. Hoover	Columbus, O.	.30	1.00	1.00	2 16	47,240
Sullivan & Graham	Columbus, O.	.35	1 25	1.50	2.25	52,575
S. O. Casparis	Columbus, O.	.35	1.50	1.50	2 32	52,800
W. H. Luchtenberg	Columbus, O.	30	1 30	1 50	2.40	53,450
George B. Swift	Chicago, Ill	.25	2 00	1.00	2 55	57,900
Alexander Tubman	Cleveland, O.	.35	1.00	1 25	3.00	63,750
Walter Bradley & Co	Oswego, N. Y.	.25	50	.80	3.17	64,190

Cement, 19,000 Bbls.	Brand of Portland Cement.	Cooperage, per Bbl.	Cloth. per Bbl.	Paper, per Bbl.
Empire Portland Cement Co., Chicago	"Empire."	2.58	2.53	2.43
Rock Plaster Mfg. Co., Columbus	"Tiger"	2.15	1 94	1.99
E. E Stitt, Columbus	"Diamond."	2 05	1 85	1.94
Acme Paving Co., Columbus	"Atlas."	2 25	2.10	1 98
Garden City Sand Co., Chicago	"Star."	2 19	2.39	2.04
J. P. Carlile, Columbus	"Medusa."	2.10	1 89	1.94
Alexander Tubman, Cleveland	"Castalia."	2.30	2 25	2.18
Kelly Island L. & T. Co, Cleveland	"Lehigh"	2.15	1.95	2 00

Auburn, Cal.—It is stated that the City Clerk will receive bids March 1 for a sewer on Park St.

Hoboken, N. J.—The Twelfth Ward Public Improvement Association is working for the construction of a main sewer to empty into the Hackensack River.

Fort Wayne, Ind.—City Engineer Randall has completed the work of preparing a map of South Wayne so that specifications can be made and the proportionate assessments estimated for the proposed So. Wayne sewer.

Flushing, N. Y.—Plans for new sewers on High St., College Point, and Prospect Ave., Flushing, are being considered by the Queens Borough Sewer Commrs.

Syracuse, N. Y.—It is stated that an 18-in. pipe sewer is to be built in Hayden St.

Ellwood City, Pa.—J. N. Humphrey writes that it was voted Feb. 21 to issue $8,000 bonds for sewer purposes.

Ponca, Neb.—Bids are wanted March 14 for constructing a drainage ditch; the work includes 36,470 cu. yds. of excavation. J. P. Eker, Co. Clk.

Honolulu, H. I.—Bids are wanted April 15 for materials for sewer construction, as advertised in "The Engineering Record."

Kansas City, Mo.—Bids are wanted Feb. 28 for a sewer in sewer district No. 44. Henry A. Wise, City Engr.

Baltimore, Md.—Bids are wanted March 1 for 600 ft. of 24-in. and 850 ft. of 30-in. sewer pipe. William W. Varney, City Commr.

Meriden, Conn.—It is stated that bids are wanted March 2 for 17,000 ft. of pipe and storm water sewers. W. S. Clark, City Engr.

Cleveland, O.—Bids are wanted March 4 and 17 for sewers. Geo. R. Warden, Dir. Pub. Wks.

Cleveland, O.—Bids are wanted March 15 for sewers in Higgins, Lenox and Purdy Sts. and Storer Ave. Geo. R. Warden, Dir. Pub. Wks.

Wilmington, Del.—The Finance Committee of the City Council has reported in favor of approving a bill providing for a loan not exceeding $125,000 in the next two years, for the benefit of the Street and Sewer Department.

Cleveland, O.—Sewer bonds to the amount of $60,000 have been sold to W. J. Hayes & Son.

Scranton, Pa.—Joseph P. Phillips, City Engr., writes that the following bids were received for constructing a sewer in Philo St. The work includes about 3,700 lin. ft. of from 30-in. to 66-in. brick sewer and about 1,500 lin. ft. of 8-in., 12-in., 15-in., and 24-in. pipe; the building of one outlet, 18 basins, 28 manholes and 150 house connections, about 2,480 lin. ft.; average depth about 12 ft.: Donohoe & O'Boyle, $21,700; A. H. Coon & Son, $22,900.

Toledo, O.—The following bids for Sewer work were opened Feb. 20 by W. O. Holst, City Clk.

	12" Sewer Pipe, 37-6" on 12" Y's.	10" Sewer Pipe, 10-6" on 10" Y's Cts.	Manholes, Plan No. 4.	Manholes, Plan No. 5.	Drop Manholes, Plan No. 18, with Connections	Manholes, Plan No. 1.
Wm. J. McMahon	$1.00	95	$18	$20	$15	....
H. J. Bower	1 00	95	15	20	22	$28
Thos. Kelley	1 15	85	15	15	15	15
M. F. O'Sullivan & H. T. Sheehan	.93	90	22	21	33	22
G H. Bodette	.96	73	25	25	60	25

Bidders all of Toledo.

BRIDGES.

Boston, Mass.—Bids are wanted March 3 for 2 retractile draws for the Summer St. bridge across Fort Point Channel. William Jackson, City Engr.

Holyoke, Mass.—Engineer James L. Tighe condemns the Main St. bridge, and estimates the cost of replacing it with a new structure at $12,000.

Leroy, N. Y.—We are informed that the Buffalo, Rochester & Pittsburg R. R. Co. will probably advertise at once for bids for a bridge to be built at Haskins' Crossing.

Hornellsville, N. Y.—Mayor F. P. Rathbun writes that an election will be held March 7 to vote on the issue of $3,600 bonds for the removal of old bridge and the building of a new bridge.

Yankton, S. D.—A bill has passed the Senate authorizing the Dakota Southern Railway Co. to construct a bridge across the Missouri River.

Stockton, Cal.—The construction of a steel drawbridge across San Joaquin River, at Brandt's Ferry, has been petitioned.

Morgantown, W. Va.—A bill has passed the House authorizing the construction of a bridge across the Monongahela River.

Boston, Mass.—The Board of Estimate and Apportionment has authorized the appropriation of $50,000 for rebuilding the draw and reconstructing the Malden bridge.

Ft. Scott, Kan.—The construction of a bridge across Mill Creek, to cost $3,500, is stated to be under consideration.

Cary, Ill.—The Joliet Bridge & Iron Co., Joliet, is stated to have received the contract for a bridge across Fox River, for $6,775.

Kansas City, Mo.—The Upper House passed an ordinance approving plans for the construction of a bridge by the Kansas City Belt Ry. Co. over its tracks, at Kansas Ave.

Des Moines, Ia.—The City Council has passed the ordinances for two bridges, one at West Sixth Ave. and one at South East Sixth St.

Philadelphia, Pa.—The Wissahickon Bridge Co. has been granted a charter to construct a bridge over the Schuylkill River, between the counties of Montgomery and Philadelphia. Capital, $10,000. Incorporators, James Christie, Charles Major, Charles C. Price and others.

Waterport, N. Y.—It is stated that a vote will be taken to authorize the appropriation of $14,000 to build a bridge across Oak Orchard Creek.

Batavia, N. Y.—A bill was passed in the Assembly appropriating $2,500 for constructing a highway and bridge on the Tonawanda Indian Reservation, in Genesee County.

Pittsburg, Pa.—The Select Council passed an ordinance granting to the Monongahela Connecting Ry. the right to build a bridge near Sylvan Ave.

Brooklyn, N. Y.—A bill passed the Assembly appropriating $12,000 for the construction of a bridge over the mill pond in the 31st and 32d Wards.

Windsor, Ont.—Press reports state that W. G. Reid, Montreal, who is building the Midland Railway, of Nova Scotia, has awarded a contract to the Dominion Bridge Co., of Lachine, for the steel superstructure of all bridges on the line between Windsor and Truro, including a structure over the Shubenacadie River, consisting of 20 spans. The contract for the stonework of this bridge will be given out early next month.

Lexington, Mo.—A bill has passed the Legislature authorizing the construction of a bridge across the Missouri River, and the city of Lexington offers a cash bonus not to exceed $50,000 to the company obtaining the contract for the construction of same. Frank Bowman, Secy. of the Committee.

Elkhart, Ind.—The Bellefontaine Bridge Co. Bellefontaine, O., is stated to have received the contract for the Sherman St. bridge, at $20,000.

Wetumpka, Ala.—D. D. Askew, City Clk., writes that a bill has passed the Legislature authorizing the Commissioners of Elmore Co. to issue $50,000 bonds for the purpose of building bridges.

Quincy, Ill.—The F. W. Menke, Stone & Lime Co., of Quincy, is stated to have secured the contract for a stone arch bridge for $4,587.

Rockford, Ill.—Edwin Main, City Engr., writes that the contract for a 44-ft. plate girder bridge over Keith Creek has been awarded to the Massillon Bridge Co., Massillon, O., for $1,200.

New Haven, Con.—It is stated that bids are wanted Feb. 28 by City Engineer Kelly for a steel bridge at Derby Ave. Appropriation, $20,000.

Macon, Ga.—Bids are wanted March 14 for a 2-span steel truss bridge over Ocmulgee River. S. B. Price, Mayor.

Montreal, Que.—Bids are wanted March 1 by the Midland Ry. Co., 30 St. John St., for the substructure of the Shubenacadie bridge.

Carrollton, Mo.—Bids are wanted March 11 for a wood and iron bridge. Chas. Finch, Commr. Co. Court.

Denver, Colo.—The Street Committee has under consideration the construction of a bridge over Monument Creek at a cost of $12,000.

Washington, D. C.—Local press reports state that bids will soon be asked for continuing the work of repairing the defective pier of the aqueduct bridge across the Potomac River.

St. Louis, Mo.—The construction of a bridge at Clark Ave. at a cost of $151,050 is stated to be under consideration.

Virginia City, Mont.—Separate bids are wanted March 7 for an iron or steel Platt truss bridge across the Jefferson River, consisting of 2 spans of 120 ft. each, with a roadway of 14 or 16 ft.; also for a 3-span Platt truss bridge of 95 ft. each. H. E. Steffens, Clk. Bd. Co. Commrs.

Washington, D. C.—A bill has passed the House authorizing the St. Louis, Siloam & Southern R.R. to construct a bridge across the White River.

Toronto, Ont.—City Engineer Rust recommends the construction of the new Don bridge.

Topeka, Kan.—The construction of a bridge on Leland St. has been petitioned.

Quincy, Ill.—Bids are wanted for the construction of a pontoon bridge 300 ft. long across the bay, as advertised in "The Engineering Record."

Suisun City, Cal.—It is stated that bids are wanted March 7 for a combination bridge on road No. 146. Address County Surveyor Steiger.

Bellefontaine, O.—Bids are wanted March 21 for the superstructure of Kiblinger bridge over the Miami River. C. D. Campbell, Aud.

Boston, Mass.—The following bids for two masonry abutments for bridge on Swett St. over the tracks of N. Y., N. H. & H. R.R., were opened Feb. 20 by William Jackson, City Engr.: Norcross Bros., $20,400; Bell & Co., $17,570; Cyrus Barton, $18,900; D. F. O'Connell, $18,800; Thomas A. Rowe, $20,263; Collins & Ham, $19,557; R. D. Shanahan, $18,500; Foley & Ryan, $20,500; W. H. Keyes & Co., $19,840; Miller & Ellis, $20,699; Ross & Fowler, $18,940; F. H. Connolly, $18,951; Holbrook, Cabot & Daly, *$16,985; Woodbury & Leighton, $20,950. Bidders all of Boston.
*Contract awarded.

New York, N. Y.—The following bids were opened Feb. 18 for constructing steel towers and end spans of the new East River bridge, as advertised in "The Engineering Record": Elmira Bridge Co., Elmira, N. Y., $1,374,000; New Jersey Steel & Iron Co., Trenton, N. J., *$1,220,230; Phoenix Bridge Co., Philadelphia, Pa., $1,315,000; Benj. Maurice & Co., Athens, Pa., $1,230,000; King Bridge Co., Cleveland, O., $1,461,000; Pennsylvania Steel Co., Steelton, Pa., $1,209,444. The total amount of material for the end span is 5,463,000 pounds, for the intermediate tower 666,300 pounds, and for the main tower 6,096,100 pounds. The total on one side of the river is 12,225,400 pounds. Of this amount 6,520,940 pounds are plates, 3,945,540 pounds are angles, 607,530 pounds are beams, channels, pins and bolts, and 688,140 pounds are castings. The rivet heads alone come to 463,250 pounds. The saddles on top of the main tower weigh 887,800 pounds.
*Contract awarded.

PAVING AND ROADMAKING.

Olympia, Wash.—The Senate has passed state road bills carrying an apropriation aggregating $120,000.

Brownstown, Ind.—Bids are wanted March 10 for graveling or macadamizing about 16 miles of county roads. John D. Durment, Co. Aud.

Peoria, Ill.—Bids are wanted Feb. 27 for about 21,650 sq. yds. brick pavement, 2,489 lin. ft. cement curbing, with about 9,249 cu. yds. of excavation and setting 10,348 lin. ft. stone curbing, as advertised in "The Engineering Record" of Feb. 18.

Brooklyn, N. Y.—Bids are wanted March 7 for macadam pavement on Avenue B, Ocean Ave. and 84th St. James P. Keating, Commr. of Highways, New York City.

Chicago, Ill.—Bids are wanted March 1 for macadam, asphalt and granite block pavement on several avenues and alleys. L. E. McGann, Pres. Bd. Local Improvements.

Scranton, Pa.—We are informed that the resolution to pave Sanderson Ave. with brick has passed the first reading in the Common Council.

La Crosse, Wis.—Frank Powell is the engineer in charge of brick paving, which, it is estimated, will cost $7,000.

Concord, N. C.—The Legislature has been petitioned to empower the County Commissioners to call an election to vote on the issue of $100,000 bonds for road improvements.

Wilkesbarre, Pa.—An ordinance has passed on first reading authorizing the issue of bonds to the amount of $30,000 for street improvements. If the ordinance becomes a law, it will be voted upon by the electors on May 9. Frank Deitrick, City Clk.

Baltimore, Md.—The Second Branch of the Council passed the ordinance appropriating $4,500 for paving on Washington St. with asphalt or brick.

Southampton (L. I.), N. Y.—It is stated that a movement is on foot to bond to the amount of $200,000 for the building a good road the length of the town.

Quincy, Mass.—The City Council on Feb. 20 passed the order authorizing the Mayor to petition the Legislature for permission to raise $150,000 outside of the debt limit for street improvements.

Pittsburg, Pa.—See "Sewerage and Sewage Disposal."

Georgetown, O.—Bids are wanted March 14 for improving roads in Jefferson Township, and until March 15 for improving roads in Lewis Township. H. L. Jennings, Co. Aud.

Brighton, N. Y.—Bids are wanted March 6 for improving the East Ave. Road in the towns of Brighton and Pittsford.

Hartford, Conn.—The Senate Committee on Good Roads recommends the appropriation of $250,000 annually for a number of years for road construction.

Spokane, Wash.—The City Commissioners propose to pave 9 streets this summer at an estimated cost of $246,000.

St. Paul, Minn.—The City Engineer has been directed to prepare revised plans and estimates for the construction of the proposed boulevard along the bluff in West St. Paul.

Detroit, Mich.—It is proposed to pave Gratiot Ave. with asphalt.

Indianapolis, Ind.—The Board of Works has adopted resolutions to pave several streets with asphalt and brick.

Ashtabula, O.—The question of paving Lake St. will be voted upon at the April election.

Kokomo, Ind.—It is stated that bids are wanted March 13 for 12,000 sq. yds. of brick pavement. Chas. R. Ford, City Clk.

Peekskill, N. Y.—The proposition to issue $100,000 bonds for street paving is to be voted upon at the election held March 7.

Montgomery, Ala.—An ordinance has been passed providing for the paving of several streets with brick.

Norwood, O.—Local press reports state that the following bids were received for improving Montgomery pike: Frank Foltz, $13,238.50; L. Drach, $13,338; A. J. Henkel & Bro., $13,567.50, and John Trapp, $13,628.50.

White Plains, N. Y.—A bill to bond the village for $150,000 to macadamize the streets has been prepared and approved by the Board of Trustees and will be submitted to the Legislature.

St. Louis, Mo.—A. N. Miller, Street Commr. writes that contracts have been awarded as follows for brick paving on a concrete base: To Gilsonite Roofing & Paving Co., for 13 alleys, amounting to $20,688; to Henry Ruekert, for 8 alleys, amounting to $8,455; to Skrainka Construction Co., for 3 alleys, amounting to $3,612; to H. Ruecking & Co., for 4 alleys, amounting to $5,213.

Grand Rapids, Mich.—The following bids for paving Ottawa St., for a total length of 1,767 ft., width of street 66 ft., width of roadway 46 ft., 5x18 in. Medina curb set on concrete, Metropolitan block, were opened Feb. 17 by the Board of Public Works, Geo. M. Ames, City Engr.: Jas. McDermott, 315 Bowery, *$16,600; Leonhard Schneider, 246 Cass Ave., $17,240; Pickett & Cowans, 40 Lake Ave., $17,500; Mathewson & Kloote, 44 James, $18,500; D. W. Boyes, 275 Stocking, $17,100.
*Contract awarded.

Sandusky, O.—According to local press reports, the following bids were opened Feb. 15 for paving Central Ave. and Jackson St. with sheet asphalt on 6-in. concrete: *a*, 2-in. wearing surface; *b*, 1½-in. wearing surface, 1-in. binder; Ayers' Asphalt Paving Co., Zanesville, O., *a*, $44,458.10; *b*, $45,277.13. Warren-Scharf Paving Co., New York City, *a*, $48,728.38; *b*, $50,093.33. F. E. Cole, Toledo, *a*, $54,091.33. Alcatraz Construction Co., Detroit, Mich., *a*, $71,231.18; *b*, $64,405.93. For paving the same streets with asphalt block on 4-in. concrete: A. G. O'Donnell, Sandusky, $55,075.60; Geo. J. Doerzbach, Sandusky, $56,062.08; C. F. Hartman, Sandusky, $55,976.09; M. J. Callan, Sandusky, $56,944.99. The Ayers Asphalt Paving Co. was the lowest bidder at $1.50 and $1.53 per sq. yd. for sheet asphalt, 31 cts. for new curb and 11 cts. for resetting.

Philadelphia, Pa.—The following bids for paving and repairing Broad St. with asphalt, were opened Feb. 17 by Thomas M. Thompson, Dir. Dept. Pub. Wks.:

	South of Subway.	North of Subway.	Bicycle Strips over P. & R. R. R Hump.	Repaving Tramway Streets with Asphalt on Concrete Base.	Repaving Tramway Streets with Asphalt on Bituminous Base.
Alcatraz Paving Co., Witherspoon Bldg..	$3.08	$3.18	$2.60	$3.50	$3.25
Penna. Asphalt Pav. Co., Fidelity Bldg..	3.25	3.23	1.98	3.35	3.30
Vulcanite Paving Co., 1710 Market St.....	3.15	3.05	2.15	3.30	3.15
Richardson & Ross, 30th & Race St.......	3.25	3.20	2.22	3.25	3.10

Bidders all of Philadelphia.

Scranton, Pa.—Joseph P. Phillips, City Engr., writes that the following bids were opened Feb. 16 for paving East Market St. with brick on a 6 in. concrete base, also for setting 6 in. x 15 in. curb on a 6 in. concrete base: Mears & Flynn, pavement, $1.78 per sq. yd.; straight curb, 63c. per lin. ft.; circular curb, 94c. per lin. ft.; M. H. Dale, pavement, $1.795; straight curb, 64c.; circular curb, 95c.

Philadelphia, Pa.—The Department of Public Works has been authorized to amend the contract awarded to Michael O'Rourke for repairs to cobble, rubble and granite block pavements on sand foundations at 17 cts. a sq. yd., so that he shall be required to keep all such in the city in repair for the lump sum of $234,500.

Decatur, Ind.—The following bids were opened Feb. 16 for the East Washington macadam road. W. E. Fulk, C. E., County Surveyor: *E. Woods & Co., $15,975; Calvin Miller, $15,998; Huffman & Liddy, $17,368.20; Modlin Bros., $16,787.58; Dunn & Goar, $16,748.

*Contract awarded.

POWER PLANTS, GAS AND ELECTRICITY.

Chanute, Kan.—City Clerk P. Hurt writes that it was voted on Feb. 14 to issue $5,000 bonds for a gas plant.

Sheffield, Ala.—A bill is stated to have been passed by Congress granting the Muscle Shoals Power Co. permission to construct a canal and electrical plant and develop the water power at Muscle Shoals.

Colorado Springs, Colo.—The Colorado Springs Light & Power Co. has been incorporated; capital, $300,000. Directors, W. P. Bonbright, Leonard E. Curtis, George Rex Buckman and others.

Suisun City, Cal.—E. J. Hamilton, of Healdsburg, is said to have completed arrangements to establish an electric light plant here.

Shreveport, La.—A charter is stated to have been granted to the Kitson Light & Heat Co. to furnish light and heat under the Kitson system in Caddo, Webster, Bossier and De Sota parishes; capital, $100,000. Incorporators, Isaac Barron, Henry Rose and others.

Springfield, Tenn.—H. E. Butcher, owner of the electric light plant, writes that the capacity of the plant will be doubled at once, also that a proposition is on foot for the erection of water works in connection with the lighting system.

Cambridge, O.—The Cambridge Electric Energy Co. has been incorporated to manufacture and sell steam and electric light, heat and power; capital, $25,000. Incorporators, Nathan H. Barber, John C. Buckett and others.

Glendive, Mont.—It is reported that Olmstead Bros. will establish an electric light plant here.

Middleport, N. Y.—The Middleport Power Co. has been incorporated to manufacture electric light, heat and power; capital, $15,000. Directors, Frank G. Lott, of Niagara Falls; Wm. J. Sterrett of Middleport; Byron C. Stanton, of Sanborn, and others.

Osakis, Minn.—B. H. McCray, of Brown's Valley, is said to have applied for a franchise for electric lighting.

St. Paris, O.—It is stated that bonds have been voted for an electric light plant.

Wilkinsburg, Pa.—The Wilkinsburg Electric Co. is stated to have received a franchise to lay pipes and maintain a system of hot-water heating.

Burke, Idaho.—The Canyon Creek Electric Light Co. has been incorporated; capital, about $1,000,000. Principal place of business to be at this place. Directors, Wm. R. Miller, John Franks, F. R. Culbertson and others.

Bridgeton, N. J.—The Light Committee is stated to have been authorized to secure bids for lighting the city for three or five years with light of 1,200 to 3,000 c. p.

Rutherford, N. J.—The East Jersey Electric Co. has been incorporated to manufacture and deal in electricity, light, heat and power of all kinds, including compressed air; capital, $1,000,000. Incorporators, Chas. F. Johnson, of New York; S. Hand Taylor, of Philadelphia, and Joseph P. Cooper, of Rutherford, N. J.

Minneapolis, Minn.—The Twin City Rapid Transit Co. will, it is reported, soon construct an electric power dam across the Mississippi River at Coon Creek, to develop about 10,000 h. p.

Savannah, Ga.—The plans for putting the wires of the Brush Electric Co. underground are stated to have been completed. It is said that the wires of both the Brush and the Edison Co. will be put underground at the same time.

Stevens' Point, Wis.—It is reported that the Jackson Milling Co. will erect a new dam across the Wisconsin River and develop electric power, to cost about $75,000. Geo. W. Paulus, Secy., Centralia.

Defiance, O.—The City Council has passed a resolution to submit to a vote at the spring election the question of bonding to the amount of $25,000 for a municipal electric light plant.

Visalia, Cal.—See "Water."

Hampton, Va.—Henry Brauns, Builders' Exchange Building, Baltimore, Md., is said to be preparing plans for a power-house to be erected here for the Newport News & Old Point Ry. Electric Co., to accommodate a plant of 2,000 h. p., for electric lighting, and a plant to manufacture 40 tons of ice daily. Wm. J. Payne, Pres., Richmond.

Willis Point, Tex.—See "Water."

Rockwell, N. C.—E. B. C. Hambley writes that bids will be asked in the spring for work in connection with the development of the water power of Yadin River; estimated cost, $2,500,000.

Ottawa, Kan.—The Electric Light Co. is stated to have received the contract for lighting the streets for 3 years at $7 per light per month for arc lights and $1 per light per month for incandescent lights.

West Newton, Pa.—J. C. Adair, Town Clk., writes that it was voted Feb. 21 to issue $16,413 bonds for enlarging the electric light plant.

Williamstown, Ky.—Bids are wanted March 7 for a 20-year franchise for an electric light plant. F. A. Charbonneau, Clk. Bd. of Trustees.

Savannah, Ga.—See "Government Work."

Providence, R. I.—Bids are wanted March 3 for electric wiring in the new State House. E. K. Glezen, Sec'y Bd. State House Commrs., 308 Industrial Trust Co. Bldg.

Pittsburg, Pa.—See "Sewerage and Sewage Disposal."

Florence, Ala.—There is said to be a movement on foot to develop the water power of Cypress Creek near this city. D. L. Foster, of Huntsville, will shortly make a survey near the proposed power plant.

Cambridge City, Ind.—See "Electric Railways."

Coshocton, O.—The Council is said to be considering the matter of granting a franchise for an incandescent electric light plant to J. M. Ickes, of Newark.

Logan, Utah.—C. Garff, Engr. in Charge, writes that bids are now being received for the construction of an electric light plant to cost $50,000.

Albany, Ind.—See "Water."

Quincy, Mich.—It is stated that bids will be received in March for an electric light plant; probable cost, $6,000.

Seymour, Ind.—The Fort Wayne Engineering & Construction Co. of Fort Wayne are stated to have submitted a proposition to the Council for an electric light plant.

Picton, Ont.—R. A. Norman, Town Clk., writes the Council is now corresponding with several Canadian electrical engineers with a view to having prepared plans and estimates for the proposed improvement of the electric light plant, which will probably require two 75 K. W. alternators, two 75 h.-p. boilers, two condensers and one 125 h.-p. engine.

Billerica, Mass.—Walter A. Drucker is stated to have received a franchise for an electric light plant. It is stated that an electric railway will also be constructed from this place to Arlington Heights.

Houston, Tex.—A site is stated to have been purchased for the proposed city electric light plant. It is said that notice will be given at once to the Electric Light Commission to prepare to build. S. H. Brashear, Mayor.

New Rochelle, N. Y.—It is stated that bids will be received March 6 by the Clerk of the Committee on Street Lighting for lighting the streets with gas or electricity for one year.

Lee's Summit, Mo.—A. C. Miller, City Clk., writes that the proposition to erect and maintain an electric light plant will be voted upon in April.

Tuskegee, Ala.—See "Water."

Boscobel, Wis.—The Erie City Iron Works, Erie, Pa., are stated to have secured the contract for the steam plant for the city electric light system at $3,700, and Keelyn & Smith, of Milwaukee, the contract for the line construction at $2,173.

Centralia, Ill.—Bids are wanted March 7 by the City Council for 53 or more electric arc lights for street lighting for a period of 5 years.

Elizabethtown, Ky.—Bids are wanted March 6 for a franchise to construct and operate an electric light plant for 20 years. R. L. Wintersmith, Mayor.

ELECTRIC RAILWAYS.

St. Catharines, Ont.—Addison B. Colvin, Pres. of the Glens Falls Trust Co., writes that the purchasers of the St. Catharines & Niagara Central R. R. are Jos. A. Powers, of Lansingburg, John W. Herbert, of Helmetta, N. J., and A. B. Colvin, of Glens Falls, N. Y. The road will be extended to Port Dalhousie, also to Niagara Falls, Canada. F. A. Cheney, at St. Catharines, may be addressed for further information.

East Bangor, Pa.—The Wind Gap, Pen Argyle & Bangor Electric Ry. Co. has been formed, and is stated to have secured a franchise to build an electric railway connecting the boroughs named and extending to East Bangor. N. D. Chase, of Easton; C. C. Richardson, of Worcester, Mass., and others are said to be interested.

Anderson, Ind.—The Madison County Commissioners are stated to have granted a right of way for a railroad from Muncie to Indianapolis.

Baltimore, Md.—The Baltimore & Northern Ry. Co. is stated to have received a franchise to extend its line.

Moline, Ill.—The Tri-City Ry. Co. is stated to have received a franchise. J. F. Lardner, Mgr.

Wilkinsburg, Pa.—The Council, on Feb. 16, passed an ordinance granting a franchise to the Edgewood & Swissvale St. Ry. Co.

Clayton, Mo.—J. T. Donovan, J. T. McDermott and others representing the Maplewood & Jefferson Barracks R. R. Co., have petitioned the County Commissioners for a franchise to build a double-track electric railroad between Maplewood and the Army Barracks.

Kutztown, Pa.—J. M. Kutz, of Mahanoy City; H. J. Schmick, of Hamburg; Dr. J. S. Trexler, of Kutztown, and others are stated to have organized the Kutztown & Fleetwood St. Ry. Co., and will apply for a charter for a trolley line.

Pittsburg, Pa.—The Monongahela & Connecting Ry. Co. is stated to have received a franchise.

Cleveland, O.—It is stated that the Cleveland & Chagrin Falls Electric R. R. Co. will extend its line from its present eastern terminus, Chagrin Falls, to Warren. The preliminary estimate on the cost of construction, including cars, is $300,000.

Oelwein, Ia.—T. Von Rolf is said to be interested in an electric line, which it is proposed to build from this city to Strawberry Point, Elkader, Monona and Waukon.

Eaton, O.—The Hamilton & Eaton Electric St. Ry. Co. is stated to have received a franchise through Preble County.

Kaukauna, Wis.—The Fox River Valley Electric R. R. Co. is stated to have petitioned the Council for a franchise.

East Taunton, Mass.—The East Taunton St. Ry. Co. is said to be considering the matter of extending its line through Lakeville and Middleboro.

Northbridge, Mass.—The Blackstone Valley St. Ry. Co. is stated to have applied for a franchise to extend its line to Whitinsville.

Beaumont, Tex.—The city has granted to E. L. Bacon, J. C. Ward, J. F. Keith and others the right to construct and operate an electric street railway for a term of 50 years. Probable cost of work, $32,000.

Pasadena, Cal.—J. G. Rossiter writes that the Los Angeles Terminal Railway Co. has recently been granted the privilege of operating a double track road. Probable cost, $350,000.

Cambridge, O.—The Cambridge & Byesville Electric Ry. Co. has been incorporated; capital, $20,000. Incorporators, Leopold Loeb, A. E. Townsend and others.

Jefferson, O.—Eugene Rawden, of Windsor, O.; W. H. Cook, Orwell, O., and others are said to be interested in the construction of an electric railway in Ashtabula County.

Jamestown, R. I.—N. S. Littlefield and J. P. Kohler are stated to have petitioned for a franchise on Narragansett Ave.

Elyria, O.—The Lorain County Ry. Co. has been incorporated to construct and operate an electric railroad and telegraph lines from Elyria to North Amherst; capital, $100,000. Incorporators, Parks Foster, W. B. Thompson, Daniel Freise and others.

Moscow, Russia.—The "Philadelphia Ledger" states that United States Consul Smith, of Moscow, writes that applications will be received not later than April 12 from contractors desiring to bid for the construction of electric roads in the city. The date of presenting final tenders will be Oct. 1, 1899. The sum of $375 must accompany each application.

Doylestown, Pa.—The Council on Feb. 20 passed an ordinance granting the Quakertown Traction Co. a franchise to construct and operate a trolley line through the borough.

Trenton, N. J.—The Lawrence Township Committee is stated to have granted the Trenton St. Ry. Co. a franchise to construct a trolley line from Trenton to Lawrenceville.

Mt. Pleasant, Pa.—A charter has been granted to the Mt. Pleasant, Scottdale & Connellsville Electric Ry. Co.; capital, $400,000. W. E. Tustin, Pres.; G. S. Lewis, Secy., both of Pittsburg.

Albany, Ind.—The question of constructing an electric line between this place and Muncie, to be owned jointly by Muncie and Albany, is reported as being agitated.

Billerica, Mass.—See "Power Plants, Gas and Electricity."

Cambridge City, Ind.—We are informed that the Cambridge City Interurban Traction Co. has received a franchise to construct an electric railway; also to furnish light, heat and power; probable cost of plant, $80,000.

Schenectady, N. Y.—It is stated that the Directors of the St. Ry. Co. have voted to issue $77,000 bonds for improving the system. W. H. White, Pres.

Rosehill, N. Y.—F. B. Mills is desirous of corresponding with contractors with a view to building an electric road.

Lebanon, Ind.—The County Commissioners are stated to have received a petition from the Indianapolis & Logansport Ry. Co. for a right of way over the roads in the eastern part of the county; also from E. T. Lane, J. E. Richtie and others of Lebanon for a right of way through the county.

RAILROADS.

Wichita Falls, Tex.—A charter has been granted to the Wichita Falls & Oklahoma Ry. Co. to construct a railroad about 20 miles long; capital, $50,000. Incorporators, J. A. Kemp, R. E. Huff, A. Newby and others.

New Orleans, La.—It is reported that the New Orleans & Carrollton Ry. Co. will expend about $200,000 in improvements. J. K. Newman, Pres.

Pittsburg, Pa.—The Suburban Rapid Transit Co. is stated to have received a franchise.

Monroe, La.—The Memphis & Monroe R. R. Co. has been organized to construct a railroad from this city through Ouachita and Morehouse parishes; capital $200,000. Dr. T. C. Brewer, Pres.; R. A. Shotwell, Secy.

Richmond, Va.—The Richmond, Petersburg & Carolina R.R. Co. has petitioned for a right of way through the city.

Madison, Wis.—The Union Construction Co. has been incorporated to build a railway line 350 miles long from Walworth County north to Douglas County; capital, $10,000. Incorporators: Edw. Friedman, R. A. Gillet and C. T. McElroy of Milwaukee.

Springfield, Mass.—The contract for building a branch line from Springfield to Tariffville, a distance of about 15 miles, for the Central New England R.R. Co., is stated to have been awarded to Ryan & Kelly, of Philadelphia, for about $325,000.

PUBLIC BUILDINGS.

Chicago, Ill.—The Bethel Congregation, at North Fair St., is reported to be preparing to build a $20,000 synagogue. S. Klee, Pres.

Sullivan, Ill.—See "Sewerage and Sewage Disposal."

Avon, N. Y.—Geo. Cary, 184 Delaware St., Buffalo, is said to be preparing plans for a $20,000 church for the St. James Episcopal Society. Rev. H. F. Darnell, Rector.

Hartford, Conn.—The trustees of Trinity College are said to have decided to erect a $40,000 building, to be known as a Natural Science Hall.

Elmira, N. Y.—The Hedding Methodist Society is said to be considering the matter of erecting a $40,000 edifice.

Lebanon, Ind.—The Commissioners of Boone County are stated to have passed an order for the erection of a new court house at a probable cost of $250,000. Boll & Taylor, of Cincinnati, are said to have been employed as architects.

Dartford, Wis.—Bids are wanted March 9 for the ironwork on the county jail. M. C. Gardenier, Co. Clk.

Canton, S. D.—Bids are wanted March 15 for a court house. M. B. Bennett, Co. Aud.

Knoxville, Tenn.—The plans prepared by Baumann Bros., of Knoxville, are stated to have been adopted for a $30,000 city hospital.

San Antonio, Tex.—We are informed that the contract for the Loan & Trust Co. building has been awarded to Thos. Lonergan & Co., of Chicago, Ill.

Sioux City, Ia.—The trustees of the Morning Side College are said to be considering the matter of erecting a $40,000 college.

London, Ont.—It is stated that the St. James Presbyterian Society will build a $25,000 church. Neil McNeil, Chmn.

Fresno, Cal.—The Board of City Trustees are said to be considering the matter of erecting a city hall.

Middletown, N. Y.—L. F. Olney, of New York City, is stated to have been selected to prepare plans for a public library.

Philadelphia, Pa.—Bids are wanted March 9 for a building. W. P. Wilson, Dir., Wilson Bros. & Co., Archts. & Consulting Engrs., Drexel Bldg.

Des Moines, Ia.—Garthwait & Co., of Chicago, are stated to have received the contract for erecting the Frankel Building; probable cost, $80,000.

Dallas, Tex.—Herbert M. Greene, Arch., is preparing plans for a 3-story fireproof building for the "Daily News."

Shepherdsville, Ky.—Bids are wanted March 6 for a court house and offices. W. B. Tilden, Co. Clk.

Mankato, Minn.—Bids are wanted March 15 (change of date) for the superstructure of St. Joseph's Hospital. J. B. Meagher, Secy. Bldg. Com.

Erie, Pa.—There is said to be a movement on foot to build a $100,000 Y. M. C. A. building.

New York, N. Y.—Bids are wanted March 6 for steel ceilings, etc., in the city hospital, Blackwell's Island. John W. Keller, Pres. Dept. Pub. Charities.

Portland, Ind.—The plans of M. S. Mahurn, of Fort Wayne, are stated to have been accepted for a $23,000 jail.

Lancaster, Wis.—Bids are wanted March 15 for building an annex to the County Asylum for insane and alterations in the county home; also for hot water heating in both buildings. Herman Grimm, Chmn. Bldg. Com.

Ithaca, N. Y.—J. Cleveland Cady, Jackson Building, New York, has prepared plans for a $100,000 church to be erected here by the Presbyterian Society.

Northfield, Minn.—It is stated that bids are wanted March 7 for an orphans' home for the Odd Fellows' Society. W. G. Nye, Chmn. Com.

Birmingham, Ala.—The following bids are stated to have been opened Feb. 20 for the construction of the administration and northeast wing of the St. Vincent Hospital: R. M. Newbold & Co., Birmingham, $64,599; Ledgerwood & Campbell, Chicago, $81,000; Meigham & Co., Birmingham, $79,753; Charles Moses, Chicago, $65,387; Cook & Laurie, Montgomery, *$67.393; M. T. Lewman & Co., Louisville, $79,912; Nicholas Ittner, Atlanta, $77,855; A. McGilvray, Birmingham, $69,067.85; T. C. Thompson & Bro., Birmingham, $67,398.

*Contract awarded.

FIRES.

Pueblo, Colo.—The De Remer Theatre has been destroyed by fire. Loss, $53,800.

Port Washington, Wis.—The plant of the Wisconsin Chair Co. is reported to have been burned Feb. 19; loss about $300,000.

NEW INDUSTRIAL PLANTS.

The Dahlonega Consolidated Gold Mining Co., of Dahlonega, Ga., will erect a 100-stamp mill at once, using a 175x30-ft. building, with additions for concentrators.

The Maryland Biscuit Co., Baltimore, Md., is preparing plans for a new plant.

The George W. Pitkin Co., Chicago, will put up a five-story and basement brick building 50x 100 ft. at Fulton and Carpenter Sts., from the plans of Henry P. Harned, 218 La Salle St. The company will put in a new boiler, but use its present engine.

The F. A. Godcharles Co., Milton, Pa., has under construction a 272x90-ft. building, which will be equipped with the necessary machinery for a rolling mill and nail factory.

The Griffin Manufacturing Co., Griffin, Ga., expects to add 600 spindles and 200 looms to its mill during the coming summer, but the plans have not yet been definitely determined.

The Lukens Iron & Steel Co., Coatesville, Pa., expects to erect a new open-hearth steel plant, with four or six furnaces, 40 tons, and to put in a universal mill.

The Hilles & Jones Co., Wilmington, Del., is about to erect a 155x80-ft. shop of steel frame construction, to be used as an erecting shop. A 40-ton four-motor electric traveling crane has been purchased.

The Attica Brick & Tile Works, Attica, N. Y., will immediately increase the capacity of its plant to 40,000 building brick daily. The rack system will be doubled, a new clay screen installed, and a number of kilns constructed.

George H. Padrick, Stanton, Ga., will at once rebuild his large lumber mill, recently burned; no machinery has yet been bought.

J. C. Williams, Sanford, N. C., is in the market for a 25-H.-P. engine, second hand or new.

The Allen B. Wrisley Co., 479 to 485 Fifth Ave., Chicago, will put up a 75x106½-ft. building, seven stories high, and install a plant of about 200 H.-P.

E. Strenberger, Clio, S. C., and several associates will put up a cotton flannel factory, either 75x400 or 100x300 ft., requiring a 400 H.-P. power plant.

BUSINESS NOTES.

The Kelly & Jones Co., Greensburg, Pa., has let contract for the erection of a 165x60-ft. addition to its iron foundry.

The Snow Steam Pump Works have received a contract for a 15,000,000 gallon triple expansion pumping engine for the Calumet and Heckla mines, to be operated with 85 pounds steam pressure.

The Goodwin Car Co., 96 Fifth Ave., New York, reports that it now has under construction a number of its 80,000 pound steel gravity center and side dumping cars, equipped with hand and air dumping apparatus, which are to be leased to several large railways for handling coal, ore and broken stone.

The National Enameling & Stamping Co., Baltimore, Md., states that its plant, particularly that at St. Louis, will be extensively enlarged. Contracts have already been let for 22 new rolling mills, with engines, buildings, etc., and arrangements have been made for the construction of three 30-ton open-hearth furnaces.

Mr. W. E. Shellings, Newburn, N. C., has offered to donate ten acres of land on either the railway or river to parties who will erect and operate a cotton mill. He states there is sufficient good clay on the property to furnish brick for a factory of any size. The property is guaranted to remain free from taxation for five years.

Mr. E. P. Mooney, for the past seven years connected with the Lehigh Valley R.R. as Traveling Engineer and Master Mechanic, and prior to that time for twenty-four years with the Lake Shore & Michigan Southern R.R. as Locomotive and Traveling Engineer, has severed his railroad connections to take charge of the Buffalo office of the Chicago Pneumatic Tool Company. The company send us the following extract from a letter from Mr. W. S. Dickson, chief engineer of the Sormovo Locomotive Company, Sormovo, Russia: "We have obtained

such good results from the various Boyer tools in our shops, and they have attracted so much favorable comment, that large business could be done for arrangement for proper representation here." The company's tools were recently given an exhibition test at the Glasgow Works of Messrs. Muir and Findley, in the presence of representatives of all the principal ship builders on the Clyde, railway engineers, locomotive builders and boiler makers. While the Boyer hammers have been in use for a number of years in Scotch works, some of the other tools are comparatively novel there, and the local representatives of the company report that their work on the exhibition was highly praised.

BUILDING INTELLIGENCE.

NEW YORK, N. Y.

516-518 E 11th st, 2 br stores and flats; cost $56,000 all; o, L Bachrach; a, G F Pelham.

Washington st, s w cor Desbrosses st, br warehouse and lofts; cost, $35,000; o, S L Mitchell; a, Kurtzer & Rohl.

251 E 7th st, br stable and factory; cost, $15,000; o, Adolph Mandel; a, Horenburger & Straub.

296 W 11th st, br tenem't; cost, $17,000; o, J H Cooper; a, G A Schellenger.

Cherry st, n e cor Catharine st, 3 br tenem'ts; cost, $85,000 all; o, Louis J Levy; a, Horenburger & Straub.

71 to 75 E 3d st, 3 br stores and flats; cost, $85,500 all; o, Jacob Kassewitz; a, G F Pelham.

504 to 512 E 81st st, 5 br flats; cost, $100,000 all; o, Andrew Brose; a, Jobst Hoffman.

5th ave, n e cor 119th st, 4 br stores and flats; cost, $92,000 all; o, Henry Rothschild; a, G F Pelham.

99th and 100th sts, 255 w 2d ave, br public school; cost, $260,000; o, City of New York; a, C B J Snyder.

W s Boulevard, 26 n 107th st, br store and flat; cost, $80,000; o, N & L Ottinger; a, Henry Andersen.

S s 99th st, 300 e Columbus ave, 2 br flats; cost $50,000 all; o, Mary McWalters; a, W C Dickerson.

Boulevard, n w cor 81st st, br store and flat; cost, $200,000; o, Alex Walker; a, G F Pelham.

W s Central Park West, 75 n 106th st, br flat; cost, $80,000; o, Patrick McMorrow; a, Neville & Bagge.

N s 80th st, 275 w Amsterdam ave, br flat; cost, $73,000; o, John J White; a, G A Schellenger.

N s 98th st, 350 e Columbus ave, br flat; cost, $25,000; o, Peter Arnot; a, W C Dickerson.

Amsterdam ave, s w cor 70th st, 2 br stores and flats; cost, $275,000 all; o, Andrew J Kerwin; a, S B Ogden & Co.

7th ave, s e cor 114th st, br flat; cost $80,000; o, Leith & Glenn; a, Neville & Bagge.

W s Amsterdam ave, 148th to 149th sts, 7 br stores and flats; cost, $205,000 all; o, Neil Hansen; a, G F Pelham.

S s 149th st, 100 e Boulevard, 3 br flats; cost, $96,000 all; o, McCracken & Dagnall; a, Neville & Bagge.

N s 131st st, 100 w 7th ave, br flat; cost, $25,000; o, A P Coburn; a, Neville & Bagge.

E s Franklin ave, 39 s Crotona Park South, br flat; cost, $19,000; o, Hy Spitz; a, M J Garvin.

N s 146th st, 100 w 3d ave, br flat; cost, $22,000; o, Thos D Malcolm; a, Neville & Bagge.

W s Willis ave, e s 3d ave, s s junction, br office and store building; cost, $55,000; o, W F & C H Smith; a, John De Hart.

S s 3d ave, 118 w Brook ave, br flat; cost, $18,000; o, Geo W Eggers; a, Edw Wenz.

E s 3d ave, 125 n 158th st, br flat; cost, $25,000; o, Geo W Eggers; a, Edw Wenz.

Brook ave, n e cor St Paul pl, 11 br flats; cost, $175,000 all; o, S & N Guidera; a, G F Pelham.

Union ave, s w cor 168th st, 5 br flats; cost, $76,000 all; o, Ledgard & Quinn; a, W C Dickerson.

S s 154th st, 345 e Morris ave, 2 br flats; cost, $24,000 all; o, A Blumenthal; a, W C Dickerson.

S s Westchester ave, w Eagle ave, 3 br flats; cost, $75,000 all; o and a, Albert Rothermel.

S s 159th st, 150 w Elton ave, 2 br flats; cost $36,000 all; o, Mrs Emma Horenburger; a, Herrm Horenburger.

W s Forest ave, 151 n Home st, br flat; cost, $15,000; o, H D Lounsbury; a, W C Dickerson.

BROOKLYN.

Lewis ave, n e cor Monroe st, br flat; cost, $12,000; o, Cornelius J Hickey; a, A S Hedman.

Knickerbocker ave, n w cor Bleecker st, br club-house; cost, $60,000; o, C Aichmann; a, P Brander.

S s Cook st, 145 e Graham ave, 2 br tenem'ts; cost, $22,000 all; o, Pomeranz & Kaplan; a, M J Smallheiser.

Cor Bushwick and Putnam aves, 3 br flats; cost, $39,000 all; o and b, Ph Steingotter; a W B Willis.

MISCELLANEOUS.

Houston, Tex.—Exhibition Hall, add'n to Convent; cost, $10,000; o, Sisters of Incarnate Word; a, N J Clayton & Co.

Macon, Ga.—Church of St Joseph; cost, $30,000; Rev J Winkelried, pastor; a, N J Clayton & Co.

Toledo, O.—Adams st, store and flat; cost, $30,000; o, W B Daly; a, A B Sturgis.

Worcester, Mass.—Vine st, br factory; cost, $12,000; o, W H Inman; a, Geo H Clemence.

PROPOSALS OPEN.

Bids Close. — See Eng. Record.

WATER-WORKS.

Feb. 27. Windsor, N. Y. .... Feb. 18
Adv., Eng. Record, Feb. 18.
Feb. 27. Well, Jamestown, N. D. .... Feb. 18
Mar. 1. Oto, Ia. .... Jan. 21
Mar. 1. Amsterdam, N. Y .... Feb. 4
Adv., Eng. Record, Feb. 4 to 25.
Mar. 1. Mt. Pleasant, Mich. .... Feb. 11
Mar. 1. Chicago, Ill. .... Feb. 25
Mar. 1. Wells, Berlin, Ont. .... Feb. 25
Mar. 1. Stayner, Ont. .... Feb 25
Mar. 3. Keshena, Wis. .... Feb 11
Mar. 4. Bonds, Cincinnati, O. .... Feb. 11
Mar. 6. Jamesburg, N. J .... Feb. 11
Adv., Eng. Record, Feb 11, 18.
Mar. 6. Bonds, Windsor, N. Y. .... Feb. 25
Mar. 7. Pipe, etc., Everett, Mass .... Feb. 11
Adv., Eng. Record, Feb. 11.
Mar. 7. Allison, Ia .... Feb. 18
Mar. 8. Bonds, McConnellsville, O. .... Feb. 11
Mar. 9. Atlanta, Ga .... Feb. 18
Mar. 11. Washington, D. C. .... Feb. 18
Adv., Eng. Record, Feb. 18.
Mar. 11. Washington, D. C. .... Feb. 11
Adv., Eng. Record, Feb 11.
Mar. 15. Belem, Para, Brazil .... Nov. 26
Mar. 15. Pipe, etc., Fayetteville, Ten. .... Feb. 11
Adv., Eng. Record, Feb. 18.
Mar. 16. Cleveland, O .... Feb. 25
Mar. 21. St. Louis, Mo .... Feb. 25
Apr. 3. Winnepeg, Man .... Feb. 4
Adv., Eng. Record, Feb. 4 to 18.
Apr. 11. Lakeport, Cal. .... Feb. 25

SEWERAGE AND SEWAGE DISPOSAL.

Feb. 28. Bonds, Havana, Ill. .... Feb. 18
Feb. 28. Steelton, Pa. .... Feb. 11
Adv., Eng. Record, Feb. 11 to 25.
Feb. 28. Kansas City, Mo. .... Feb. 25
Mar. 1. Mt. Pleasant, Mich .... Feb. 11
Mar. 1. Cleveland, O. .... Feb. 18
Mar. 1. Auburn, Cal .... Feb. 25
Mar. 1. Pipe, Pittsburg, Pa. .... Feb. 25
Mar. 1. Pipe, Baltimore, Md. .... Feb. 25
Mar. 2. Cleveland, O .... Feb. 18
Mar. 2. Meriden, Conn. .... Feb. 25
Mar 3. Keshena, Wis. .... Feb. 11
Mar 3. Cincinnati, O. .... Feb. 11
Mar 3. Cleveland, O. .... Feb. 11
Mar. 4. Cleveland, O .... Feb. 25
Mar. 6. Woonsocket, R. I. .... Feb. 4
Adv., Eng. Record, Feb. 4, 11.
Mar. 6. Virginia City, Nev .... Feb. 25
Mar. 7. Niles, O .... Feb 11
Adv., Eng. Record, Feb. 18.
Mar. 9. Norfolk, Va .... Feb. 11
Adv., Eng Record, Feb. 11 to 25.
Mar. 10. Cleveland, O .... Feb. 18
Mar. 11. Cleveland, O. .... Feb. 18
Mar. 14. Ponca, Neb. .... Feb. 25
Mar. 15. Cleveland, O .... Feb. 18
Adv., Eng. Record, Feb. 18, 25.
Mar. 16. Cleveland, O. .... Feb. 18
Mar. 17. Cleveland, O. .... Feb. 25
Apr. 15. Honolulu, H. I. .... Feb. 25
Adv., Eng. Record, Feb. 25.

BRIDGES.

Feb. 27. Monticello, Mo. .... Feb. 4
Feb. 28. Bellefontaine, O .... Feb. 18
Feb. 28. New Haven, Conn .... Feb. 25
Mar. 1. Quebec, Que .... Jan. 7
Mar. 1. Substructure, Montreal, Que. .... Feb. 25
Mar. 2. Shreveport, La .... Jan. 21
Mar. 3. Boston, Mass. .... Feb. 25
Mar. 4. Villagrove, Ill .... Feb. 18
Mar. 7. Virginia City, Mont. .... Feb. 25
Mar. 7. Suisun City, Cal. .... Feb. 25
Mar. 9. Shreveport, La. .... Feb. 11
Mar. 10. Cleveland, O. .... Feb. 18
Mar. 11. Carrollton, Mo. .... Feb. 25
Mar. 14. Macon, Ga. .... Feb. 25
Mar. 15. Chicago, Ill .... Jan. 21
Adv., Eng. Record, Jan. 21.
Apr. 1. Substructure, St. Joseph, Mo. .... Jan. 7
Apr. 10. Chicago, Ill. .... Feb. 18
Adv., Eng. Record, Feb 18.
Mar. 21. Superstructure, Bellefontaine, O. .. Feb. 25
—— Quincy, Ill. .... Feb 25
Adv., Eng. Record, Feb. 25.

PAVING AND ROADMAKING.

Feb. 27. Yonkers, N. Y. .... Dec. 3
Feb. 27. Portsmouth, Pa. .... Feb. 4
Feb. 27. Peoria, Ill. .... Feb. 18
Adv., Eng. Record, Feb. 18.
Mar. 1. Chicago, Ill .... Feb. 25
Mar. 1. Pittsburg, Pa. .... Feb. 25
Mar. 1. Bonds, Bridgeport, O. .... Feb. 4
Mar. 1. Batavia, O. .... Feb. 11
Mar. 1. Bonds, Zanesville, O .... Feb. 11
Mar. 1. Clinton, Ia .... Feb. 18
Mar. 1. Bonds, Sandusky, O .... Feb 18
Mar. 1. Bonds, Scottsboro, Ala. .... Feb. 18
Mar. 2. Cleveland, O .... Feb. 4
Mar. 3. Bedford, Ind .... Feb. 11
Mar. 4. Washington, D. C. .... Feb. 4
Adv., Eng. Record, Feb 4.
Mar. 4. Cleveland, O .... Feb. 11
Mar. 6. Brighton, N. Y. .... Feb. 25
Mar. 7. Joplin, Mo .... Feb. 4
Mar. 7. Cleveland, O .... Feb. 11
Mar. 7. Brooklyn, N. Y. .... Feb. 25
Mar. 10. Brownstown, Ind. .... Feb. 25
Mar. 11. Woodbury, N. J. .... Feb. 11
Mar. 13. Kokomo, Ind. .... Feb 25
Mar. 14. Cleveland, O .... Feb. 18
Mar. 14. Georgetown, O. .... Feb. 25
Mar. 15. Georgetown, O .... Feb. 25
Mar. 16. Lebanon, Ind. .... Feb. 18

POWER, GAS AND ELECTRICITY

Feb. 27. Vincennes, Ind. .... Feb. 11
Adv., Eng. Record, Feb. 11 to 25.
Feb. 28. Darlington, O. T .... Feb. 4
Mar. 1. Sault Ste. Marie, Mich .... Dec. 24
Mar. 1. Spartanburg, S. C .... Jan. 14
Adv., Eng. Record, Jan. 14 to Feb 11.
Mar. 1. Baltimore, Md .... Feb. 18
Adv., Eng. Record, Feb. 18, 25.
Mar. 1. Supplies, Pittsburg, Pa. .... Feb. 25
Mar. 3. Electric wiring, Providence, R. I. .. Feb. 25
Mar. 6. Cambridge, O .... Feb. 18
Mar. 6. Portland, Me. .... Feb. 4
Adv., Eng. Record, Feb. 4.
Mar. 6. Elizabethtown, Ky. .... Feb. 25
Mar. 6. New Rochelle, N. Y. .... Feb. 25
Mar. 7. Centralia, Ill. .... Feb. 25
Mar. 7. Williamstown, Ky .... Feb. 25
Mar. 8. Halifax, N. S .... Feb. 11
Adv., Eng. Record, Feb. 11, 18.
Mar. 31. Telephone, Shanghai, China. .... Nov. 19
—— Pleasantville, O. .... Dec. 24

GOVERNMENT WORK.

Mar. 1. New York City .... Feb 4
Adv., Eng. Record, Feb. 4 to 25.
Mar. 2. Plattsburgh, N. Y .... Feb. 18
Mar. 3. Water, etc., Keshena, Wis. .... Feb. 11
Mar. 4. San Francisco, Cal. .... Feb. 11
Mar. 6. Portland, Me. .... Feb. 4
Adv., Eng. Record, Feb. 4 to 25.
Mar. 7. Camden, N. J. .... Feb. 11
Adv., Eng. Record, Feb. 11 to 25.
Mar. 8. Wharf, Rockpoint, Md. .... Feb. 11
Mar. 8. New York, N. Y. .... Feb. 11
Adv., Eng. Record, Feb. 11 to 25.
Mar. 10. New York City .... Feb. 11
Adv. Eng. Record, Feb. 11 to 25.
Mar. 10. Baltimore, Md. .... Feb. 11
Adv., Eng. Record, Feb. 11 to 25.
Mar. 10. New York City. .... Feb. 18
Adv., Eng. Record, Feb. 18, 25.
Mar. 14. Plumbing, New York, N. Y. .... Feb. 18
Mar. 15. Rock Island, Ill. .... Feb. 18
Adv., Eng. Record, Feb. 18, 25.
Mar. 15. Baltimore, Md. .... Feb. 18
Adv., Eng. Record, Feb. 25.
Mar. 15. San Francisco, Cal. .... Feb. 11
Mar. 23. Kansas City, Mo .... Feb. 25
Adv., Eng. Record, Feb. 25.
Apr. 6. New Orleans, La .... Feb 11
Adv., Eng. Record, Feb. 11 to 25.

BUILDINGS.

Feb. 27. Heating, etc., school, Ponca, Neb. .. Feb. 18
Feb. 27. School, New York, N. Y .... Feb. 18
Feb. 28. School, Ponca, Neb. .... Feb. 18
Mar. 1. Arkadelphia, Ark .... Jan. 14
Mar. 1. Nacogdoches, Tex. .... Feb. 11
Mar 2. School, New York, N. Y .... Feb. 18
Mar. 2. Ashland, O .... Feb. 25
Mar. 4 School, Cayuga, N. D .... Feb. 25
Mar. 6. School, Eau Claire, Wis. .... Jan. 28
Mar. 6. School, Madelia, Minn. .... Feb. 25
Mar. 6. Shepherdsville, Ky .... Feb. 25
Mar. 6. Steel ceilings, New York, N. Y. .. Feb. 25
Mar. 6. Schools, New York, N. Y. .... Feb. 25
Mar. 7. Northfield, Minn .... Feb. 25
Mar. 8. Aberdeen, S. Dak .... Jan. 28
Mar. 9. Dartford, Wis. .... Feb. 25
Mar. 9. Philadelphia, Pa. .... Feb. 25
Mar. 10. Ventilating, etc., Cleveland, O .... Feb. 18
Mar. 11. School, Wheaton, Minn. .... Feb 18
Mar. 14. School, Algona, Ia. .... Feb. 25
Mar. 15. Lancaster, Wis .... Feb. 25
Mar. 15. Mankato, Minn. .... Feb. 25
Mar. 15. School, Louisville, Ky. .... Feb. 25
Mar. 15. Canton, S. D. .... Feb. 25
Mar. 15. Plans, Wilkesbarre, Pa. .... Jan. 28
Mar. 30. Iowa City, Ia. .... Feb. 18
Apr. 3. Many, La. .... Jan. 21
Apr. 14. Plans, Bradford, England. .... Jan. 21

MISCELLANEOUS.

Mar. 1. Shaft, Rouse, Colo. .... Feb. 18
Mar. 2. Plumbers' supplies, Brooklyn, N.Y. Feb. 25
Mar. 3. Garbage disposal, Atlanta, Ga. .... Feb. 18
Mar. 4. Washington, D. C. .... Feb. 11
Adv., Eng. Record, Feb. 11.
Mar. 7. Street cleaning, Cleveland O. .... Feb. 4
Mar. 8. Williamsport, Pa. .... Feb. 25
Adv., Eng. Record, Feb. 25.
Mar. 10. Garbage disposal, Brooklyn, N. Y. Feb. 18
Mar. 11. Washington, D. C. .... Feb. 18
Adv., Eng. Record, Feb. 18.
Mar. 15. El. Ry., Shanghai, China. .... Nov. 19
Oct. 1. Railroad, Moscow, Russia. .... Feb. 25

NEW SCHOOLS.

Wilmington, Del.—S. S. Reed & Bro. Co. are stated to have received the contract for building the new high school, at $141,600.

Davenport, Ia.—An election will be held March 13 to vote on issuing $54,000 bonds for new schools.

Ashland, O.—Bids are wanted March 2 for a school in Dist. No. 2. J. W. Gardner, Clk. of Bd.

Salinas, Cal.—The citizens are stated to have voted to erect a $30,000 school.

Rock Island, Ill.—John Volk & Co., of Rock Island, are stated to have received the contract for a new school at $31,195.

Dubois, Pa.—The plans of Chas. M. Robinson, of Altoona, are stated to have been accepted for a school; to cost about $30,000.

Westfield, N. J.—At the annual school meeting March 21 the citizens will be asked to vote on appropriating $45,000 for a new school.

Sherman, Tex.—The Council is said to have voted to appropriate $20,000 for a school.

Lagrange, Ill.—The plans of J. Neal Tilton, Clark St., Chicago, are stated to have been accepted for an addition to the high school.

Superior, Wis.—It is stated that a $25,000 addition will be erected to the Blaine school, to include a heating plant.

Lancaster, Pa.—A brick and stone school is to be built at a cost of $25,000. Archt., C. Emlen Urban.

Louisville, Ky.—Bids are wanted March 15 for a school, including lighting, ventilating, heating, etc. Wm. J. Davis, Secy. Com. on Bldgs.

Ironwood, Mich.—Dan Egan, of Ashland, Wis., is stated to have received the contract for a high school here, at $30,000.

Madelia, Minn.—Bids are wanted March 6 for a parochial school. M. J. Holper, Pastor, 217 Hickory St.

Wells, Minn.—C. D. Orff, of Minneapolis, is stated to have been selected to prepare plans for a $23,000 school.

Algona, Ia.—Bids are wanted March 14 for a high school in the Independent school district. C. M. Doxsee, Secy. Bd. Directors.

Elkton, Ky.—Bonds amounting to $13,700 are stated to have been voted for a high school.

Cayuga, N. D.—Bids are wanted March 4 for 2 schools. Monroe Kast, Clk. Tewaukon School Dist.

Mattoon, Ill.—The citizens are stated to have voted to issue $25,000 school bonds.

New York, N. Y.—Bids are wanted March 6 for school No. 109. John E. Eustis, Chm. Com. on Bldgs.

New York, N. Y.—The following bids were opened Feb. 21 by the Committee on Buildings, Bd. of Educ., for public school No. 170: H. Proost, 1180 Broadway, $322,600; H. M. Weed & Co., 97th St. and Boulevard, *$294,700; Jas. J. Loonie, 287 4th Ave., $296,856; John H. Parker Co., 256 Broadway, $309,995; Murphy Bros., 407 E. 101st St., $304,984; Luke A. Burke, 401 W. 59th St., $306,000; Thos. Cockerill & Son, 550 W. 51st St., $324,392; P. Gallagher, 150 5th Ave., $311,975; John J. Hopper, 217 W. 125th St., $312,000; Collier-Weeks Co., 163 W. 23d St., $312,687; P. S. Brennan, 1748 Washington Ave., $298,650; Mapes-Reeve Construction Co., 150 Nassau St., $312,915.

*Contract awarded.

STREET CLEANING AND GARBAGE DISPOSAL.

Manchester, N. H.—The Committee on Streets and Sewers is said to have asked for $12,000 for a crematory.

GOVERNMENT WORK.

Annapolis, Md.—It is stated that the following bids were opened Feb. 17 at the Navy Department, Washington, D. C., for the boathouse and armory at the U. S. Naval Academy: P. J. Carlin, 26 Court St., Brooklyn, N. Y., $750,000; John Gill & Son, and D. W. Thomas of Baltimore, $820,323; Grace & Hyde, New York City, $855,000; William H. Ellis, Cincinnati, $835,000; the Structural Iron Co., Baltimore, $976,000; Woodbury & Leighton, Boston, $840,000. Appropriation by Congress, $600,000.

Kansas City, Mo.—Bids are wanted March 23 by the Superv. Archt., Treas. Dept., Washington, D. C., for the interior finish, vault doors, linings, plumbing, gas piping, etc., for the U. S. Post Office and Court House, as advertised in "The Engineering Record."

Kaukauna, Wis.—Press reports state that plans have been prepared for the U. S. Government dry dock to be located in Kaukauna.

Savannah, Ga.—The following bids were opened Feb. 17 by the Secretary of the Treasury, Washington, D. C., for combination gas and electric light fixtures for the U. S. Court House and Post Office at Savannah: Cassidy & Son Mfg. Co., N. Y. City, $3,362.75; Horn & Breman Mfg. Co., Philadelphia, Pa., $2,862.75; W. C. Vosburgh & Co., Brooklyn, N. Y., $6,890.65; H. Rankin Co., N. Y. City, $2,119.10; Mitchell-Vance Co., N. Y. City, $3,920.42; R. Hollings & Co., Boston, Mass., $2,988.50.

Kansas City, Mo.—The following bids were opened Feb. 23 by the Supervising Architect, Treas. Dept., Washington, D. C., for the fixing in place complete the boiler plant, low pressure and exhaust steam heating and mechanical ventilating apparatus, supply pumps and tanks for water supply, etc., and pipe and duct coverings for the U. S. Post Office and Court House, as advertised in "The Engineering Record"; Chafer & Becker, Cleveland, $37,824; Richard T. Connell, Kansas City, $52,017; Goss Heating & Plumbing Co., Kansas City, $55,080; Edwin D. Hornbrook & Co., Kansas City, $54,892, $52,195; James Cotter, Kansas City, $44,340; Borger Bros. & Co., Columbus, $42,341.37; Pittsburg Htg. Supply Co., Pittsburg, $37,940; The Cullen & Stork Htg. & Vent. Co., St. Louis, $48,887; The Front Rank Steel Furnace Co., St. Louis, $51,887; Chas. B. Kruse Htg. Co., Milwaukee, $40,974; L. J. Mueller Furnace Co., Milwaukee, $41,586; J. J. Hanighen, Omaha, $54,900; G. A. Suter, New York City, $49,680; Thomas & Smith, Chicago, $40,195.

Duluth, Minn.—The following bids were opened Feb. 16 by Major Clinton B. Sears, Corps of Engrs. U. S. A., for setting Concrete Footing Blocks and building Concrete Superstructure in place on South Pier of Duluth Ship Canal, and for building and piling Concrete Footing Blocks for the North Pier of Duluth Ship Canal, Minn., (cement and gravel furnished by the U. S.) as advertised in "The Engineering Record."

Name and Address of Bidder.	Setting 8 Footing Blocks, 606, per bl.	Building in place Concrete Superstructure, 7,634 cu. yds., per cu. yd.	Building and Piling Concrete Footing Blocks, 2,310 cu. yds. per cu. yd.	Total.
King & Steele, Duluth, Minn.	$10.50	$6.10	$5.25	$65,897.90
Frank Campbell Duluth, Minn.*	3,000.00	4.05	3 90	42,926.70
MacLeod, Campbell & Smith Co., Duluth, Minn.	7.75	5 50	5.50	60,008.50
Engle & Osman, Duluth, Minn.	5.00	3 91	3.50	41 363.94
Chas Stone, St. Paul, Minn.	2.10	3.65	3.90	38,313.70
Butler-Ryan Co. St Paul, Minn.	8.00	4.25	3.90	46,941.50
P. McDonnell, Duluth, Minn.	8.00	4.75	5.25	53,877.00

*Bidder says these figures are in total.

Pensacola, Fla.—Press reports state that the following bids were received for building the government wharf at Fort Barrancas, Pensacola: J. H. Gardner, of New Orleans, $18,059; Henry Monk, of Nashville, $8,500; C. H. Turner, of Pensacola, $11,819.20; Grant Wilkins, of Atlanta, $17,300.

Washington, D. C.—The following bids were opened Feb. 16 by the Chief Clerk, Treas. Dept., for electric motors for fans in U. S. Post Office Building: Thresher Electric Co., Dayton, O., $3,600; J. H. Phinney, Washington, $4,115; Crocker-Wheeler Electric Co., N. Y. City, $4,700; General Electric Co., Schenectady, N. Y., $4,985; C. & C. Electric Co., N. Y. City, $4,042.

MISCELLANEOUS.

Little Rock, Ark.—The Ways and Means Committee of the House has decided to report favorably on the bill authorizing the St. Francis district to issue $750,000 bonds to build and maintain levees.

Shreveport, La.—Hunter Bros., of Shreveport, were the successful bidders for building the Riverside levee, at 13.2 cts. per cu. yd. This levee is 8,000 ft. in length and will be 10.2 ft. in height, and contain about 120,000 cu. yds. of earth.

Montreal, Que.—Local press reports state that the Road Committee is considering the matter of constructing a subway under the C. P. R. tracks at the head of St. Denis St. Probable cost of work would be $55,000.

Providence, R. I.—Local press reports state that the following bids were opened Feb. 16 for building the tunnel at the new State House: Norcross Bros., Boston, $2,175; McKinion Pile Driving & Bridge Building Co., $2,184; John F. Daniels, $2,820, and W. H. Sherman, $3,070.

Ottawa, Ont.—Local press reports state that the Department of Public Works will build a wharf on the Hull side of Ottawa River. Probable cost, $50,000.

Newark, N. J.—The following bids were opened Feb. 20 by the Essex County Park Commrs., for constructing stone heads for subways Nos. 1 and 2, at Branch Brook Park, as advertised in "The Engineering Record;" Howard J. Cole, Engr. in charge:

Bidder.	Milford Granite.	Indiana Limestone.	Buff Bedford.	Grey Belleville.	Rock Excavation, per cu. yd.	Will Complete in
Central Contracting Co., New York	$21,750	....	$2[illegible],000	$21,750	$2.90	3 Mos.
Peter Vanderhoof Sons Co., Newark, N. J.	23,896	22,896	....	.....	1.50	90 Dys.
Kelly & Kelly, New York	19,268	16,729	Maine Granite. 18,630	Rock Castle. 17,929	1.50	2 Mos.
Clinton Stephans, Jr., New York	18,950	19,000	....	....	1.00	3 Mos.
Frederick Wm. Shrump, Pleasantdale, N. J.	18,590	17,000	Pleasant Valley. 16,500	Ohio 17,056; Minneapolis. 17,076	1.50	4 Mos.
McGrath & Fordyce, Newark, N. J.	17,271	....	White Granite. 19,574	....	2.50	90 Dys.
E. R. Patterson Con. Co., New York	17,415	....	...	......	3.50	100 Dys.
Norcross Brothers, Boston	19,600	15,187	Branford Granite. 18,800	Troy White Granite. 18,500	2.50	2 Mos.
E. M. Waldron & Co., Newark, N. J.	22,700	18,345	Stanhope 16,900	....	3.00	90 Dys.
Eugana Lentilhon, New York	22,000	19,251	....	....	5.00	150 Dys.

Williamsport, Pa.—Bids are wanted March 8 for the city's portion of an undergrade crossing at the intersection of the Philadelphia & Erie R.R. with East Third St., as advertised in "The Engineering Record."

Boston, Mass.—The following bids were opened Feb. 21 by the Harbor and Land Commissioners for the construction of oak pile platform at the new pier, South Boston Flats, as advertised in "The Engineering Record": *a*, platform; *b*, ballast: Miller & Ellis, 17 Milk St., *a*, $144,844; *b*, $1. Thos. A. Rowe, 209 Washington St., *a*, $133,975; *b*, $1. J. N. Hayes & Co., 17 Otis St., *a*, $160,000; *b*, $1.10; Thos. E. Ruggles, 17 Otis St., *a*, $149,950; *b*, $1. W. H. Keyes, 17 Otis St., *a*, $129,758; *b*, $1.15. G. A. Cahil, Wolsey Block, Jamaica Plain, *a*, $119,872; *b*, $1. Morrison Bros., 45 Milk St., *a*, $166,494.93; *b*, $1.15. Geo. H. Cavanagh, 164 Devonshire St., *a*, $170,000; *b*, $1.10. Aug. Bellevue & Co., 17 Otis St., *a*, $134,901; *b*, $1. Wm. J. Lawler, 16 City Sq., *a*, $135,280; *b*, $1.50. Perkins, White & Co., 16 City Sq., *a*, $141,000; *b*, $2. Bidders all of Boston.

Philadelphia, Pa.—The following bids were opened Feb. 23 by the Fairmount Park Commrs. for rubble masonry: Robt. Patton, 624 N. 35th St., *$2.23; T. F. Reilly, Harrison Bldg., $2.55; McManus Const. Co., 1430 S. Penn. Sq., $3.57; F. J. Hill, Harrison Bldg., $2.45; Jno. McParland, 41st St. & Haverford, $2.43.

Bids received for the construction of the river wall were as follows: *a*, stone wall; *b*, concrete foundation: McManus Const. Co., *a*, $2.54; *b*, $4.50. Phila. Const. Co., Girard Bldg., *a*, $3.90; *b*, $5.95. Jno. McParland, *a*, $2.38; *b*, $1.67. Robt. Patton, *a*, $2.28; *b*, $2.10. T. F. Reilly, **a*, $2.13; **b*, $1.75. J. H. Deehan, 811 N. 16th St., *a*, $2.44; *b*, $3. Sparks & Evans, 20 S. Broad St., *a*, $2.36; *b*, $1.50.

*Contract awarded.

Brooklyn, N. Y.—Bids are wanted March 2 for plumbers' supplies. George C. Clausen, Chm. Commr. of Parks, New York City.

PROPOSALS.

Railroad Crossings.

WILLIAMSPORT, PA.

Sealed proposals will be received until 1[illegible] o'clock, noon, of Wednesday, March 8th, 1899, by the City of Williamsport, Pa., fo[r] the construction of the city's portion of a[n] undergrade crossing at the intersection o[f] the Philadelphia & Erie Railroad with Eas[t] Third St., and for an undergrade foo[t] crossing at the intersection of Pine Stree[t] and the Philadelphia & Erie Railroad, i[n] accordance with the provisions of an ord[i]nance approved April 4th, 1898, and a[n] amendment thereto approved July 21st, 189[8].

Said crossings at East Third Street con[]tains the following principal approximat[e] quantities: 7,600 cubic yards excavation, 3[illegible] cubic yards concrete masonry, 800 lineal fe[et] handrailing, 530 feet 15-inch pipe sewe[r], 7,000 square feet cement sidewalks, 7[illegible] square yards vitrified brick paving relayin[g], 1,100 square yards new vitrified brick pa[v]ing, etc.

The foot crossing at Pine Street contai[ns] the following principal approximate quant[i]ties: 677 cubic yards earth excavation, 1[illegible] cubic yards concrete masonry, 118 cu. yd[s.] brick masonry, 13,000 white-glazed brick, 1[illegible] lineal feet of handrailing, 408 square fe[et] cement paving, 30 feet 10-in. sewer conne[c]tions, etc.

Plans and specifications can be seen [at] the office of the City Engineer.

Separate bids to be made for each cros[s]ing, and marked "Proposals for East Thi[rd] Street Undergrade Crossing," and "Propo[s]als for Pine Street Undergrade Crossing[."] All bids to be accompanied by a certifi[ed] check for ten per centum of the amou[nt of] bid; said sum to be forfeited in case t[he] successful bidder shall fail to execute t[he] contract for the construction of the wo[rk], the city reserving the right to reject a[ny] and all bids.

GEO. D. SNYDER,
City Engineer.

February 20th, 1899.

Proposals continued on pages xi and xii

THE ENGINEERING RECORD.
Volume XXXIX. Number 14.

TABLE OF LEADING ARTICLES.

The Engineering Record, conducted by Henry C. Meyer, is published every Saturday at 100 William Street, New York. Its opinions on technical subjects are either prepared or revised by specialists.
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THE NERNST ELECTRIC LAMP.

Enough information has now come across the Atlantic to enable some sort of an idea to be formed of the new electric lamp which the brilliant young professor of the University of Göttingen, Walther Nernst, has recently invented. The idea of lighting an electric lamp with a match in the good old-fashioned way seems a step backward, and when the announcement was made that the new lamp was started in this manner there was an immediate feeling that it would not be of much use in these times when the delay incident to turning the button of an ordinary incandescent lamp is considered a drawback by "busy" men. It seems, however, that this match business is not an essential feature of the new invention, which opens up attractive commercial possibilities.

Some twenty years ago, when the incandescent lamp was in its infancy and its efficiency was not discussed by its friends, a kaolin-candle lamp was brought out by Paul Jablochkoff. This device, it may be recalled, was a strip of kaolin along which was placed a match of graphite or carbon powder and treacle, a combination which will be recognized as now frequently used in the more humble illuminating field of stove shining. In the Jablochkoff lamp this material was used as a conductor to bring the kaolin to such a temperature that it would become incandescent. The inventor chose to devote his energies more to his other noted lamp, the carbon-candle, and the kaolin-candle became of interest simply as a step in the history of electric illumination. The same idea was taken up later by a German investigator. In his attempts to produce an electric lamp without a vacuum bulb he devised a mantle which proved to be of much more service in connection with a gas jet, and was developed into the now familiar Welsbach light.

Professor Nernst's fundamental idea in designing his new lamp is very simple. It was merely to obtain in a suitable form some highly refractory material which would not be destroyed when brought to incandescence in the free air. This idea was, of course, an old one, and was very unpromising when he took it up, because the highly refractory oxides, which at present seem to be the only materials satisfying the requirement, are good insulators. They have a property, however, of becoming electrolytes when hot, and the new electric lamp takes advantage of this property. The nature of material used for the incandescent portion of the lamps has not yet been made public, but it is believed to be a mixture of some of the rare earths, such as thoria, ceria or zirconia. These are made into a small white rod, mounted on two platinum wires. The rod and wires are placed in a holder which fits ordinary electric light fixtures. As the rods fall in resistance as the temperature increases, an increase of current produces a decrease of resistance, which tends to cause some instability in running in parallel on supply circuits. This is corrected, according to Mr. James Swinburne, by the use of a resistance in series, made of very fine wire, and amounting for ordinary circuits to 10 or 12 per cent. of the whole resistance of the lamp. Such a lamp will not light up of itself when the current is turned on, for the rod is an insulator when cold, so it has to be warmed with a match or small spirit lamp. When these rods were first made they lasted about 200 hours, but they have already been improved so as to have a life of about 500 hours. When they are worn out new rods and wire mounts are placed in the holders.

This description applies simply to what is referred to as the small elementary lamps. For the benefit of those people who have got beyond the match stage, an electric heater can be supplied, arranged close to the rod and in shunt with it. This is described as follows by Mr. Swinburne: "As soon as the rod gets hot enough to conduct, its current works a tiny cut-out in the resistance circuit. In large lamps the resistance arrangement is arranged as a sort of hood, which covers the rod. As soon as the latter conducts, not only is the resistance circuit broken, but an electro-magnet lifts the little hood clear of the rod. In all these forms the rod and its mountings are replaceable without interfering with the rest of the lamp."

To understand the commercial possibilities of such a lamp it is only necessary to consider the low voltage at which incandescent lamps must be operated and the uniformity of pressure necessary for their successful use. It is this low voltage which calls for such a large expenditure of money for conductors, an expenditure far greater than that for any other portion of many lighting systems. In the new lamp the incandescent material has a very high specific resistance, making it easy to give small lights with high voltages and to use conductors of greater resistance. In the case of Nernst lamps of 20 to 200 candle-power, the first cost is stated to be much higher than the first cost of the incandescent type, but as the rod itself is the only part which has to be replaced it is claimed that this question of first cost is not of much importance. To the central station manager the striking feature of the new lamps, however, is that there is said to be no trouble in making them to work in parallel at 500 volts and, by using double rods, at 1,000 volts.

ELECTRICITY FOR FROZEN WATER PIPES.

During the recent cold snap which extended so widely over the country, about 400 service pipes were frozen in Madison, Wis. One of the instructors in the department of electrical engineering at the University of Wisconsin, which is located in that city, suggested the use of electricity as a means of thawing out these services. The suggestion was not followed up at once, but in a few days Mr. T. W. Wood, another instructor in the same university, found one of his neighbors in considerable distress because the local plumbers could give him no relief from a frozen pipe 5 feet below the surface, without excavating the service, which was bent so as to prevent the insertion of steam hose in the usual manner. Mr. Wood talked the matter over with Prof. D. C. Jackson, and they spent considerable time calculating how much current would be needed to heat the pipe sufficiently to thaw it, and how the electricity would be obtained and controlled. They finally became convinced that the method was practicable, and obtained wires and transformers for the purpose. The apparatus was arranged so as to send a considerable current at a low voltage through the pipe, and within about 20 minutes after the current was turned on, the surface was free from ice. The apparatus was transferred to another place, where but 12 minutes elapsed between the turning on of the current and the freeing of the pipe.

In each case the service was merely warmed so that it could be held comfortably by the hand, and was not endangered in any way. In the second experiment the circuit was run from the local electric light wire through a leader to an outside fixture on one house, through the piping and service of that house to the street main, along the main to the service pipe of the second house, and through some of the piping of that house back by another leader to the electric company's lines. These experiments attracted immediate attention, and the Madison Gas and Electric Company began experiments of the same sort at once, which were so successful that householders made urgent requests for similar treatment of frozen mains on their premises. The gentlemen who devised the system and the university authorities have been overwhelmed with requests for information concerning the process, and President C. K. Adams of the university has been forced to issue a bulletin on the subject, from which the following quotation is made:

"The source of electric power which is required in thawing service pipes should be capable of producing 300 amperes of electric current, with a pressure of from 50 to 60 volts. This power may be obtained by means of an alternating current transformer connected with electric light lines or any other similar source. Whenever several pipes in a city are frozen we advise that the water works and electric light companies be asked to join in the effort to facilitate the work of thawing. Although up to the present time experience has been chiefly confined to service pipes, the method is applicable to street mains in case sufficient power is obtainable. It has been computed that 75 horse-power is requisite to thaw out within 30 minutes a frozen main 6 inches in diameter for a distance of 100 feet. For a longer distance corresponding power would be required. It is ordinarily found that the time needed for thawing any length of pipe less than 200 feet does not exceed half an hour after the electricity is applied."

The plan was tried in Milwaukee, where it was probably first used in thawing about 40 feet of 1-inch pipe, which was done in 25 minutes. The current was taken in this instance from an Edison circuit, and was so strong that it was run through a couple of barrels of water, which served as a resistance. About 175 amperes current was used, and the pipe became so hot that it could not be handled. As soon as water began to drop from the nearest faucet the current was turned off, and the pressure of the water cleared the pipe. In Chicago Mr. Francis H. Soden used the system with much success on a number of pipes, some of them 80 feet long and 1 inch in diameter. He took the current for the purpose from an alternating lighting circuit, and reduced it by a transformer to 25 volts. The pipes were warmed to 40 or 50 degrees only, which loosened the ice gradually without injuring the metal in any way. In Des Moines, Col. E. G. Pratt of the Capitol City Electric Company has tried the process and found it to work well. Eighty feet of ¾-inch pipe were thawed under his direction in 7 minutes, and a large number of services were freed by his company. He uses a transformer to reduce the pressure to 30 to 50 volts, and allows the current to remain on the pipe only long enough to melt the outer part of the core of ice. The longest pipe thawed out in Des Moines in this way of which any record has been received is 150 feet.

THE CHARACTER OF FLUID MOTION.

For several years some unusually interesting experiments on the character of fluid motion have been conducted by Professor H. S. Hele-Shaw, of University College, Liverpool. He has from time to time described the progress of the experiments and the results, which have confirmed in a remarkable manner some of the theories advanced on mathematical ground to explain the laws of the flow of liquids. In the "Proceedings" of the Institution of Naval Architects for 1898, there appeared a number of engravings from photographs of thin sheets of water into which bands of colored liquid were allowed to flow from suitable apparatus. The experiments have a peculiar interest from the fact that, in a certain limited number of cases, it had been possible to predict and delineate lines of flow by means of higher mathematics which are absolutely corroborated by the investigation. In a paper at the recent British Association meeting, Professor Sir George Gabriel Stokes presented a mathematical demonstration that the method of thin sheets, upon which the experiments depend, must give, when a viscous fluid is used, the theoretical results which have hitherto only been obtained mathematically for a perfectly frictionless or inviscid fluid. He says: "The experiments afford a complete graphical solution, experimentally obtained, of a problem which from its complexity baffles the mathematician except in a few simple cases."

The original experiments were made with water, but as it is the property of viscosity

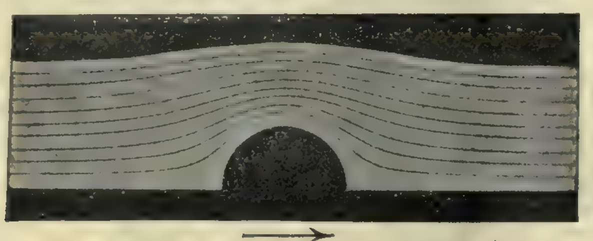


FIGURE 1.—FLOW PAST AN OBSTRUCTION.

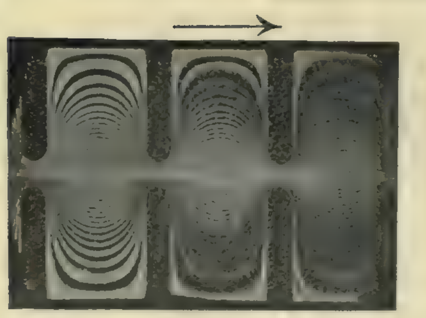


FIGURE 2.

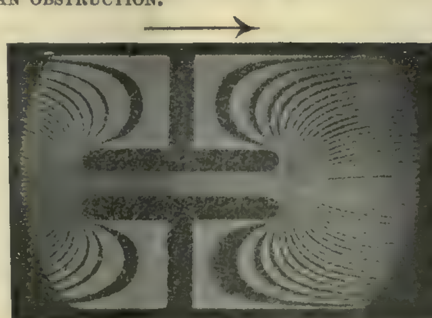


FIGURE 4.

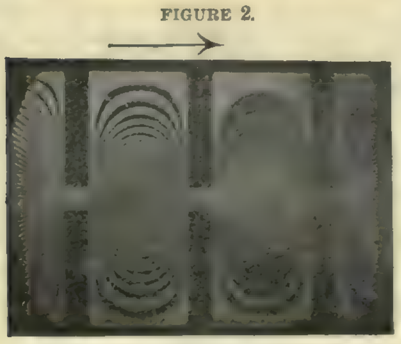


FIGURE 3.

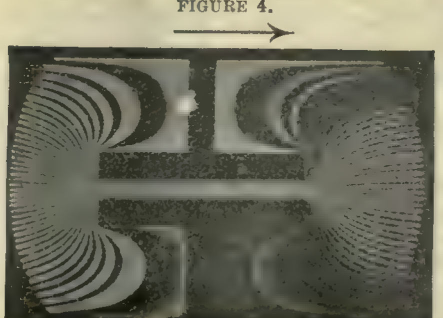


FIGURE 5.

THE STREAM LINE EXPERIMENTS OF PROFESSOR HELE-SHAW.

upon which their success depends, various other more or less viscous liquids were tried. Glycerine enabled even better results to be obtained than when water was used, and afforded, it is said, not merely an approximate, but an absolute and exact coincidence of results with those previously calculated. In a recent paper before the Liverpool Engineering Society, Professor Hele-Shaw described a number of his later experiments, and through his courtesy an abstract of some of them is herewith presented with reproductions of some lantern slides showing the curves of motion.

In the case of a body moving through a frictionless liquid of indefinite extent, there is no theoretical limit to the distance on either side to which the effect will be felt. As there is no immediate drag on the water at the actual surface of solid, owing to there being no friction, the particles will glide past each other so as to make room for the moving body at different speeds to an almost indefinite distance on either side. In thus sliding past each other, the particles will not be able to produce any whirling or turbulent motion, and, consequently, after the body has passed, they will return to their original state without the loss of any energy and without producing any tendency to resist the motion of the body, which they will press upon equally behind and in front. When, however, the body is moved through water or any other actual liquid, owing to its viscosity or friction, the particles do not adhere to the skin of the moving body, nor glide past each other in the same way as in the previous case, but drag upon each other. This may not, at a certain distance from the skin, result in actually producing turbulent motion, because the relative velocity of the particles to each other may not be very great, and hence the change of movement may be very much the same as with a perfect liquid. In the immediate neighborhood of the skin, however, where the changes of velocity are relatively greater, turbulent motion of the water is produced, which absorbs the energy by what may be considered as a series of whirlpools or vortices of smaller or greater size, and the resulting conditions of flow are entirely different on account of viscosity to those with a perfect liquid. By allowing the liquids to flow between plates very close together, the conditions are such that the viscosity of the liquids on the plates prevents whirlpool motion being set up, and the flow may now occur in exactly the same way as in a perfectly frictionless liquid.

The idea of what are called stream lines has long been familiar to students of hydromechanics, that is to say, the idea of imaginary lines existing in the flowing liquid, which, although it is perfectly impossible to distinguish the movement of separate particles themselves, would represent at once the character of the flow. Mathematical expressions can be obtained in certain cases, such as for the motion past a circular cylinder, of such imaginary stream lines. Inasmuch as when there is no turbulent motion in the flow between plates

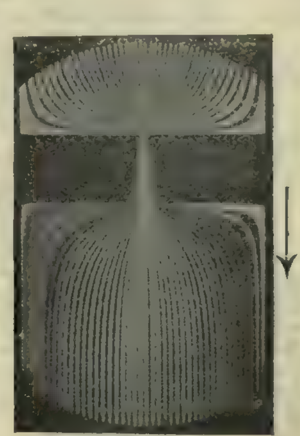


FIGURE 6.

FIGURE 7.

close together, bands of color, which will not mix with the general body of the liquid, can be made to flow so as to represent stream lines, it is thus possible to measure exactly their relative changes of position in passing around a circular cylinder, and compare them with the position of the stream lines obtained by calculation. Lines of this sort were shown by Professor Hele-Shaw in his paper before the Institution of Civil Engineers. Later it occurred to him that if these results could be obtained with water, much better ones would be given by using a more viscous fluid. The most successful which was tried was glycerine, as before stated. The comparison between the theoretical and actual flow lines past a circular cylinder was again gone over, three important modifications being adopted. In the first place, instead of having the film of fluid pass through rectilinear boundary lines the calculated theoretical-curve boundary lines were used. In the second place a much longer distance of flow was used, so as to avoid any errors in the small holes from which the lines of colored liquid issued. In the third place, these holes themselves were drilled at distances corresponding exactly with the position they would take at that point of their path.

A reproduction of a photograph of curves produced with these precautions is shown in Figure 1. It was carefully compared with a large scale drawing of the theoretical stream lines, and after much time and trouble had been expended in perfecting the experimental arrangements, it was ultimately proved by this means that the agreement between theory and experiment was absolutely exact when glycerine was used.

When the fluid is made to pass through a series of contracted orifices into what may be regarded as embayments, the stream lines take the forms shown in Figures 2 and 3. The diameter of the opening is exactly the same in each case, but in Figure 2 the edges are rounded, and in Figure 3 they are square. The effect of this is obvious; in the former of the two diagrams, the flow is much more perfectly maintained, while in the case of the square edges, it will be noticed that in each successive embayment the main body of fluid is tending to lose its proper formation, owing to its loss of power to reach the outer portion of the embayment. Furthermore, it will be noticed that the squareness of the figure, which is fairly well maintained in Figure 2, is gradually lost in Figure 3. These diagrams also show the great difference in velocity in the inner and outer portions of the flow, for it must be understood that the width of the colored bands is originally exactly the same, and therefore their width at any subse-

quent period is a direct measure of the velocity of the motion at that point. The great difference of velocity will thus be seen between the flow in the central and outer portions of the channel.

An interesting feature of this diagram which Professor Hele-Shaw points out particularly is the possibility of flow around sharp edges. It is impossible to conceive mathematically of such a thing as this occurring with a perfect liquid without what is known as discontinuity of flow taking place at the same time, since the flow of such a liquid around a sharp projecting edge must result theoretically in an infinite velocity at that point. The reason for this will be readily understood by men who have attempted to turn a heavy, rapidly moving mass around a very sharp corner without applying a great force. It must be remembered that in Figure 3 the viscous liquid has been made to behave like a perfect liquid, because the inertia which it would have in moving around the corner is counteracted by the enormously intensified effect of viscosity owing to the thinness of the film between the two glass plates. Hence the tendency of a particle to rush across in turning a sharp corner is largely destroyed. In Professor Lamb's "Hydrodynamics" this difficulty of the sharp edge is referred to as follows: "Unless the pressure at a distance be very great, the maintenance of the motion in question would require a negative pressure at the corner, such as fluids under ordinary conditions are unable to sustain." Professor Hele-Shaw points out that such a negative pressure is possible with a viscous fluid which is adhering to the sides of its channel. It is known that capillary forces may be very large, and it would be interesting to investigate this matter to determine the extent to which this negative pressure or tension holding the fluid to the edge causes the result shown in Figure 3.

This feature is brought out in a still more notable manner in Figures 4 and 5, in which reentrance orifices are used. The great differences of velocity at various points are shown in a striking manner in these illustrations, particular attention being drawn to Figure 5. On the right hand side of the outlet orifice in this figure, it will be noticed that the outside color band passes through an extremely severe ordeal in going round a sharp corner, but emerges without being broken up. On the other side, however, the extreme outside band has been slightly broken up at its outer edge, so that the color band appears to be mixing with the clear fluid, and to come into actual contact with the sides of the passage when in this state.

The remarkable way in which the stream line motion can be secured with a thin film of liquid through a very narrow orifice is shown in Figure 6, and may be profitably compared with Figure 7, in which, with a thick film and a much wider orifice in the diaphragm, the effect of turbulent flow is very evident.

THE CORNELL HYDRAULIC LABORATORY.

[By J. H. Massie.]

A work which in almost all of its aspects is entirely new, and in many of them absolutely unique, has been undertaken at Cornell University in connection with the College of Civil Engineering. Within the last few weeks there has been completed on the Cornell campus, at Ithaca, a laboratory which in all probability will be the scene of some of the most elaborate and extensive experiments ever attempted in hydraulics. The outfit and plant at the disposal of the experimenters will be the largest as well as the most complete of its kind in the world. The sole object of the laboratory is to foster the progress of hydraulic science. In accordance with the wish of its originator and designer, Prof. E. A. Fuertes, director and dean of the College of Civil Engineering, the laboratory will be open, under some slight restrictions, to any engineer who may wish to conduct in it experiments necessary in the course of his practice, or to pursue an original investigation.

The laboratory is located at a spot peculiarly suited in topographical conditions for such an undertaking. Close to the colleges of engineering, marking the northern boundary of the university campus, runs a gorge whose rocky sides descend precipitously from the groves on its borders a hundred feet or more to a stream below. The eastern end of the gorge is marked by the site of the Triphammer Fall, one of the most picturesque of the many beautiful falls in the vicinity of Ithaca, over which flows the water of Fall Creek, which at this point can deliver from 10 to nearly 5,000 cubic feet per second. Excluding the dry seasons, the average flow is in the neighborhood of 2,000 cubic feet per second. What is at present the main building is in the gorge at the foot of the fall, and into it the water of the creek may be conducted at a head of nearly 80 feet, or at pleasure in smaller volume, by serving the water from the reservoir above the campus, at a head of 245 feet. The bed of the gorge is of such nature that experiments may be conducted on water conduit pipes of large diameter straight away from the main building for nearly 2,000 feet, and beyond this distance with both horizontal and vertical curves of large radii for over two miles.

The general scheme of construction of the laboratory comprised a large reservoir to ensure as far as possible a large constant supply of water, a canal in which to conduct various experiments relating to waterways, and a large standpipe terminating in one of the laboratory buildings; this building was planned to contain the greater part of the movable testing apparatus referring to pipe investigations.

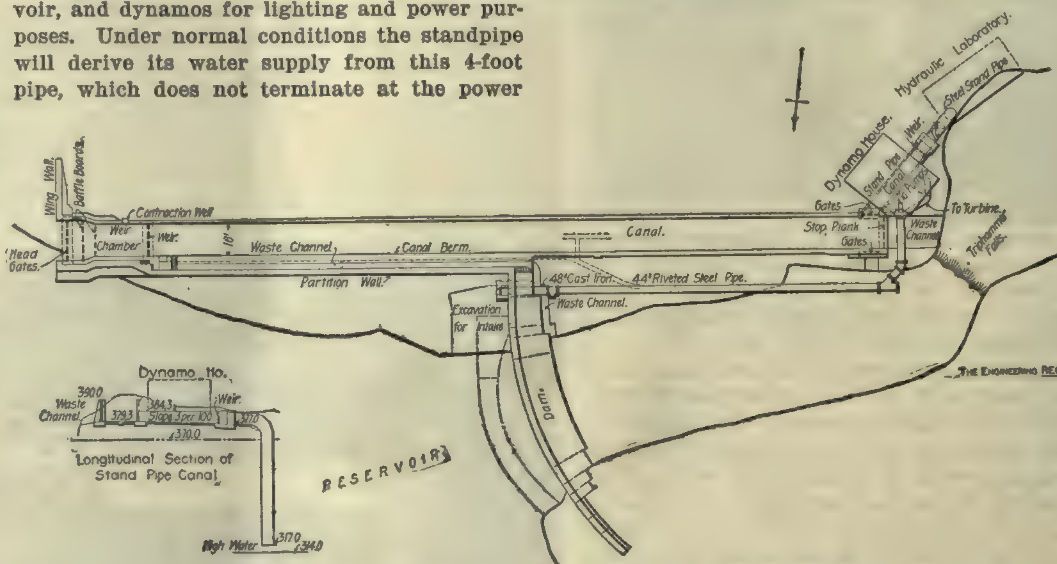
The reservoir was secured by erecting a concrete dam just at the verge of the fall. It contains in the neighborhood of 60,000,000 gallons of water, and covers an area of almost 23 acres. The dam was built 15 feet below an old stone dam, which had been used formerly for storing water, to be pumped into the university reservoir. The new dam rises 10 feet above the old one, causing the water to spread out into a small lake, which is supplied by the watershed of Fall Creek, embracing 117 square miles. Although it is built in the form of an arc, it is constructed to act as a gravity dam rather than as an arch. It is made entirely of concrete and is anchored securely in solid rock foundations and abutments. Steps were constructed on the western or downstream face with a view to break

TRIPHAMMER FALLS AND THE NEW CORNELL HYDRAULIC LABORATORY.

the force of the falling water during floods, which frequently occur at this locality during wet seasons. As an additional factor of safety the old dam was left standing, and the space between the two packed with puddled clay. North of the dam a promontory of rock was stripped of earth, and cut down until its top presented a plane surface a foot below the lip of the dam. This will act as a spillway during the major portion of the year. To protect them from floods, which frequently rise to a depth of 4 or 5 feet, the banks at its north side have been reveted with a dry wall for some distance back from the fall. Provision has been made for considerably increasing the storage capacity of the dam by adding flash boards, both to it and to the spillway.

In order to accommodate urgent demands by various water developing companies for the testing of turbines it is now proposed to cut a gap in the dam, flanked by strengthening buttresses. By means of gates in the dam and in the flume, which it will be necessary to build, the water may then be diverted either into the canal for calibrating purposes, or into the wheel chambers to be constructed below the dam, for efficiency tests.

The canal was blasted out of solid rock upon the southeast side of the dam. The finished cut is 500 feet long, 16 feet wide, and is able to carry a depth of 10 feet of water, which may be delivered under 20 feet head. The walls are constructed of concrete, with a backing of asphaltic waterproofing to prevent leakage. Underneath is a subchannel to drain the surrounding rock strata, which contain many springs. The amount of water entering the canal is regulated, by means of a number of devices, with the greatest nicety. At the upper, or eastern, end it is roughly controlled by means of five ordinary sliding gates, while a sixth gate is provided with means for making more delicate adjustments of the amount of water received. The entrance chamber, which is somewhat funnel-shaped, is provided with baffle boards, so as to bring the water into undisturbed conditions as soon as possible after it is admitted to the upper bay. In front of the last weir is a movable cradle, which receives the water from the weir so long as the conditions of flow are not uniform, emptying into a practicable tunnel within the concrete wall which separates the water in the canal from that in the pond. When a uniform condition of flow has been secured, by the movement of a lever the cradle is withdrawn from the weir and the water is then discharged directly into the canal. The weirs in the canal may be so calibrated that by replacing them under identical conditions the volumes of water can be accurately ascertained. Within the walls, special contrivances to be read by filar micrometers are placed at short intervals from each other, by means of which the height of the water along the canal is given with great accuracy. The canal can be emptied at pleasure, either as a waterfall about 80 feet high, or into a steel standpipe 6 feet in diameter, and over 72 feet in height, which pierces the roof of the laboratory, a building 50 feet long by 24 feet wide, standing on rock foundation vertically below the standpipe. Parallel to the canal and outside its walls is a pipe 4 feet in diameter, which, at will, can be made to deliver its water either directly into the canal or into the standpipe, or under a head of 80 feet into a power house, in which are situated pumps for lifting water from the lake into the university reservoir, and dynamos for lighting and power purposes. Under normal conditions the standpipe will derive its water supply from this 4-foot pipe, which does not terminate at the power house, but will be continued on downstream for purposes other than experimentation. Upon the walls of the canal are two rails, which support a truck propelled at adjustable velocities by a small motor. A chronograph marking seconds registers automatically the time expended during any portion of its run, and by this means the truck's position and velocity may be determined with any desirable degree of accuracy. In addition to this, the truck will be provided with appliances for determining the resistance to the motion of bodies in water. In the canal will be established evaporometers, piezometers, micrometers and many other similar appurtenances contributing to accuracy of observation. About half way down the 6-foot steel standpipe will be fitted a number of special castings, to which may be attached mouthpieces, nozzles and pipes of different sizes. A platform at this point offers facilities for the convenient attachment of apparatus to determine the coefficient of efflux in thin plates, tubes, valves, cocks and other forms of orifices, up to 12 inches in diameter, and under constant and variable heads.



GENERAL PLAN OF THE WORKS FOR HYDRAULIC EXPERIMENTS.

THE DAM AND CANAL; VIEW LOOKING UPSTREAM.

On the south bank of the canal there are now several temporary buildings, which will be replaced by more substantial ones at an early date. At the north end, also, will be erected a long, sightly building, to contain much of the apparatus and delicate instruments used in experiments, as well as portions of the equipment for tests on the upper waters of the pond and canal.

In the building on the floor of which the standpipe rests, special castings and reducers will be attached to the pipe, capable of taking pipes and valves from 6 inches up to at least 6 feet in diameter. In addition to this, the building will contain weirs, scales, tanks, pumps, dynamos and other specially designed apparatus. A number of the latest patterns of Venturi meters, which do not use electric counters, will also be provided. The walls and roof of this building are of considerable thickness, to enable it to withstand the weight of the ice which collects on it in great masses during the winter.

Of the tests which it is hoped will ultimately be completed at this laboratory, much more could be said than the limits of this article will permit. When it was designed, the announcement of the work proposed to be carried on in it, as given in the report to the Board of Trustees by Director Fuertes, included the following programme:

"Studies upon the dragging and suspending power of water at various stages of its saturation with sediment.

"The effect of transverse, longitudinal and submerged dams, under standard conditions, which may be modified at will by disturbing influences covering any variety of complications.

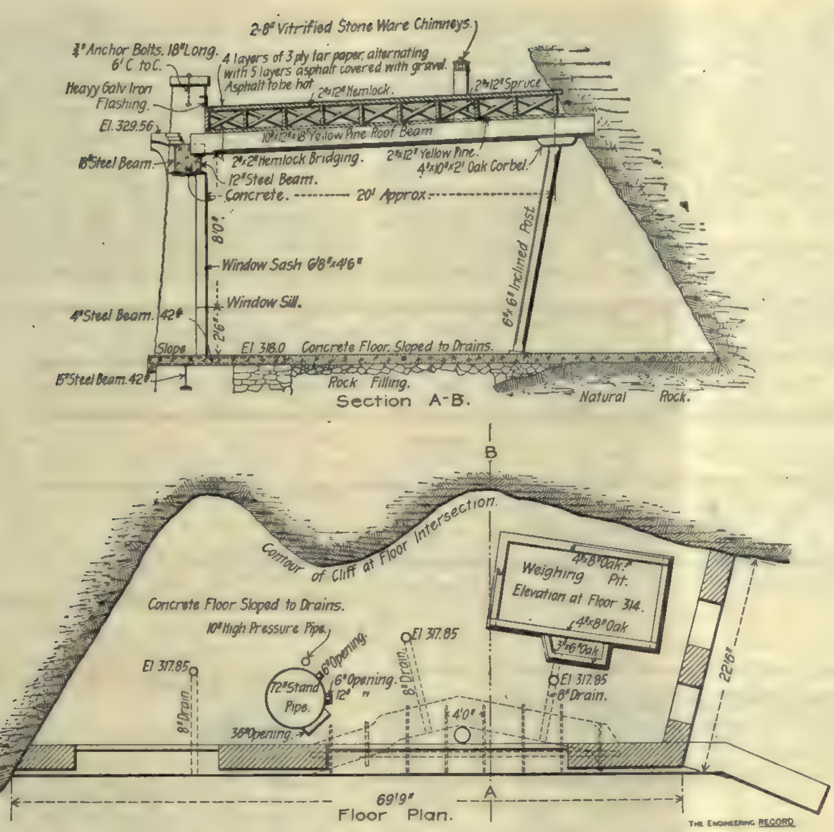
"The determination of corrections to be made in the beds of streams to give them the most stable longitudinal profile.

"Study upon the conditions of such rivers as build their minor beds upon their major bed. Major Leach's recent paper upon 'What the Mississippi is, and What it Needs,' offers numerous suggestions of usefulness for this laboratory.

"Study of littoral cordon formation, and of channels and bars, deltas, and of deposition of sediment from rivers entering into quiescent water, and against high tides.

"Study of the conditions affecting the length of tangents and degree of curvature in natural and constrained water courses, looking to secure permanence of channels and depths of water.

"Studies upon the delivery and conditions of the watershed of the stream and tributaries which feed the canal, in reference to the



CONSTRUCTION OF THE HYDRAULIC LABORATORY.

amount and kinds of matter suspended by floods, the interrelations of the deliveries of tributary watersheds, and such studies as may prove useful for determining the coefficient of flood volume, lengths of dams and spillways, and heights of floods over them, so as to perfect the formulæ for the delivery of watersheds, if this be possible.

"Experiments upon the rating of current meters, and general studies upon the motion of water in open channels, in pipes and over weirs, under variable conditions of velocity, materials of the bed, conditions of surface, contractions and heads.

"The determination of the resistance to the motion of boats in canals in reference to their respective cross sections, effects of waves, etc.

"Experiments on water jets, forms of water wheel buckets, ratios of areas and forms of propellers, including water jet propulsion.

"The uses of the laboratory are not restricted simply to questions strictly classified as of hydraulic importance. For example, a solution will be attempted of the problem of the relations that should exist between the grade of a sewer and the volume of flush water required to produce a given effect, which are at present almost entirely unknown.

"The engineer who is to supply drinking water to cities, and makes it more or less stagnant behind dams and impounding and distributing reservoirs has had, hitherto, no definite knowledge of the best means for preserving a standard purity in his water supplies. The laboratory offers opportunities for study of the modes of life and means of death of the infinite number of micro-organisms found in water, which prey upon human health.

"The hydraulic laboratory lends itself admirably to studies now being made at various places in an effort to find out how to populate drinking water with forms of life capable of destroying dangerous organisms."

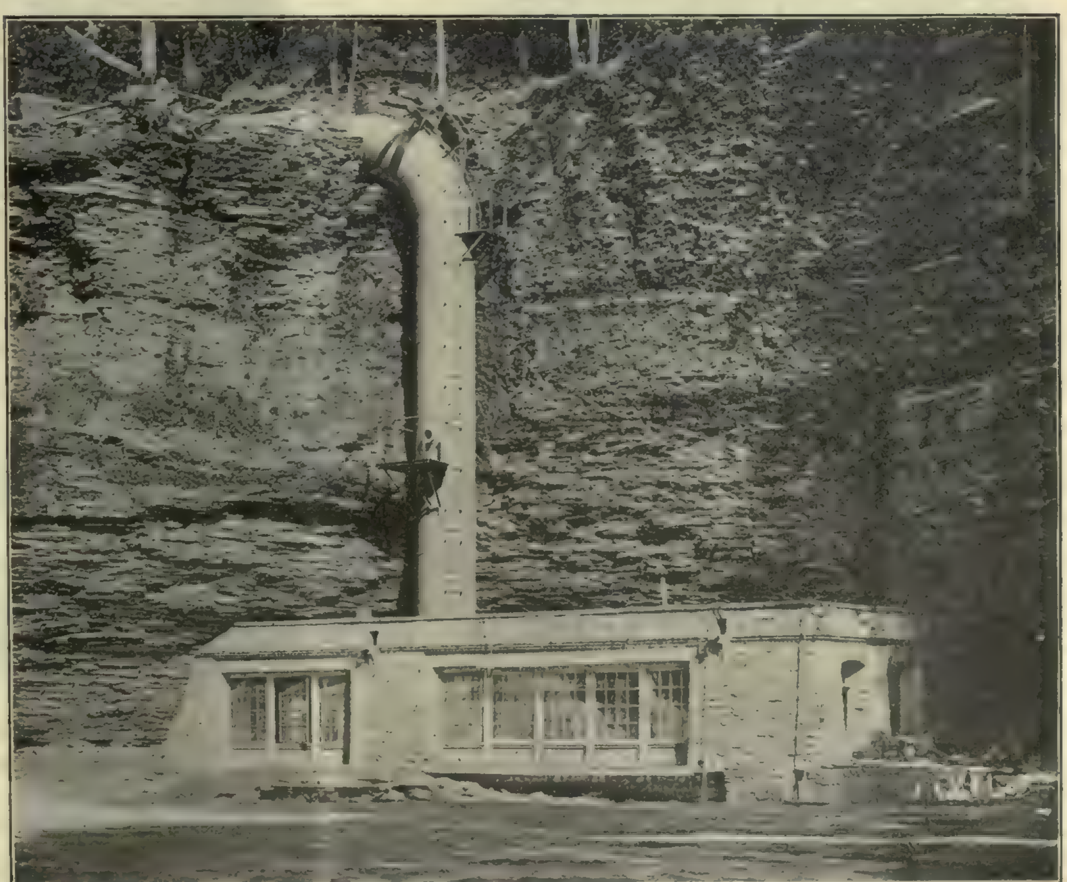
It is as yet too early to refer to prospects and projects in detail. The present difficulty lies in blocking out from the shapeless mass of ideas and possibilities such methods of procedure as may, by themselves, justify preference to this or that other line of work. Details of the present intentions to develop methods of procedure, which the problems in hand may largely modify, would be of little interest now.

There are at present three mechanicians engaged in turning out special instruments generally needed in all fundamental experiments. Probably the first experiment to be made will bear upon the calibration of weirs, and it is expected that the results will lead to a modification of the formula accepted hitherto as correct. While there is doubtless a relation between the head back of any pond, referred to the lip of the weir, this relation is so affected by innumerable, unknowable conditions of the water prisms approaching the weir, that no set of coefficients can be devised to meet the conditions of every case. The mechanicians are now at work upon a very valuable modification of the Pitot tube, designed by Mr. Gardner S. Williams, the engineer in charge of the laboratory, which will enable any observer to study the conditions of the flow of water filaments at the weir itself. It seems more than probable that these experiments will amplify and simplify all questions of delivery over weirs and bring to light in a manner never before realized the true method of their calibration, not only when the water flows with or without end contractions over a thin edge, or, as is usually the case, over lips of considerable width.

Other appliances are being constructed which will be employed in determining the actual distribution of velocities in pipes, and for the continuation of experiments recently begun at the Detroit water-works by Professor Williams, who has already done some work in this direction. For this purpose a large number of special castings are being devised to be connected with smooth brass tubing of many different diameters. The study of the distribution of these velocities will be undertaken with the assumption that they are not propagated in lines lying in a plane, but in curves, which probably project as loops at right angles to the flow. The apparatus to be employed for these measurements along the length of straight and curved pipes to determine the velocity and direction of the water filaments is extremely sensitive and accurate. There seems to exist not only varieties of opinion among hydraulicians with regard to this question, but preliminary experiments seem to point to results entirely unexpected.

It is at this time too early to indicate further what may be done in reference to losses of head through orifices and nozzles, pipes and closed conduits. There are some limits to this question, beyond which there is no very reliable information, especially in the development of water supplies for large cities, in which much of the work that has been done is in a very unsatisfactory condition.

Experiments will be undertaken at once upon the resistance of standard geometrical bodies moving in water, with such modifications of form, surface and relative dimensions as may bring under systematic analysis experiments made in this direction in the past.



THE HYDRAULIC LABORATORY AND STANDPIPE.

The conditions of the pond at present, and of the canal, especially after it shall have been lengthened to two or three times its present dimensions, as is proposed, will enable those working at the laboratory to make experiments on the rectification of water courses with a

view to improve the profiles of the thalwegs and to study the relations of curvature to permanence of banks and bottoms.

The question of area and form of propellers is also a problem demanding investigations, for which this laboratory offers opportunities. A considerable amount of work has already been done with this end in view by Prof. Durand, principal of the School of Marine Engineering.

In so far as the ordinary student in engineering at Cornell is concerned, it is not probable that there will be much, if anything, in his curriculum specifying compulsory work in this hydraulic laboratory. As announced by the director, the work done in it will refer mainly to experiments having no other purpose than to solve problems in advanced work, in which undergraduates may be employed as intelligent assistants. The old hydraulic laboratory in the Civil Engineering College will be used, as heretofore, as an adjunct to the classroom study of theoretical hydraulics. On the other hand, the graduates who wish to specialize in hydraulics will be taken to the large laboratory, and there encouraged and assisted in pursuing original investigations.

To the profession the laboratory offers a fair prospect that in the comparatively near future engineers will be able to undertake and solve many problems whose solution has hitherto proved impossible. It is the stated intention and purpose of those in charge of the work to make it scientific and reliable, and to investigate as fast as means and circumstances afford those problems presented which are considered worthy. This fact has already been appreciated, and the Director of the College is now in communication with engineers, both in this country and in Europe, with reference to experiments which these engineers desire to have undertaken for the advancement of hydraulic science. Some of these bear on what has already been stated with reference to weirs. Propositions have come from India, through a Scottish engineer, for determining the volume of flow in open channels of equal sectional area, but with differently proportioned wetted perimeters. The problem of irrigation in the West has also brought inquiries of a definite nature to the laboratory authorities. Various companies interested in water power development and turbine construction have also applied for their aid. In addition to this, as noted before, Professor Fuertes has announced that the laboratory is at the service of any engineer or any corporation desiring to conduct experiments tending to advance the interests of hydraulic or sanitary science, with only the condition that the work be done without expense to the university beyond the use of equipment, and that it does not interfere with the regular programme of work under way for the time being.

All the experimental work will be done under the supervision of Mr. Gardner S. Williams, who has been appointed professor of experimental hydraulics in charge of the laboratory, and who resigned the position of chief engineer to the Board of Water Commissioners of Detroit in order to come to Cornell.

By direction of Professor Fuertes, all questions submitted to the faculty of the laboratory will be studied by a board composed of himself, as Director of the College; Professor Williams, as engineer in charge of the working of the laboratory, and Professor I. P. Church, as professor of hydraulics, whose well-known qualifications will be a source of strength to the discussions and formulations of the theories of the new hydraulics which this laboratory may bring to light. This board, with the cooperation of the engineers interested in special experimentation, the magnificent equipment owned by the university, and the facilities it furnishes in men, libraries, leisure, locality and opportunities, bids fair to open a memorable page in the history of hydraulics.

THE TEMPERANCEVILLE BRIDGE.

The Pittsburg, Cincinnati, Chicago & St. Louis Railway Company decided recently to make a partial renewal of a double-track, three-truss deck bridge at Temperanceville, Pa. Two spans of the old Keystone pattern, each 117 feet 9 inches long, with wooden floor beams resting on their top chords, were replaced by new spans of the same dimensions but heavier construction, with pin-connected tension members

There are counters with sleeve nuts in every panel. The bed plates are made very deep and stiff to distribute the pressure over a large area of the masonry. Some of the special and typical features of the design are shown in Figures 2, 3, 4 and 5, and the details not shown are of the same general character and conform to standard practice. An elevation of one end of a side truss is shown in Figure 2 and a corresponding elevation of one-half of the end view

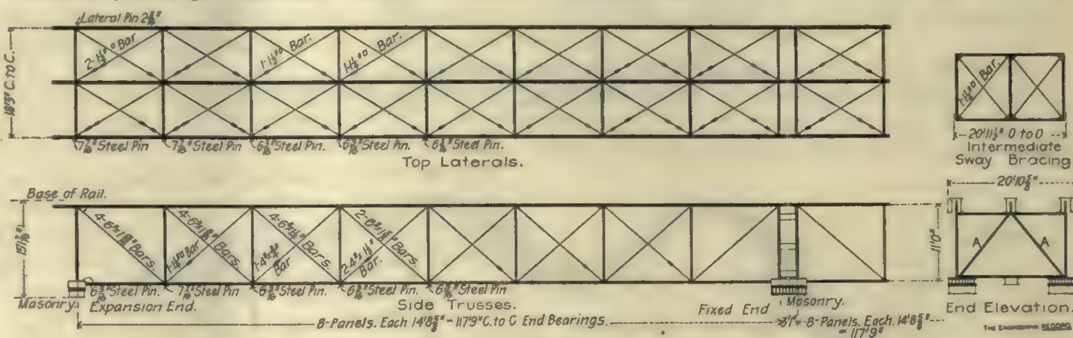


FIG. 1

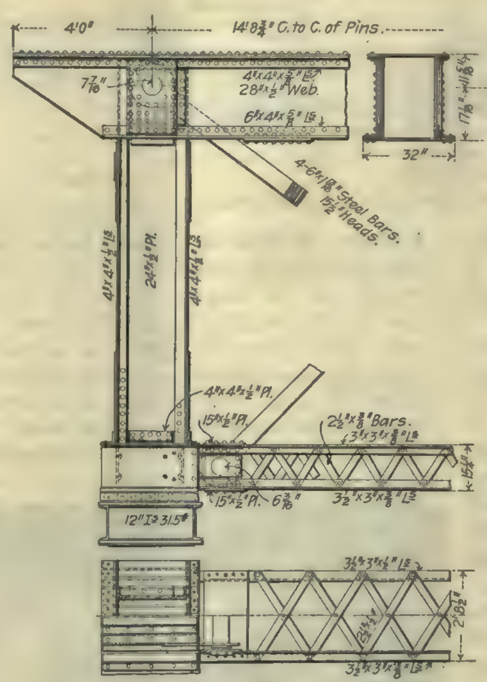


FIG. 2

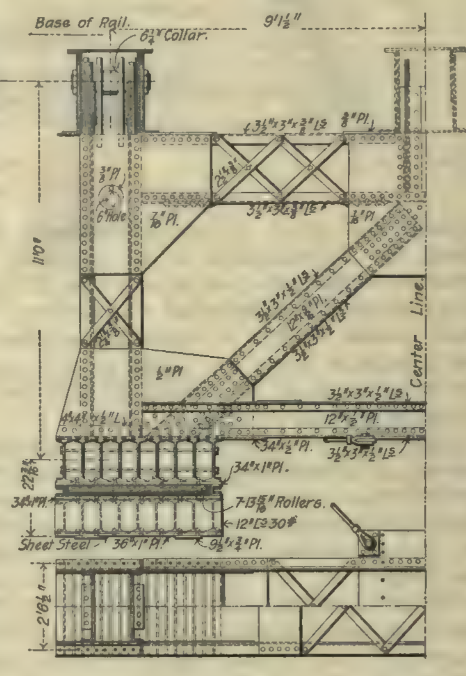


FIG. 3

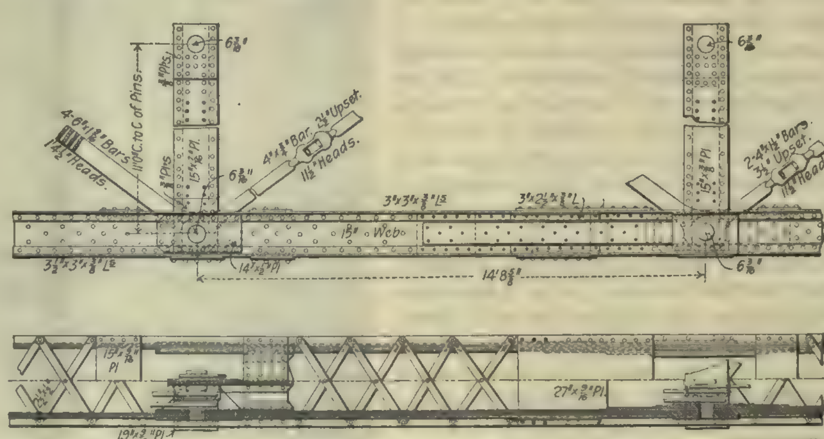


FIG. 4

DETAILS OF TEMPERANCEVILLE BRIDGE.

and rigid sway bracing. The diagrams shown in Figure 1 indicate the arrangement of the principal members. The center truss differs from the side trusses in that the end vertical posts are omitted and the weight of the truss and its load is carried through the end top chord bearings, which are supported at each end by a pair of inclined braces AA in the transverse vertical plane, which transmit the pressure to the pedestals of the side trusses, thus leaving the middle of the abutments clear and concentrating all the loads on the two seats at each end. The lower chords are stiff members, and both top and bottom chords have reinforced web plates in the middle panels. The top chords are spliced at every panel point and the bottom chords have center diaphragm plates for pin bearings.

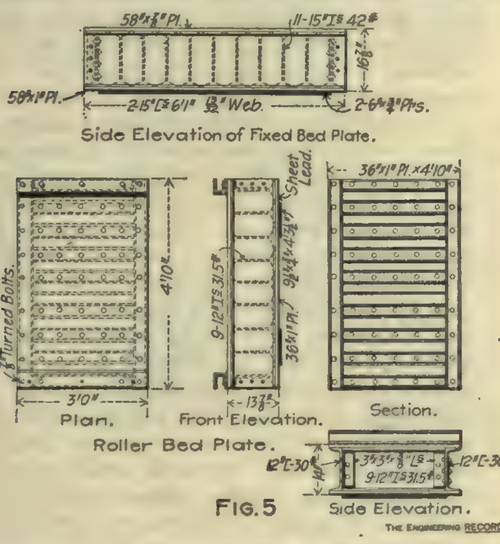
of the bridge is shown in Figure 3. The heavy riveted sections of the center panels of a side truss bottom chord, with truss connections and field riveted splice and pin packing, are shown in Figure 4. The fixed end bed plate is similar to that at the roller end which is shown in Figures 2, 3 and 5, except that as it receives two spans instead of one it is 6 feet instead of 3 feet long and is built of 15-inch instead of 12-inch beams. Both sets of bed plate beams are filled with concrete and seated on sheet lead plates on the masonry. All top lateral pins are 2 11/16 inches and all bottom lateral pins are 2 3/16 inches in diameter and are secured with cotters.

The bridge was proportioned in accordance with the 1897 bridge specifications for the Pennsylvania lines west of Pittsburg. Total

dead load, 3,600 pounds per lineal foot; live load for side trusses, two-thirds of (50,000 pounds concentrated plus 5,000 pounds per lineal foot), for center truss, 52.2 per cent. of the load for the side trusses. Lateral loads, on top chords, 200 pounds dead and 300 pounds live per lineal foot of track; bottom chord, 150 pounds dead per lineal foot of track. The unit strains allowed are: Tension, for plates and shapes, 8,500 $(1 + p)$; for rolled bars, 9,000 $(1 + p)$; for floor-beam hangers, suspenders and counters, rolled bars, 8,000 $(1 + p)$; for wind bracing squares, 12,000 $(1 + p)$; for centrifugal force traction bracing and sway frames, squares, 11,000 $(1 + p)$. Compression, l = length, r = least radius of gyration and h = height of chord section. General formula: $s = (1 + p)(9,000—40 (l \div r))$; for top chord with cover plate, $s = (1 + p)(9,000—103 \times (l \div h))$; for top chord without cover plate, $s = (1 + p)(9,000—108 (l \div h))$; for lateral struts, $s = (1 + p)(11,000—52(l \div r))$. For steel shop rivets: Bearing, 11,000 $(1 + p)$; shearing, 5,500 $(1 + p)$. Iron field rivets: Bearing, 8,000 $(1 + p)$; shearing, 4,000 $(1 + p)$. On pins: Shearing, 6,000 $(1 + p)$; bearing, 12,000 $(1 + p)$; bending = 15,000 $(1 + p)$.

In all the preceding formulae p is the quotient of the minimum divided by the maximum absolute stress in any member.

The limiting conditions made it necessary to erect the bridge by special methods on timber piers or trestle bents parallel to the masonry



DETAILS OF BED PLATES.

piers and extending close to them underneath the existing old structure and beyond it on both sides, so as to receive the new trusses on one side and provide support for the old ones to be moved out laterally on the opposite side. Describing the field work, Mr. S. P. Mitchell, manager of the Edge Moor Bridge Works, writes:

"On account of the network of tracks under this bridge, the very limited headroom, etc., it was practically impossible to put in false work on the line of the bridge, take down the old structure and put up the new one in the usual way. Further than this, there is a very heavy traffic over the bridge, and it was desirable to interfere with it during erection just as little as possible. To cover these conditions it was decided to erect the new bridge to one side of the old one and then shift the old one out and the new into position. On the easterly span it was impossible to move the old bridge out bodily far enough to allow the new one to come into its place on account of local obstructions, so the old and new spans were moved together about 10 feet, then the floor and lateral systems were removed from the old span, the outstanding truss was guyed so as to hold it in position and the inside truss lashed to the new span; the movement of the new span and one of the old trusses was then completed. In other words, on account of lack of room the floor and lateral systems had to be removed from the old spans and the trusses telescoped. This operation, including the removal of the entire floor system, the cutting out of the lateral system and the moving of the spans, occupied one hour and fifty minutes. In the westerly span there was room enough to move the old span out bodily, and the new and old spans were rolled over together in one minute and forty seconds. The spans were moved on rollers about 3 inches in diameter, rolling between rails."

The designs for the bridge were made in the office of Mr. William D. Johnson, chief engineer of the railway, and the bridge was built and erected by the Edge Moor Bridge Works, Wilmington, Del., Mr. W. H. Connell, president, and Mr. C. W. Bryan, chief engineer.

NOTES.

A Marked Saving due to Mechanical Draft has been observed in the fuel tests of the 1,000 h. p. steam plant of the United States Cotton Company at Central Falls, R. I. The introduction of a fan costing $550 made it possible to change from Cumberland coal to a low-grade mixture, resulting, according to a pamphlet issued by the B. F. Sturtevant Company of Boston, Mass., in an annual saving of $6,500. The fan engine speed is regulated automatically to accommodate itself to the steam pressure. No economizer is used, but the temperature of the escaping gases is said to seldom exceed 400 degrees Fahrenheit.

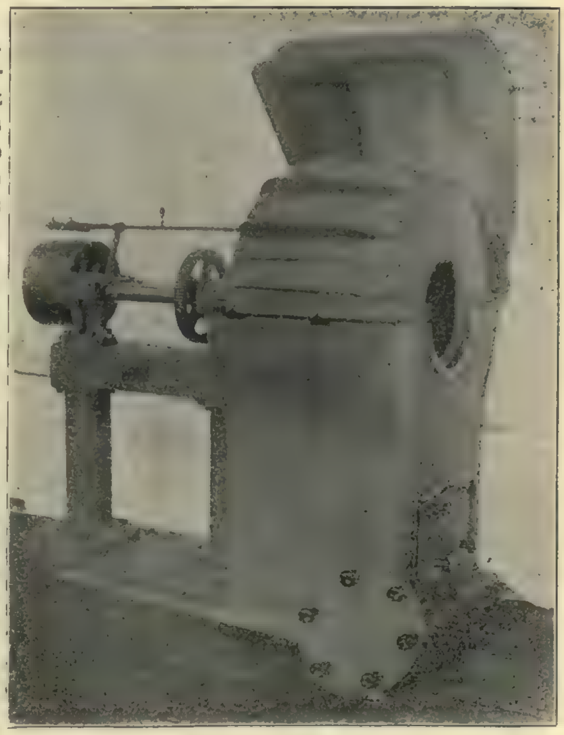
Pipe Laying in Frozen Earth is carried on in Boston, Mass., by means of a portable heating plant to thaw out the ground. The exact amount of pipe to be laid during a day is determined in advance. The night before the work begins a portable boiler is hauled to the place, and connected with perforated 1½ pipes laid on the surface of the ground. These are covered by a wooden casing of a width approximately equal to that of the trench, and earth is piled over the joints and other points where leakage may occur. Steam at 40 to 60 pounds pressure is then turned on the pipes, and in this way the earth is thawed so as to be readily removed by the trench gang when it arrives in the morning.

An Exhaust Pipe Accident occurred under unusual conditions at the Eastern Power Station of the Brooklyn Rapid Transit Company some time ago. Mr. James Anderson writes that the pipe was a 36-inch cast-iron connection between the engines and condensers on one side of the engine room. Through a mistake of one of the engineers, communication from the pipe to one of the condensers was cut off while two of the engines were exhausting into it; in this way it was subjected to inside pressure great enough to cause an explosion. "The accident was due to the loss of condensing water simultaneously on five of the engines. This demanded very quick work on the part of the engineers changing from the condensers to atmosphere. The fact was overlooked that at the time two of the engines were working on one condenser; one of these was left on the exhaust or vacuum line after the rest were let go free, and all the condensers were shut off, thereby closing all exits for the steam, with the results noted."

METHODS OF TESTING PAVING BRICK.

At the recent convention of the Indiana Engineering Society Prof. W. K. Hatt of Purdue University presented an important paper on methods of testing paving brick, a subject which is now beginning to receive the attention it has needed for some time. This material has been undergoing the same process of development that marks the history of other building materials. For some time it was purchased without strictly scientific specifications, reliance being placed in a large measure on the reputation of the manufacturers. Definite standards, however, are as desirable for paving brick as for other materials, and it is interesting to notice that Professor Hatt concludes that, when a few questions as to methods of procedure are settled by further experiment, the results of rattler tests may be expected to furnish an indication of the quality of these bricks of an equivalent degree of accuracy to the tests of other materials.

In the case of brick the purpose of the specifications should be to obtain a material "having the same properties as that in pavements which have stood the test of time, and to insure securing as good material as the samples submitted by the contractors with their bids." The qualities which are desirable are hardness to resist the abrasive action of traffic, toughness to resist the chipping effect of the calks of horses' shoes, strength to resist the direct pressure of wheels, and imperviousness to water, so as to resist the action of frost. These properties can be determined by testing; the effect on the life of the pavement, of the size of the brick and the manner in which it is laid does not, of course, come under the head of Professor Hatt's inquiry. The ordinary tests of brick have been simple and easily made, and have been used for some years without any critical examination of their value. While they may distinguish between a very soft and a hard paver, they do not seem to grade the different classes of material properly.



THE PURDUE UNIVERSITY RATTLER.

The absorption test, to determine the amount of vitrification, is properly made with brick which has been divested of its surface in the rattler. After having been dried for two days at a temperature of 240 degrees it is kept under running water for two more days. The difference in its weight after drying and after remaining in the water enables the percentage of absorption to be obtained; five brick are necessary for a satisfactory result. This test has been criticised for a number of reasons. In the first place it is impossible to obtain any figures representing the total porosity in any reasonable time. It is difficult to dry the bricks, and the absorption usually proceeds very slowly for the first few days of immersion. In the second place, the rate of absorption of different bricks differs greatly, so that the results of a two-day or three-day test may be very misleading. Bricks with the same total absorption may vary as much as 10 to 1 in the rate of absorption in short periods. In the third place, there seems to be no relation in the case of different makes of brick between a low rate of absorption and good wearing qualities, as is evident from the accompanying diagrams in

which the results of both rattler and absorption tests are copied. In the fourth place, while a brittle, overburned brick will show a low rate of absorption, its weak inner structure, easily affected by frost, would not enable it to pass the rattler test.

The cross-breaking test is useful in determining faults of structure and in opening the interior of a brick to inspection; whether, however, it discloses the toughness of the sample, as is frequently stated, may be open to argument. A study of the tests made on paving bricks discloses only a very general relation between the curves of the breaking and rattler tests, not definite enough for competitive tests. Even when the greatest care is taken there may be in the cross-breaking tests a variation of from 40 to 60 per cent. between the results obtained with individual bricks of the same sample lot. The average of results thus discodrant, Professor Hatt points out, will have but little meaning. The individual bricks do not differ in their quality to this extent. The diagrams show that in a general way like variations may be noticed between the results on the cross-breaking and rattler tests, but the discrepancy is nevertheless so serious that the use of any rating formula depending on them must be quite illogical. Mr. F. F. Harrington's test of samples of under-burned and over-burned brick, in comparison with tests on properly burned samples, shows that the cross-breaking tests may rate the soft-burned brick higher than the over-burned material.

The crushing test, like the cross-breaking test, subjects the brick to stresses which it is unlikely it will ever have to resist, although this is no reason why both may not be of value in showing the quality of the samples. A brick having a close, homogeneous structure may behave well in the crushing test, although the quality of brittleness will not be indicated. There is no connection between the results of compressive and rattler tests.

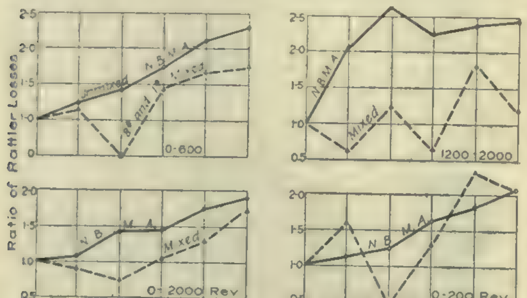
The tests for hardness and specific gravity are so unnecessary that no attention is paid to them. These strictures are justified by the quantitative results of a critical examination. Many will not be inclined to go so far. However, the weight of evidence, as contrasted with opinion, is against these tests.

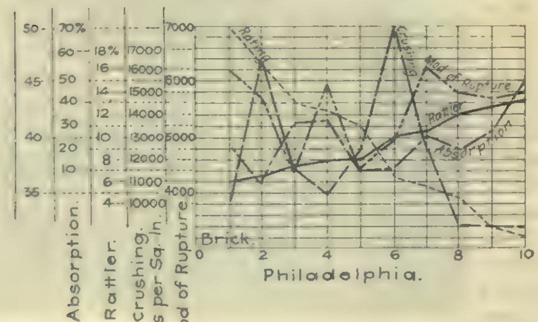
The remaining test which it is possible to employ is made with a machine developed from the foundry rattler. If it be admitted that the essential qualities of toughness and hardness are not shown either by the absorption, cross-breaking or compressive tests, then the rattler test deserves careful consideration as the last hope of the engineer. This is made by revolving bricks in a tumbler, in which they receive the blows of brick falling on brick or cast-iron blocks falling against them, thus chipping the edges away and revealing any lack of toughness. Farther along in the test the bricks are subjected to rubbing action against each other or the cast-iron blocks. Different engineers have used different apparatus and methods in conducting these tests, so that frequently no comparison can be made between the results.

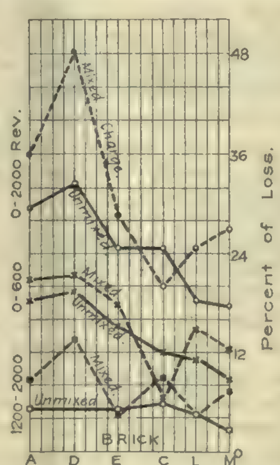
If brick are subjected to test in such a rattler and are taken out and weighed at intervals, the rate at which they are chipped or worn at different stages of the test may be determined, and a curve may be drawn expressing the behavior of the brick throughout the test. The character of this curve will disclose the properties of the brick, and comparative curves of the results of tests of different samples will show the relative value of the materials. For example, in the diagram of the results of tests made with unmixed charges in accordance with the National Brick Manufacturers' Association rules, the curve D is plotted from the results obtained with a brittle brick which loses a large percentage during the first part of the test, but, having good wearing qualities, does not lose so much during the remainder of the time it is in the rattler. Curve I in the same diagram shows the properties of a brick which is tough and able to withstand the blows during the first part of the test, but too soft to withstand the wearing action at the final stages of the test. Curve M is that of a tough, hard brick. Curve E is that of one of good quality. By tabulating the percentages of loss from 0 to 600 revolutions the comparative toughness of a sample may be obtained, and by tabulating the percentages of loss from 1,200 to 1,800 revolutions the comparative hardness may be obtained.

Considerable work has been done to standardize the rattler tests. Mr. J. H. Burt, in the "Technograph" for 1896, reported that specifications for these tests from 15 cities showed the following range of values: Length of rattler, 24 to 54 inches; diameter, 15 to 40 inches; revolutions per minute, 15 to 55; duration, 30 to 360 minutes; weight of iron, 50 to 800 pounds; loss permissible in one hour, 3 to 20 per cent.

In seeking for a proper abrasive material he found by trial that the losses for 8-pound shot were greater, and those for 1-pound shot were less than the losses for an unmixed charge, and with mixed 8-pound and 1-pound shot the percentages of loss were independent of the number of brick. On the other hand, the percentages of loss increased with the number of brick used in the case of an unmixed charge. His results indicated that an unmixed charge or one mixed with 1-pound shot failed to detect the brittleness of a brick. He recommended that not less than six bricks be tested, in order to eliminate accidental effects on single brick in the rattler. He further advised making two tests, one for impact or chipping with 200 pounds of 8-pound shot, and the other for abrasion or wear, using the same quantity of 1-pound shot.







Comparison of Mixed 8* and 1* Shot, and N. B. M. A. Unmixed.

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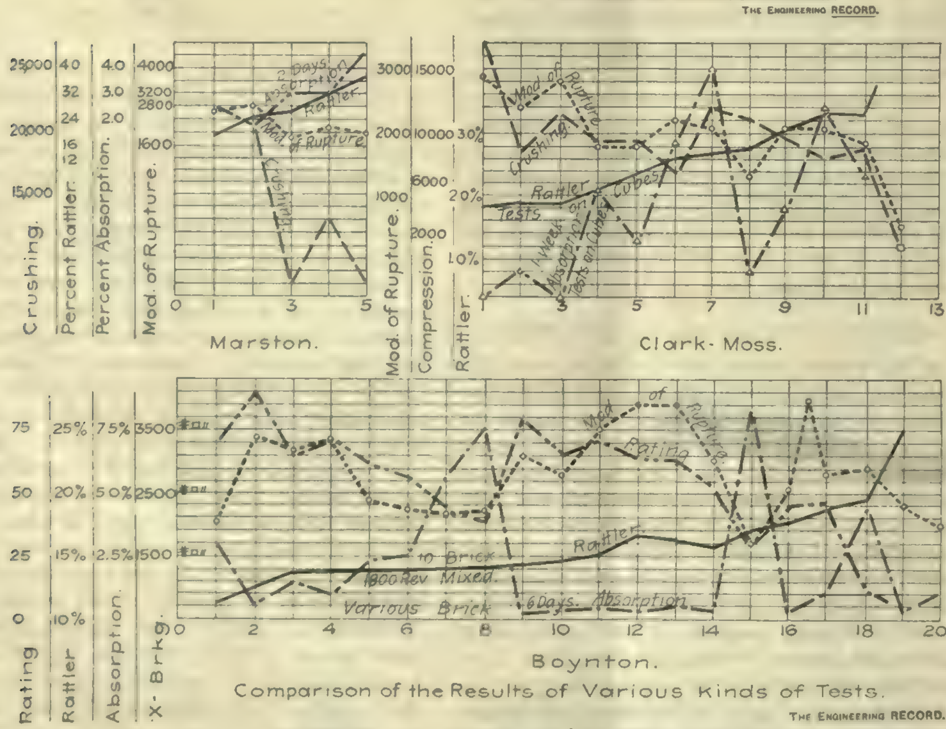

Comparison of the Results of Various Kinds of Tests.

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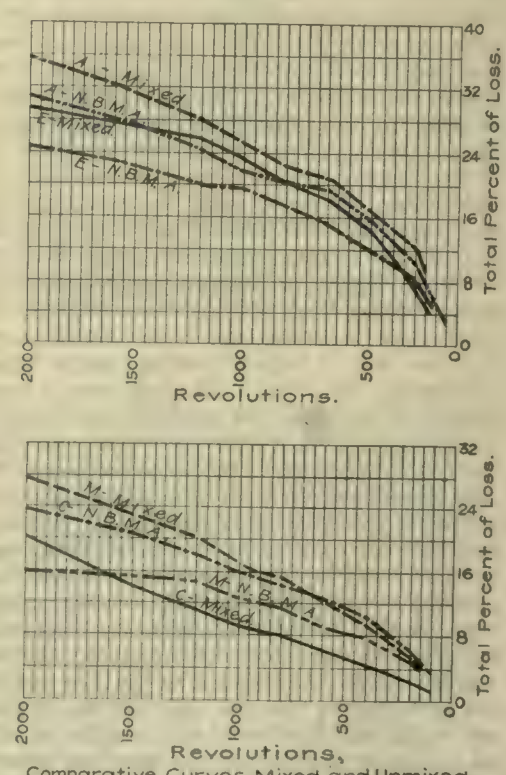


Comparative Curves. Mixed and Unmixed.

THE ENGINEERING RECORD.

RESULTS OF TESTS OF PAVING BRICK BY DIFFERENT EXPERIMENTERS.

In the first case the samples should not lose more than 15 per cent. of their weight in 750 revolutions, and in the second case not more than 12 per cent. in 1,500 revolutions, the speed to vary between 20 and 30 revolutions per minute.

Professor Hatt also refers to the experiments made by Mr. E. P. Boynton at Cedar Rapids, Iowa, in 1896. The brick were made from a variety of clays, which were subjected to chemical analyses and ordinary physical tests. No connection between the chemical composition of the clay and the physical qualities of the brick could be detected. The rattler tests were made with 10 brick, 300 pounds of 2-pound cubes, 340 pounds of 2-pound spheres and 120 pounds of foundry shot weighing from a quarter to a half pound each. The results are shown in one of the accompanying diagrams. It will be noticed that there is only a general resemblance between the cross-breaking and rattler tests, and that the rating formula used by Mr. Boynton follows the cross-breaking test closely.

As a result of the investigations made for the National Brick Manufacturers' Association the rattler recommended by that body was fixed as 28 inches in diameter, 20 inches long, and run at 30 revolutions per minute for 1,800 revolutions. An unmixed charge of 15 per cent. of the capacity of the rattler is advised, no granite or foundry shot being used. The investigations of Mr. F. F. Harrington showed that an over-burned or under-burned brick could be detected from the curve of the rattler losses. He found that bricks of a small size were at a disadvantage in the rattler test when compared with those of larger size of the same quality. The heavier bricks are capable of striking more severe blows and will lose more rapidly at first, yet the net result is to bring the smaller brick into a disadvantageous position. It would seem therefore that the rating of the rattler test according to the size of the brick is a logical procedure. Professor Talbot of the University of Illinois has protested against the method of testing brick without any abrasive material. That is to say, his recommendations are directly opposite to those of the National Brick Manufacturers' Association.

The experiments now in progress in the laboratory of Purdue University will, it is hoped, clear up much of the discrepancy in the various results and methods of rating. They are intended to determine: 1. The relative effect of mixed and unmixed charges in the rattler test. 2. The effect of testing cold and wet brick. 3. The effect of alternate freezing and thawing on the brick and on their resistance in the rattler. 4. The relation between tests for cross-breaking, absorption and crushing.

The tumbler used in these experiments was built by the University, and gives good satisfaction. It is of the Association standard size, but opens at one end, so that brick may be inserted or taken out with the least trouble. It is run at 30 revolutions per minute. The samples of brick are stored in the laboratory, and when tested are dry and at a temperature of about 70 degrees Fahrenheit.

The first tests were made without any filling material. Ten per cent. of the volume of the rattler was filled with the brick, and the loss in weight was determined at intervals, as indicated on the accompanying diagrams and in the following table. Two similar tests were required for final results.

Experiments at Purdue University.

Sample.	Chipping. 0-200 With shot.	Chipping. 0-200 No shot.	Chipping. 0-600 With shot.	Chipping. 0-600 No shot.	Wear. 1200-2000 With shot.	Wear. 1200-2000 No shot.	Wear. 0-2000 With shot.	Wear. 0-2000 No shot.	Absorption, Percentage.	Modulus of Rupture.
A..	11.6	10.2	20.4	18.0	8.3	5.1	35.5	29.5	3.9	2,402
B..	6.6	5.0	16.5	10.4	7.6	14.9	32.2	32.2	..	....
C..	2.5	6.3	6.0	12.8	9.0	5.5	10.0	24.5	..	1,994
D..	13 3	9.2	21.2	19.7	13.3	5.0	48 2	32.5	2.2	2,165
E..	7.6	8.2	18.0	14.9	4.4	4 8	28.5	24.5	1.8	3,388
F..	..	7.6	..	14.2	..	5.4	..	25.2	..	....
G..	..	8.0	..	14.5	..	4.9	..	24.8	..	....
H..	..	6.4	..	12.6	..	6.5	..	25.0	2.4	....
I...	..	6.2	..	13.0	..	6.4	..	27.4	..	....
J...	..	6.7	..	12.5	..	4.3	..	24 5	..	....
K..	..	5.4	..	11.5	..	3.7	..	19.4	2 9	2,108
L..	9.2	5.8	14.5	10.8	4.3	4.3	24.5	18.2	2.4	2.248
M..	5.6	5.0	12.2	8.5	7.0	2.1	27.2	17.0	1.7	2,163

Note: The percentages of absorption give the results at the end of six days.

The brick were weighed on a scale reading to a quarter of a pound, and in case one was broken during the test it was the practice to weigh any piece of more than 8 ounces. When a brick breaks in two the percentage of loss increases and the test is not strictly comparable with those when there is no such fracture. Still, the fact that a brick breaks usually indicates that there is some defect of structure, and this increased loss should be counted against it. It is remarkable how closely two tests on the same brick will agree, like those of the brick J which are plotted in one of the accompanying diagrams. The average discrepancy is shown in the case of the brick F in the same diagram. This shows that the rattler has a uniform action.

It was intended to compare tests of the same brick with and without cast-iron shot, but the rattler broke down and only six comparative tests were made. A study of the accompanying diagrams will show that the unmixed charge does not fail to discriminate between the different samples of brick.

A series of tests was also made to determine the effect of cast-iron shot. The advantage of using them is that fewer brick need be employed, and the results are not so much influenced by the number of brick. The shot must not be miscellaneous foundry scrap; there must be a definite number of large shot to give impact, although not too large to cause unevenness of action or injury to the rattler, and a definite number of small shot to produce the abrasive action. For a tumbler like that shown in the illustration the charge would be 75 pounds of 8-pound shot and the same quantity of 1-pound shot. Both sizes have edges rounded to half an inch radius; the larger measure 2½x3⅛x5¼ inches, and the smaller 1x1½x2½ inches. It will be noticed that the larger size has about the same weight as brick. It was found during the test that the brick seemed to break no more often with than without the shot. The great loss in the case of samples D with shot was due to the failure of three bricks of rather poorly united material of different colors. An anomalous result was obtained in the case of brick C, which had many laminations, and broke up considerably in the unmixed charge. Its surface was very smooth, and the small loss may have been due to the glancing of the shot off the surface without doing any damage. In all other cases the curves for the shot-filling tests lie higher than those for the others.

The deductions which Professor Hatt has made from these experiments are as follows:

1. The rattler test is quite competent and all that is needed to select good brick for pavements, and accurate enough to grade competitive samples properly.

2. It may be made either with or without shot, but preferably with shot of the size already mentioned (Prof. Talbot's standard), and at the rate of speed used in the Purdue University experiments.

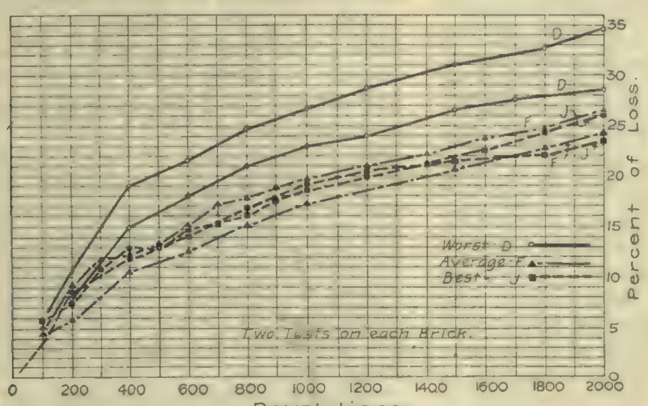
3. The toughness will be indicated by the percentage of loss during the first 600 revolutions.

4. The abrasive resistance is measured by the percentage of loss between 1,200 and 2,000 revolutions.

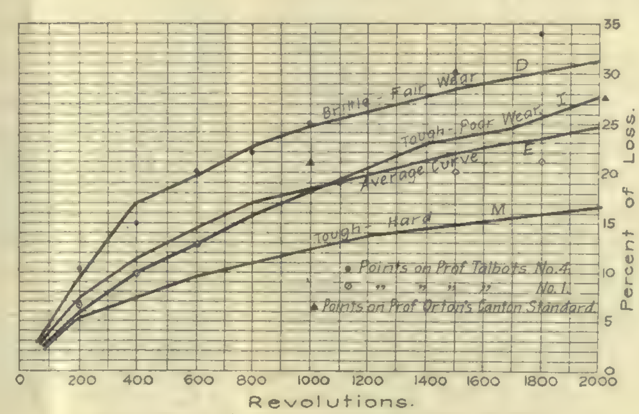
5. The tests for cross-breaking, crushing and absorption may be omitted.

6. Rating formulas are of no value and should not be employed.

In connection with these rattler tests a few for cross-breaking and absorption were also made, and the results will be found in the table. They show no better relation among themselves or with the results of the rattler test than are evident in the experiments of Mr. Boynton.



Uniformity Comparison of Tests N.B.M.A.



Representative Curves. Unmixed Charge N.B.M.A.

THE ENGINEERING RECORD.

RESULTS OF PAVING BRICK TESTS AT PURDUE UNIVERSITY.

In concluding this abstract it should be stated that sample A was a mixed shale and fire-clay, side-cut, repressed, stiff mud brick. Sample F was a side-cut, repressed, stiff mud shale brick. Sample H was a repressed, end-cut, mixed shale and fire-clay brick. Sample K was a side-cut, plain shale brick, and sample M a side-cut, repressed clay brick. The series of tests will be complete at the end of the year, when Professor Hatt will report.

THE RIGHT TO WITHDRAW ERRONEOUS BIDS.

One of the most important lawsuits ever tried in New York, from the point of view of contractors and engineers, was brought by the Moffett, Hodgkins & Clarke Company against the city of Rochester. The decision of the United States Circuit Court in the case, in favor of the company, was reviewed in these columns on April 30, 1898. The city, however, did not accept the decree as final. It was felt, to use the words of Mr. Emil Kuichling, M. Am. Soc. C. E., that "if this decision is a sound one, then the practice of advertising for proposals for the performance of public work becomes a simple farce, and all charter provisions which require the executive officers of municipalities to advertise for proposals can only have the effect of imposing unnecessary expense upon the taxpayers, and of inviting fraudulent collusion between bidders after the proposals have been opened and read." The case was accordingly appealed by the city to the United States Circuit Court of Appeals,

Hon. Joseph H. Choate, recently appointed Ambassador to Great Britain, appearing for the municipality. On account of the great importance of the points at issue, the full decision, which was written by Judge Wallace, is here reprinted from 91 Fed. Rep. 28:

By the decree appealed from, the complainant has been released from the obligation to enter into and perform a contract with the City of Rochester for the construction of certain municipal works conformably to the terms of a written proposal delivered by the complainant to the executive board of said city. The decree adjudged the proposal void, and ordered it rescinded, upon the theory that it embodied terms inserted by the mistake of the complainant. The case presents the general question of the power of a court of equity to rescind a contract on the ground of mistake.

Under the provisions of the charter of the City of Rochester, the Executive Board has control of the waterworks of the city, and authority to let contracts for such extensions and additions as it may from time to time determine to make. In December, 1892, the board, having determined to make extensions and additions, invited proposals for contracts, among them for those known as "Contract No. 1" and "Contract No. 2." This was done pursuant to section 172 of the charter, which reads as follows:

"The Executive Board is hereby directed to cause a notice to be published in one or more of the daily newspapers of said city, at least 10 days before the letting of any contract, for sealed proposals therefor, each to be accompanied by a bond signed by at least two responsible sureties, conditioned that the person, firm or corporation making such bid, if it is accepted, will perform the work or furnish the materials, or both, mentioned in such proposals, and fulfill any contract that may be made with him, them or it, and the amount specified in the bond shall be recoverable thereon in case the proposer fails to perform the conditions of the bond and its accompanying proposal; such bids shall be opened on the day named in such notice. Said board may let any contracts as it deems for the best interests of taxpayers, but it shall publish all bids received by it, and the persons, firms or corporations to whom contracts are awarded. Such contracts shall be enforceable by and in the name of the City of Rochester, or said Executive Board as such. Neither the principal or sureties on any bid or bond shall have the right to withdraw or cancel the same until the board shall have let the contract for which such bid is made, and the same shall have been duly executed."

Contract No. 1 contemplated the construction of a masonry conduit for a distance of 12,000 feet from Hemlock Lake northward. Contract No. 2 contemplated the construction of a riveted steel pipe conduit, either 38 or 40 inches in diameter, and 140,000 feet long, commencing at the north end of said masonry conduit, and terminating at Mount Hope Reservoir, with an option to the Executive Board of selecting either one of two different routes (designated as "A" and "B"), over a length of about 8,000 feet.

The notice inviting bids required separate bids for the different contracts. It stated that the award would be made as soon as practicable after the bids were publicly opened and read, and that, after the delivery of the bids to the Board, "the bid cannot be withdrawn." The complainant, a corporation engaged in the contracting business, submitted proposals for each of the two contracts. Each was distinct in itself, but instead of being inclosed in a separate sealed envelope, as required by the notice to the bidders, the complainant inclosed and delivered both under one cover.

The proposals of the various bidders for the work were opened by the Board at the time specified in the notice, and severally read in the presence of the bidders. For contract No. 1 the bid of the complainant was about $81,000 higher than that of the lowest bidder. For contract No. 2, route A, 38-inch pipe, the bid of the complainant was $903,324, being about $220,000 below that of the next lowest bidder; and for route B, 38-inch pipe, the bid of the complainant was $857,552, being about $273,000 below that of the next lowest bidder.

The evidence satisfactorily proves that the complainant made a clerical error in inserting in the proposal for contract No. 2, route B, the price of 50 cents, instead of 70 cents, per cubic yard for certain earth excavation (of the estimated quantity of 184,000 cubic yards), whereby the total amount of the bid, when the various items were tabulated, was $36,800 lower than it would otherwise have been. The evidence also indicates that the complainant made an erroneous estimate of the cost of certain tunnel excavation by omitting to take into consideration certain features of the work, and in consequence inserted in that proposal the price of $1.50 per cubic yard, whereas it would have otherwise inserted a price of $15. At the estimated quantity of this excavation, the bid was $27,000 less than it would have been at $15 per cubic yard. These errors were doubtless attributable to the haste in which the specifications were considered and the proposals prepared by the complainant—a haste which was unnecessary and almost inexcusable. At the time of the public reading of the bids the complainant called the attention of the Board to the mistake in the price for the earth excavation, but did not mention the other alleged error. It did not ask to withdraw the bid, and took no further action in that behalf until about 20 days thereafter, and when the Board had already awarded contract No. 1 to the lowest bidder. The complainant then sent a communication to the Board, insisting that its bid for the whole work included in contracts No. 1 and No. 2 was a single proposal, protesting against letting the two contracts to different contractors, and stating that clerical errors had been made in the proposal for contract No. 2, route B, in the prices for earth excavation and tunnel excavation, and the details of the errors. The communication concluded as follows: "We therefore respectfully request either that the contract in its entirety for both sections of the work be awarded to us, at the corrected prices, or that we may be allowed to withdraw our proposal." The Board, after receiving this communication, adopted resolutions awarding contract No. 2, route B, to the complainant. Thereupon the complainant commenced the present action.

It is manifest that one of the alleged mistakes—that in respect to the tunnel excavation—was not a mistake in any legal sense, but was a negligent omission, arising from an inadequate calculation of the cost of the work. Courts cannot permit such omissions to be brought forward by those who make them as a ground for receding from their engagements. The party in fault must have exercised at least the degree of diligence which may be fairly expected from a reasonable person.

It is also manifest that the complainant did not intend to give the Board an opportunity to correct the mistakes and award the contract on the corrected basis. There was no color of foundation for the assertion that the proposals were to be treated as a single bid for contracts No. 1 and No. 2, and that both contracts must be awarded to the complainant or neither. The position thus taken by the complainant was well calculated to excite distrust on the part of the Board, and induce its members to believe that the alleged mistakes were an afterthought, conceived when the complainant had become convinced, by studying the proposals of its competitors, that it could not profitably carry out the contract on the terms proposed.

The case differs quite radically from any reported in the books arising under the head of mistake. The contract contemplated an extensive and important undertaking, the cost of which could only be intelligently estimated after a thorough investigation of all the conditions by competent experts. It was to be let, after a competitive bidding, by a board of public officers, who were not permitted to exercise any favoritism or indulgence, who were required by law to consult alone the interests of the municipality they represented, and who would be exposed to just censure if they should tolerate any modification of a proposal in his own favor by a bidder. The statute, as well as the notice to bidders, informed all bidders that a proposal once submitted could not be withdrawn. A proposal made under such circumstances is entitled to be regarded as having some attributes of finality which do not belong to ordinary contracts.

Although the charter provisions do not preclude any relief by the court to a bidder in a proper case, it is designed in order to protect the city from the danger of collusion between the Board and bidders, or between bidders themselves, to constitute a proposal a perfect contract, as regards the bidder, from the time of its delivery to the Board. The statute would be a nullity if the Board or the courts could rescind such a contract whenever the bidder had made a mistake in the terms of his proposal. The nature of the contract forbids the court to interfere with it, much less to annul it, upon any latitudinarian notions of the doctrine of mistake as administered in equity.

The general doctrine is succinctly expressed in 15 Am. & Eng. Enc. Law, p. 628, as follows:

"In order that a mistake may come within the cognizance of a court of equity, it must be shown to be—First, material, or the moving cause of the complaining party's action; second, mutual, or shared in by both parties to the transaction; third, unintentional; and, fourth, free from negligence."

The salutary power of courts of equity to rescind or reform contracts which do not express the real intention of the parties is not to be extended to cases where the contract, because of the mistake of one of the parties, fails only to express the meaning of that party, and he seeks relief purely on the ground of his own mistake. The correct rule is as stated in Addison on Contracts:

"Where a mistake is unilateral, and the party by whom it was made is the sufferer, relief will not be granted unless there has been some undue influence, misrepresentation, surprise or abuse of confidence." 2 Add. Cont. p. 1182.

The court below adopted the opinion which has been sometimes expressed obiter by judges, and frequently quoted by text writers, that equity will not reform a written contract unless for the mistake of both parties, but may rescind and cancel one upon the ground of a mistake by either. Thus, it is said in Dulany v. Rogers, 50 Md. 533: "A mistake on one side may be ground for rescinding, but not for reforming, a written agreement." See, also, Diman v. Railroad Co., 5 R. I. 130; Hearne v. Insurance Co., 20 Wall. 491; Smith v. Mackin, 4 Lans. 41. The opinion seems to have originated in the observation in Mortimer v. Shortall, 2 Dru. & War. 373, that "a mistake on one side might be a ground for rescinding a contract, but could never be relied on as a reason for taking from a man what he thought he was to get under his agreement"—an observation which is neither lucid nor logical when read disconnected from the contract. What the proposition means, and all it means, is that a contract cannot be reformed into a new contract for the mistake of one party only, but may be rescinded for a mistake of one party whenever the circumstances of the case are such that it would be inequitable to allow the other party to enforce it, and inadequacy of consideration alone is not such a circumstance. Eyre v. Potter, 15 How. 58, 59. A very extended examination of the reports has failed to disclose a case in which a judgment rescinding a contract has proceeded solely upon the ground that the terms

as reduced to writing, although expressing the understanding of one party, did not express that of the other. In all the reported cases where there was not the element of mutual mistake, or mistake of one side with knowledge on the other, there was, in the language of Addison, "some undue influence, misrepresentation, surprise, or abuse of confidence," or the contract was so oppressive as to be unconscionable.

The courts have refused to reform contracts, and decreed rescission, where it was plain that the terms did not represent the real agreement of the parties, and it was not satisfactorily proved what were the terms of the real agreement in its entirety, or where the further terms could not be given effect without contravening the statute of frauds. So, also, there are many cases in the reports where the courts have refused to decree specific performance of contracts which, because of the mistake of one party, did not embody his understanding, and in these cases the plaintiff was left to his remedy at law. They proceeded on the principle that a court of equity, in the exercise of judicial discretion, will sometimes refuse specific performance of a contract which it would not order to be delivered up; "for," to use the language of Lord Elden, "the distinction is always laid down that there are many cases in which the party has obtained a right to sue upon the contract at law, and under such circumstances that his conscience cannot be affected here so as to deprive him of that remedy, and yet, on the other hand, the court, declaring he ought to be at liberty to proceed at law, will not interpose actively to aid him, and specifically enforce the contract." Mortlock v. Buller, 10 Ves. 307. The exposition of the principle is given by Chief Justice Shaw in Railroad Corp. v. Babcock, 6 Metc. (Mass.) 352, thus:

"In an application to a court of equity for a specific performance, a decree for such performance is not a matter of strict right, on the proof of the agreement, but may be rebutted by showing that to require such an execution would be inequitable. A defendant, therefore, may not only show that the agreement is void by proof of fraud or duress, which would avoid it at law; but he may also show that, without any gross laches of his own, he was led into a mistake, by an uncertainty or obscurity in the descriptive part of the agreement, by which he in fact mistook one line or one monument for another, though not misled by any misrepresentation of the other party, so that the agreement applied to a different subject from that which he understood at the time; or that the bargain was hard, unequal, and oppressive, and would operate in a manner different from that which was in the contemplation of the parties when it was executed. In either of these cases equity will refuse to interfere, and will leave the claimant to his remedy at law."

A review of the multitude of adjudged cases upon the point is impracticable, but those which are cited and relied upon by appellee as sustaining the proposition that a court of equity will rescind a contract merely for the mistake of one party will be referred to and considered. They are Smith v. Mackin, 4 Lans. 41; Rider v. Powell, 28 N. Y. 310; Jackson v. Andrews, 59 N. Y. 244; Crowe v. Lewin, 95 N. Y. 423; Griswold v. Hazard, 141 U. S. 260, 11 Sup. Ct. 972 999; Webster v. Cecil, 30 Beav. 62; Railroad Co. v. Jackson, 24 Conn. 514; Rowland v. Railroad Co., 61 Conn. 103, 23 Atl. 755.

Smith v. Mackin was a case where the plaintiff had agreed in writing to surrender possession of certain real estate supposing it to be a part only of that which was included in the description, and, having discovered that the description covered the whole, brought an action to rescind the agreement. As the court states in the opinion: "The defendant knew how the fact was at the time the contract was made, and was also aware of the plaintiff's misapprehension in regard to it." The case was one where the defendant's conduct was unconscionable.

Rider v. Powell was an action to reform a bond and mortgage. As expressed, the bond and mortgage did not correspond with the agreement of the parties, which fact the plaintiff discovered the next day. The defendant knew all along that it did not. His conduct was unconscionable.

Jackson v. Andrews was an action brought to reform a deed given by the plaintiff to the defendant, and also a mortgage given by the defendant to the plaintiff, upon the theory that the land was to be conveyed without a warranty of title, and that the covenants of warranty in the deed were inserted by the fraud of the defendant or by mutual mistake, and the plaintiff sought to reform the mortgage by inserting a covenant by the defendant that the entire principal should become due after default in payment of any installment of principal or interest for 30 days. Issues of fact were submitted to a jury, and of their findings the court observed:

"It will be seen that, while this verdict furnishes evidence that the plaintiff may not have known fully the facts—perhaps the contents of the paper executed and received by him—it utterly fails to show that the defendant ever agreed or understood that he was to receive a deed of the lots without covenants as to title, or to give a mortgage containing any provisions in addition to that delivered by him."

The court held that the court below properly refused to decree for reformation.

Crowe v. Lewin was an action brought to rescind a contract for the exchange of land for which conveyances had been executed. The court said:

"In this case the minds of the parties never met. The contract in form was not a contract in fact. It originated in mistake, and that mistake not mutual and about the same thing, but different on the part of each. What one meant to sell the other did not mean to buy, and what one meant to buy the other did not mean to sell."

A decree was entered requiring a reconveyance by the parties, respectively; thus rescinding the transaction. The case was one where the contract did not express the intentions of either party.

Griswold v. Hazard was an action to cancel or reform a bail bond by one of the sureties. Referring to the conclusion that the bond ought not to be allowed to stand uncorrected, the court said:

"If it be not justified on the ground of mistake as to the mutual agreement, superinduced by the conduct of the party seeking now to take advantage of it, there could be no escape from the conclusion that the taking of a bond that made Griswold absolutely liable as surety for any amount adjudged to be due from Durant, and not greater than the penalty so named, was, under all the circumstances disclosed, a fraud in the law upon him."

Webster v. Cecil was an action to rescind an agreement for the sale of lands evidenced by a written proposal by one party and a written acceptance by the other. The proposal of the vendor, by inadvertence on his part, named a price which was less than half that which he had just refused, upon the offer of the vendee, during the negotiations. The case was one where the vendee knew when he transmitted his acceptance that the proposal did not express the intention of the vendor.

The cases in 24 Conn. 514, and 61 Conn. 103, 23 Atl. 755, were actions at law where the question was whether a railroad company was entitled to charge its ordinary freight rates for carrying after there had been a preceding negotiation, in which the minds of the parties had not met, in respect to a different rate. They throw little light upon the present question.

In the opinion of the court below some of the foregoing adjudications were cited, and in addition the cases of Bradford v. Bank, 13 How. 57, and Snell v. Insurance Co., 98 U. S. 85, were cited.

Bradford v. Bank was a bill for specific performance of an agreement by the defendants to convey land. So far as the case involved the question of mistake, it was one of a mutual mistake of parties.

Snell v. Insurance Co. was a suit to reform a policy of insurance. The court said:

"We have before us a contract from which, by mistake, material stipulations have been omitted, whereby the true intent and meaning of the parties are not fully or accurately expressed. In the attempt to reduce the contract to writing there has been a mutual mistake, caused chiefly by that party who now seeks to limit the insurance to an interest in the property less than that agreed to be insured. The written agreement did not affect that which the parties intended. That a court of equity can afford relief in such a case is, we think, well settled by the authorities."

A court of equity cannot undertake to make a contract for parties which they have not made themselves, and would equally transcend its just powers by compelling a party to relinquish the fruits of a contract which he has honestly made, and in which there is no taint of wrong to affect his conscience. The rescission or cancellation of a contract is certainly as drastic an interference with its provisions as a modification of it. The consequences may be equally or even more injurious to the party who is deprived of the benefit to which he is entitled by it; and there is no sound reason, and, as we think, no well-considered authority, for the proposition that, although a court of equity will not reform a contract except for the mistake of both parties, it will rescind one merely for the mistake of one party.

"It would be the height of injustice to alter a contract on the ground of mistake, where the mistake arises from misconception by one of the parties, in consequence of his imperfect explanation of his intentions. To make a contract, it is requisite that the minds of the contracting parties agree on the act to be done. If one party agrees to a contract under particular modifications, and the other party agrees to it under different modifications, it is evident that there is no contract between them. If it be clearly shown that the intention of one of the parties is mistaken, and represented by the written contract, that cannot avail, unless it further be shown that the other party agreed to it in the same way, and that the intention of both of them was, by mistake, misrepresented by the written contract." Spencer, C. J., in Lyman v. Insunrance Co., 17 Johns. 376. See, also, Nevius v. Dunlap, 33 N. Y. 676; Insurance Co. v. Davis, 131 Mass. 316; Ludington v. Ford, 33 Mich. 123; Dyas v. Stafford, 7 L. R. Ir. 606. These observations are as opposite to an attempt to rescind a contract as to attempt to reform one.

By the decree of the court below, the contract completed by the terms of the proposal has been completely annulled. It may have been an improvident contract on the part of the complainant; but, clearly, justice would have required nothing further, if the contract had been an ordinary one, entered into by a proposal and acceptance, than to reform the contract so as to correct the mistake, and, as reformed, permit the city of Rochester to have the benefit of it. As it is, the complainant has been wholly absolved from the obligations of a contract which it deliberately entered into, and which it was the legal duty of the Executive Board to cause to be fulfilled. If the complainant in its bill had prayed for a reformation, and offered to execute the contract when so reformed as to correct its own mistakes, it would have presented itself in an attitude which would, at least, have commanded the sympathy of the court. As the case has been presented, it seems to be without equity, and the decree is therefore reversed, with costs, and with instructions to the court below to dismiss the bill.

MUNICIPAL NOTES.

In the season of municipal reports, which has just begun, the student of city affairs has an opportunity to investigate at his leisure some of the anomalous methods of caring for public property in the larger American communities. It is surprising that so many different methods of looking after public works could be thought of, even by such a resourceful people as those of the United States. If an attempt is made to compare the cost of the work which may be called city engineering in New York, Chicago, Boston, Philadelphia, St. Louis, Denver and San Francisco, the labor will be found nearly as fruitless as the tasks of Tantalus. In each city, except Boston, and even there when the State sewerage, water and park systems are considered, more than one official is engaged in the responsible direction of engineering works. Hence it is that comparisons between the annual reports of different cities, as they are usually presented, are liable to lead to erroneous deductions, and, for this reason, the attempt of several societies of municipal officers to introduce uniform systems of summarizing statistics concerning public works is to be commended. It may be doubted if all of the proposed forms can be employed in some cities, because their peculiar form of government will make the labor of computing and classifying the data too great for the return it will bring. But in spite of the differences in the forms in which annual reports now appear, they contain much interesting and valuable information, and extracts from some recent documents of this sort are presented herewith.

The report of Mr. S. D. Heffner, superintendent of the water-works of Bradford, Pa., contains an interesting account of the method of stopping trouble with leaking hydrants, due to their careless use by drivers of sprinkling carts. Several were found to be leaking from not being properly closed, the valve seats being cut as a result. Accordingly the superintendent and the street commissioner designated several hydrants in convenient places, which alone were to be employed in this way, and the drivers of the carts were furnished with lists of them. The men paid no attention to these directions, however, and when their authority to neglect instructions was questioned, the water department was told very emphatically that it was none of its business, as the chief of the fire department allowed any hydrant to be used. As soon as the matter was brought to the attention of the mayor, it was quickly settled, for he put the control of the hydrants in the hands of the water commissioners; since that time there has been no trouble with disabled hydrants on account of street sprinkling.

The financial affairs of the water-works in this city seem to be in an excellent condition. The plant was begun in 1874, and is a gravity system supplied almost exclusively from a water shed of 12,000 acres. There are two reservoirs holding 35,000,000 gallons, and 31¼ miles of pipe. The total population of the city is about 20,000, and the number of consumers is estimated at 18,100, the average supply per consumer per day being about 110 gallons. The total cost of the works to date has been $281,700. While the department is earning a profit above its fixed and running charges, it is furnishing water worth $11,000 a year for public purposes, and this fact is commented on by Mr. Heffner as follows: "The city as a whole requires water for fire protection, sprinkling streets and for other public purposes, and water used in this way should be charged to and paid for by the consumer, that is, by the city. And as all property profits equally by this service, this cost of water should be met by general taxation. If this is not done the individual water takers must be called upon to pay not only for the cost of furnishing the water they use, but also for the cost of the water used by the city in its corporate capacity."

Another report which contains interesting information for water-works managers is that of Mr. R. N. Ellis, superintendent of the water and sewerage systems of Jacksonville, Fla. New pumping machinery has recently been installed in this city, requiring a building about double the area of the old one. In order to utilize the old pump well and chimney, the new building was erected around and over the old one, which was removed as soon as the roof of the new one was finished. The new pumping machinery consists of two Worthington triple-expansion engines having steam cylinders of 10, 16 and 25 inches diameter, plungers of 18½ inches diameter, and a stroke of 18 inches. There is a surface condenser located in the discharge pipe, while each engine has an independent air pump. Each pump is rated at 5,000,000 gallons in 24 hours against a head of 275 feet, and a duty trial of the engines when working against a domestic pressure of 120 feet gave 82,000,000 foot-pounds per 100 pounds of coal. Steam is supplied by two Babcock & Wilcox boilers of 200 horse-power each. All the water of condensation from the engines is returned through a filter, which removes the oil, into a hot well, whence it is pumped through a heater into the boilers. It is stated that but little water has to be added to the condensation, and a large saving in fuel has resulted from the arrangement.

The water supply comes from a number of artesian wells, and it is interesting to learn from Mr. Ellis' report that the yield of these wells is slowly decreasing as others are sunk in the city. The yield is 2,250,000 and 2,850,000 gallons in 24 hours at elevations 15 feet apart. The water flows into two aerating basins or directly into the pump well, as may be desired. Each basin is 50 feet in diameter and 5 feet deep. The walls are of brick laid in Portland cement mortar and the bottoms are of concrete. The aeration is effected by allowing the water to flow over the end of an upright pipe connected with the discharge mains from the wells.

A storage basin 200 feet long, 160 feet wide and holding 2,400,000 gallons has also been built recently, and some of the methods employed during its construction are worth recording here. The reservoir is nearly all in excavation, with natural banks on the north, east and part of the south sides. The remainder of the south side and that on the west had to be excavated for the width of the bank to the bottom of the reservoir, as the material was unfit to build an embankment upon. There was considerable water to contend against during the excavation, and to control it while grading and lining the reservoir, a sump was sunk on the west side just inside the toe of the slope; it was 3 feet in diameter and 4 feet deep. An 8-inch pipe was laid from this sump to a well in the reservoir embankment; it had an inside diameter of 4 feet, and was bricked up with a 9-inch wall as the bank was built. A 6-inch pulsometer was set over the well to keep it free from water. A line of 6-inch terra-cotta pipe was laid along each side of the reservoir 3 feet from the toe of the slope, and four lines were run from this pipe to the sump well. The joints of the pipe were made with hemp packing, which allowed the water to seep through, but kept out the sand. These lines of pipe collected the water so that a concrete bottom could be laid. Three inches of broken stone was first spread on the bottom, and then 8 inches of Portland cement concrete, which was started at the high side of the reservoir and worked toward the sump. The slopes were lined with 9 inches of brick set in Portland cement mortar, and both bottom and sides were then plastered with a ½-inch coat of the same mortar.

A water tower or elevated tank of the form first introduced into this country a number of years ago by Mr. Freeman C. Coffin has also been erected recently at Jacksonville by Messrs. R. D. Wood & Company. It is supported on 10 posts, each having an independent foundation or base 9 feet square at the bottom, 3¼ feet square at the top and 7½ feet deep. Each consists of 18 inches of Portland cement concrete at the bottom, 4½ feet of brickwork in Portland cement mortar and a granite cap 18 inches thick. The tower is built of steel throughout. Each post is made of four 6-inch Z bars and a plate, and has five panels of a little over 20 feet each; the posts curve outward from the tank in the manner shown in "The Engineering Record" of February 11, 1893. Each is connected at the panel points with those on either side by 8-inch horizontal I-beam struts and diagonal ties. The base of the skeleton support is 65 feet in diameter, and the top 30 feet; the height is 100 feet. The tank is 30 feet in diameter and 45 feet high, with a conical bottom. A 20-inch pipe connects it with the base casting at the end of the force main; this pipe enters the bottom of the tank through an expansion joint. The tank is covered with a sharp conical roof with four gables built of ⅛-inch galvanized iron carried by a frame of angle irons. The ball of the finial is open on its lower half, and has an enclosed arc electric lamp suspended in it, which can be lowered to the top of the tank for trimming. A balcony 3 feet wide is carried around the base of the tank on steel brackets riveted to the top of the posts, while around the top of the tank there is a track for a two-wheel trolley to be used in painting or repairing. A recording gauge with high and low-water alarm is located in the engine room of the pumping station, and connected with the tower by a ¾-inch galvanized iron pipe. The tower can be shut off from the pumps by a hydraulic gate valve at the pumping station.

The chemical precipitation plant at Worcester, Mass., the largest in the United States, was heavily taxed during 1898 by the unusual rainfall, as the city's separate system of sewers is not yet finished and the works receive a large part of the storm water. The annual report of Mr. Harrison P. Eddy, superintendent of sewers, contains a number of valuable tables, showing the results attained at the plant since it was put in operation. As in previous years, frequent analyses have been made of the Blackstone River water at various points above and below the outfall from the purification works. These show that the condition of the river water below the outfall has been improved, while that above has been growing worse. During the year ending November 30, an average of 17,700,000 gallons of sewage have been treated daily, and for this treatment 1,073 pounds of lime have been used for each 1,000,000 gallons. About 50½ million gallons of sludge have been removed from the settling basins, and over 20,000 two-horse loads of dry sludge have been hauled away for use on neighboring farm lands.

The garbage crematory in Lowell, Mass., which was described in these columns on April 8, 1893, was the first built in the State. It is operated by the board of health, and in the annual report of this body for 1898 there is an account of the work done at the plant during that year. The total amount of material burned was made up of 1,646 tons of swill and market refuse, 229 cats, 191 dogs, 8 loads of bedding, 227 bags of rags, 46 mattresses, 3 hens, 1 load of rubbish, 95 pounds of meat, 1 lounge and 6 pigs. The cost of burning is given as follows: Coal, $521.90; wood, $53.67; labor, $777.18; lease of land, $150; analysis of ashes, $12; oil, $6.48; weighing coal, $28.25; mason's work, $88.01; plumber's work, $6.72; total, $1,644.21. The report says concerning the work of scavenging: "Owing to the inadequate size of the furnace, as well as an insufficient appropriation for carrying on this work, Lowell burns about 50 per cent. of the city garbage, meaning swill and market refuse; the other half is collected by

licensed farmers, who use it as a fertilizer or feed it to hogs. During the winter months nothing is burned at the cremator except market refuse and refuse from hospitals and those houses reported to the health office as containing a case of infectious or contagious disease; the swill during these months is sold to farmers."

The filter beds of Poughkeepsie, N. Y., which were described at length in these columns on March 19, 1898, were cleaned eight times during 1898, according to the report for that year of Mr. Charles E. Fowler, superintendent of public works. Moreover, the sand was removed and washed between October 12 and November 5. The cost of keeping the beds free from ice during the year is given as $290.89; cleaning, $730.12; washing and replacing sand, $516.93. A number of bacterial analyses were made during the year by Dr. D. B. Ward, with the following results:

Bacterial Analyses of Raw and Filtered Water, Poughkeepsie.
(Colonies per Cubic Centimeter.)

1898.	Settling Basin.	—Effluent.— Old Bed.	New Bed.	—Efficiency.— Old Bed.	New Bed.
Jan. 6	17,850	132	348	99.26	98.02
Jan. 19	27,000	480	900	98.20	96.60
Jan. 27	17,850	52	60	99.70	99.66
Feb. 4	13,950	144	88	98.96	99.36
Feb. 24	19,600	690	298	96.47	98.47
Mar. 25	9,600	804	...	91.62	....
April 11	5,580	118	74	97.90	98.67
Nov. 12	6,570	560	96	91.97	98.53
Nov. 19	4,200	1,120	80	73.33	98.09
Nov. 23	5,370	224	144	95.82	97.30
Dec. 3	3,900	144	310	96.30	92.05
Dec. 10	2,420	164	272	93.22	88.76

The report for 1898 of the Watuppa Water Board of Fall River, Mass., of which Mr. W. W. Robertson is clerk and Mr. Patrick Kieran is superintendent, contains some interesting facts concerning the use and waste of water in that city. The total number of services there is 6,576, and of these 6,128 are metered; which enables the officials to keep a fairly good watch over the water supply. The total amount of water pumped during the year is given as 1,144,657,850 gallons; of this quantity, 58.47 per cent. was used by private consumers, 14.23 per cent. was used for public purposes, and the remaining 27.30 per cent. cannot be accounted for, although the following extract from Mr. Kieran's report throws some light on one possible source of loss: "At the beginning of 1897 a careful and thorough inspection for the large amount of water not accounted for was commenced, and this still continues in all places not metered, both public and private, with satisfactory results. On March 24 a small leak was discovered on an 8-inch water pipe owned by a corporation, and while the water was shut off for repairs it was found to greatly decrease the consumption, which was immediately noticed at the pumping station, and which commenced again as soon as the water was turned on. A visit to the place was made at once, and for reasons best known to the parties in charge the waste was stopped before anything could be found. This waste commenced with a small quantity and gradually increased to the enormous quantity of between 600,000 and 700,000 gallons a day at the time of discovery. On April 21 notices were served on all parties having fire or sprinkler pipes on their premises, not connected with meters, to have all drip or waste pipes empty above the surface of the ground. The reason for this was that in many cases these pipes were found to be in use to flush out the sewer pipes on the premises. This notice has been complied with in about all cases, except where satisfactory reasons have been given."

For some time there has been trouble during certain seasons of the year with the water supply of Middletown, Conn., and in the annual report of the water commission of this city, of which Mr. J. C. Broatch is secretary, there is an interesting account of the difficulty, which has been confined almost wholly to what is known as the Laurel Brook reservoir. The water of this basin is usually in its best condition and free from vegetable flavor during March, April and May, when its temperature is sufficiently low to prevent the growth of vegetable organisms, and in June before they make their appearance. It is also good during November and December, when the low temperature has killed the growths and they have settled to the bottom. The result of the decay of vegetable matter is more noticeable during the winter, when the ice prevents the escape of the gases and the water becomes impregnated with them. Over 500 cartloads of this matter were removed from the reservoir during the summer, and this amount was but a part of the whole quantity it contained. The trouble is ascribed to the condition of the bottom. Before it was overflowed it was mostly a swamp, from which none of the surface soil was removed. During the early part of the summer a bad flavor was also detected in the water from the second of the reservoirs, known as the Higby Mountain basin. This bad flavor was found to be confined to the water near the bottom, so arrangements were made to take the supply from near the surface, which remedied the trouble.

The trouble caused by clogging in service pipes is referred to in the report of the Taunton, Mass., water commissioners, and the board has adopted the conclusion of their superintendent, Mr. Charles F. Chase, that tin-lined services are better than those lined with cement or lead. Complaints have been received of bad water or of rusty water in localities near dead ends, or where it has been impracticable to flush the pipes satisfactorily. The rusty water is found for the most part in residences where the house pipes are plain wrought iron, and the complaints have been more numerous since the city introduced a purer water supply. Moreover, it has been found that many instances of poor pressure in buildings were due to the filling up of service pipes between the street main and the cellar wall. In a majority of cases the trouble was remedied by running a large wire through the pipe from the stop-and-waste cock in the cellar as far as the service cock, and often as far as the corporation cock. When this method failed the work of the wire was followed by the use of a ¼-inch pipe. As a last resort the service had to be dug up.

The tenth annual report of the metropolitan sewerage commission of Massachusetts, of which Mr. George A. Kimball, M. Am. Soc. C. E., is a member, and Mr. William M. Brown, Jr., M. Am. Soc. C. E., is superintendent and chief engineer, is of particular interest because it is the first to give the results of the completed system, which was practically finished during the year. The district which the works are designed to serve embraces an area of 164 square miles, and include a part of Boston, the whole territory of thirteen municipalities and part of the territory of eight more. It will be recalled by those familiar with articles on the subject in earlier volumes of this journal, that the district is divided into three general sections. The north metropolitan system intercepts sewage from Woburn, Stoneham, Winchester, Arlington, Belmont, Somerville, Cambridge, Medford, Melrose, Malden, Everett, Chelsea, Charlestown, East Boston and Winthrop; it is 49.626 miles long and discharges into deep tide water off Deer Island. The Charles River Valley system intercepts the sewage of Waltham, Watertown, Newton, Brighton, Brookline and a part of the Back Bay district of Boston; it is 8.098 miles long, and discharges into the main interceptor of the Boston main drainage works, owned by the city of Boston. The Neponset River Valley system intercepts sewage from West Roxbury, Dedham, Hyde Park, Milton and part of Dorchester, and it will eventually receive sewage from parts of Brookline and Newton. It is 11.3 miles long, and discharges into the Dorchester intercepting sewer, owned by the city of Boston. The report under review is so replete with important information concerning these great works that a condensation of the more important data would require more space than can be spared for the purpose at present, and the reader is referred to the full document for further facts.

The protection of bridges from the smoke of locomotives passing below them has become a problem of much importance, and for this reason particular attention is drawn to the following note in the annual report of City Engineer L. M. Hastings of Cambridge, Mass: "During the past season these bridges were thoroughly scraped and cleaned and given two coats of a specially prepared paint, and the parts exposed to the direct action of smoke and gases from the locomotives were still further protected by being covered with heavy sheet lead. While this is expensive at first, it is hoped that the method will prove ecenomical and efficient in the end." The report also contains a valuable folding plate illustrating a variety of methods of construction adopted for sewers requiring special foundations.

A special system of water-works has recently been constructed at New London, Conn., for industrial purposes. In the annual report for 1898 of Mr. W. H. Richards, engineer and superintendent of the Water Commission, it is stated that the supply was obtained by constructing a low earth dam with a concrete corewall, which formed a reservoir of 65,000,000 gallons capacity. A 12-inch main runs into the city, and there are a number of special distributing mains already laid. Owing to the fact that the Common Council has insisted on charging the same price for this water as for the better domestic supply, but little use has yet been made of it.

Cleaning water mains by means of scrapers, like the go-devils used in oil pipe lines, is described in an interesting section of a recent report by Mr. William Murdoch, engineer and superintendent of the water and sewerage systems of St. John, N. B. The apparatus consists of two pistons fastened to an iron rod which projects several feet beyond the forward piston and carries two sets of radial arms. These slope back somewhat and are fitted with steel scrapers, which shear off the accumulations on the inside of the pipe. The scraper is introduced at special hatch boxes, and is forced through the mains by the pressure of the water behind the pistons. Its position is readily determined by the noise it makes as it scrapes its way along. During one run the rear piston was pulled off, and it was necessary to force water backward through the main and drive the derelict nearly a mile in this manner in order to recover it. The use of the apparatus on but a portion of the mains has caused a marked improvement in pressure throughout the city.

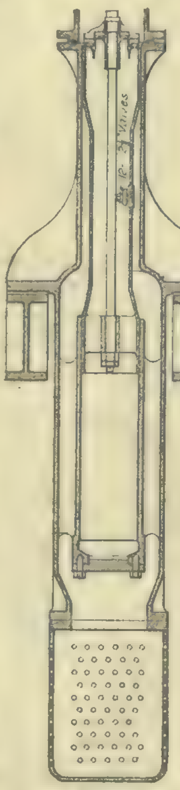
The asphalt pavements of Buffalo, N. Y., are discussed at length in the annual report for 1897 of the Department of Public Works, which has just been published. During 1878-97 inclusive over 3,800,000 square yards of such pavement were laid in the city, at a total first cost of over $11,200,000. Of this surface about 2,034,000 square yards are now maintained at the city's expense, and the report gives voluminous tabular statistics concerning this important subject. The report also contains reports of many chemical and bacteriological examinations of the river and tap water, which will be of value to sanitary engineers.

The subject of water rates is receiving attention in Plymouth, Mass., where Mr. R. W. Bagnell is superintendent of water-works, and it is a pleasure to reprint from the annual report for 1898 the following sensible recommendations on this head: "The present rates are in many cases unjust and inequitable. A certain portion of the expense of maintenance should be borne by the town at large, a certain portion

by the future inhabitants, the balance by the present population. To arrive at a fair distribution of the proportion to be borne by each requires careful study. It seems proper in any case that the waste of water should be prevented and that no part of the town should suffer for lack of water by the wasteful use of others."

A NEW DEEP-WELL PUMP.

The Brighton Corporation, England, acting on the advice of its water engineer, Mr. J. Johnston, Assoc. M. Inst. C. E., has recently erected a set of three-throw deep-well pumps, which are of interest as marking a departure from the ordinary construction, inasmuch as the fixed bottom valve is entirely dispensed with, the suction and delivery valves both being located in the bucket. The bucket is made longer than usual, being 3 feet 9½ inches in length, and consists of two grooved piston heads, fitting the barrel, and connected together by a waist piece of smaller diameter, carrying the disk suction valves. There are 12 of these valves, each 2⅛ inches in diameter. There is a shrouding on the outside of the barrel, and on the lower end of this is a strainer about 22 inches long and 15 inches in diameter.



NEW DEEP-WELL PUMP.

The pumps at Brighton are 8 inches in diameter, and have a stroke of 2 feet. They pump from a well 8 feet in diameter and 160 feet deep. The total lift, including friction, is 230 feet. The rest level is 80 feet below the surface, and at this level the three rising mains are joined into a single delivery chest. The three pump-rods work through stuffing-boxes in the top of this chest, and at the back a single rising pipe is connected, which takes the water to the surface. An air vessel is fitted above the delivery chest.

Normally the pumps are intended to work at 28 strokes per minute, giving, with the usual allowance for slip, a discharge of 600,000 gallons in 24 hours. The pumps being of the three-throw type with the three discharges connected with one rising main, the buckets are somewhat less accessible than the usual type of a single pump, in which the rising main forms a continuation of the working barrel. But on a recent occasion the whole of the working parts of one engine were drawn, examined and replaced in 25 minutes from the time of stopping the engine to restarting.

Almost any desired area can be obtained through the suction valves of this pump by lengthening the barrel. The area available through these valves controls the possible bucket speed, as the latter must not be too great for the water to follow the bucket. With the ordinary construction of deep-well or mine pumps, this area is limited by the necessity of making the bottom valve small enough for withdrawal through the working barrel and rising pipe. This pump was designed by Mr. Herbert Ashley, of the East London Water-Works, Clapton, London, and was built by the Glenfield Company, Kilmarnock. These facts have been obtained from "Engineering."

DUTY TRIAL OF A 30,000,000-GALLON PUMP AT BUFFALO.

The city of Buffalo, N. Y., has recently put in operation a 30,000,000-gallon pumping engine which was built by the Lake Erie Engineering Works, of Buffalo, for the water-works of that city. The duty trial was conducted by Mr. Newcomb Carlton, of Buffalo, and that gentleman has kindly furnished "The Engineering Record" with a copy of his report. The test is a noteworthy one in that the engine developed a duty of 158,600,926 foot-pounds per 1,000 pounds of dry steam consumed. This duty has only been exceeded by the Snow engine* at Indianapolis, which gave a duty of 167,800,000 foot-pounds. Upon the million-heat-unit basis, the Buffalo engine exceeded all but the Leavitt engine, at Chestnut Hill, and the Indianapolis engine, attaining a duty of 141,848,396 foot-pounds.

The engine is of the vertical triple-expansion crank-and-fly-wheel type, with the steam cylinder-barrels jacketed and with two reheating receivers. The high-pressure cylinder-jackets and the first reheating receiver is supplied with steam at boiler pressure. The second receiver, intermediate and low-pressure jackets take steam at about 60 pounds pressure. The cylinder heads are not jacketed, owing to the valves being incorporated in them.

The pumps consist of three single-acting outside-packed plungers, located directly under the steam cylinders. There are in each suction and discharge chamber 198 valves, each 4¾ inches in diameter. The air pump is single-acting and is driven from the low-pressure cross-head. The boiler-feed pump is driven in the same manner. The air-pump cylinder is 33 inches in diameter and the stroke is 5 feet. The following are the principal dimensions of the engine:

Dia. h. p. cylinder, in.	37
Dia. int. cylinder, in.	63
Dia. l. p. cylinder, in.	94
Dia. piston rods, two for each cylinder, in.	5
Clearance h. p. cylinder, per cent.	1.42
Clearance int. cylinder, per cent.	1.22
Clearance l. p. cylinder, per cent.	1.02
Ratio of volumes	1 : 2.9347 : 6.5558

The test of the Buffalo engine was conducted in accordance with the A. S. M. E. code, the feed water being weighed, etc. The water pumped was measured by plunger displacement and also by a Venturi meter. As the latter was not calibrated for the high head against which the engine was pumping, the water pumped, as shown by the meter, was 3.56 per cent. less than that shown by plunger displacement. The instruments used in testing were standardized, and the moisture in the steam was determined by a Barrus calorimeter. The steam condensed in the jackets and reheaters was cooled and weighed. A leakage test of the boiler was also made, and the leakage deducted from the feed water. The following are the data and principal results of the test:

Duration, hrs.	11
I. H. P.* h. p. cylinder	399.59
I. H. P.* int. cylinder	365.26
I. H. P.* l. p. cylinder	513.21
I. H. P.* whole engine	1,278.06
Aver. steam pipe press., lbs.	156.1
Aver. vacuum, in.	26.25
Aver. r. p. m.	21.54
M. E. P. h. p. cylinder, lbs.	58.96
M. E. P. int. cylinder, lbs.	18.37
M. E. P. l. p. cylinder, lbs.	11.55
Friction of engine, per cent.	4.98
Dry steam per I. H. P., lbs.	11.82
Steam condensed in jackets and reheaters, per cent.	14.2
Dry steam per I. H. P. per hour, jackets and reheaters, lbs.	1.68
Dry steam per I. H. P. per hour, exclusive of jackets and reheaters, lbs.	10.14
B. T. U. per I. H. P. per hour	13,213.6
Water plungers, number of	3
Dia. of plunger, in.	42
Stroke of plunger, ft.	5
Temp. of feed-water, deg. F.	88
Total head, lbs.	89.56
Moisture in steam, per cent.	.335
Duty per 1,000 lbs. dry steam, ft.-lbs.	158,600,926
Duty per 1,000,000 B. T. U., ft.-lbs.	141,848,396
Capacity, 24 hours, aver. piston speed 215.41 ft. per min., U. S. Gals.	33,486,464

* From cards taken during six hours of the test.

* A recapitulation of the data and principal results of the tests of a number of the most economical American pumping engines was printed in "The Engineering Record" of Jan. 28, 1899.

INVESTIGATIONS OF A BLOWING FAN.

At the recent meeting of the American Society of Heating and Ventilating Engineers, a paper was presented by Prof. R. C. Carpenter, of Cornell University, entitled "Investigations of a Blowing Fan." An abstract of this paper is given herewith, and concludes the list of papers presented at the meeting which have appeared in these columns since that time.

The paper describes a series of experiments extending through three years, made on a blowing fan constructed for the purpose, and it discusses general laws derivable from the data observed. The experiments were made at Sibley College, and Prof. Carpenter expresses indebtedness to Messrs. E. P. Haines, S. G. Hobert, H. J. Parker and P. S. Wilcox, students at the institution, for much of the matter included in the paper.

The experimental fan consisted of a horizontal shaft to which were fastened eight blades, 12 inches by 18 inches, each bolted to its arm to facilitate removal or change of form. The hub of the fan was of cast-iron, having a central disc to which the arms, made of ⅞ angle-iron, were bolted, and was held in position on the shaft by set screws, so as to be readily removable. The fan was mounted upon the overhanging end of a horizontal shaft, and was 4 feet in external diameter and 18 inches in width. The casing for the sides of the fan was constructed of matched flooring 8 x 8 feet in size, and one side of this was braced firmly in position, while the other was left to be moved as desired. The periphery or scroll of the case was made of a strip of sheet iron 18½ inches in width, and arranged so that it could be fastened to the sides of the casing by means of screws and braces in any desired position with reference to the fan wheel. A discharge passage was built, which, like the casing, had two sides adjustable, so that the area of cross section of the discharge could be varied as desired. The fan, as just outlined, could thus be adjusted in many particulars, and, it was considered, presented better opportunities for studying the laws relating to the motion of air than were afforded by any of the commercial forms.

There were in all two series of tests. The first experiments were undertaken principally to determine the effect of the casing, and the variation of pressures produced in different parts of it. The second series had for an object the determination of the most efficient form of fan blade and the effect of different sizes of outlet and inlet. In the first series of tests the fan was driven by a separate engine, the power being determined by measuring indicator diagrams and correcting these results by the power required to overcome the friction of the engine. In the later tests power was obtained from the main line shaft of the building and was measured before being supplied to the fan by a transmission dynamometer; in this case no connection was necessary.

The first run of the first series was made with the fan revolving in free air with no side casing or scroll. The power for this condition was found to vary with the cube of the number of revolutions. In this connection the direction of air currents was studied by the use of dust, smoke and light threads of cotton, from which it was noticed that when running under such conditions, the currents of air instead of entering principally from the center were in fact drawn in most strongly at the sides and near the outer extremity of the blades, and even at the outer corners; the air was expelled most strongly at the middle of the outer edge, and with only a light force along the remainder of this edge. The current of air was found to leave the fan approximately at an angle of 30 degrees with the tangent to the periphery of the wheel.

The second run was made with the sides in

position, but with no inlet passage and with no scroll. The results showed a small amount of air delivered and little power required.

For the third run, the peripheral casing was put in place and was adjusted circularly about the fan, allowing but ½-inch clearance between the tip of the fan blade and the casing, and forming a tight cylindrical box without inlet or outlet. The results of this run showed that the power required was negligible below 500 revolutions per minute, and less than could be measured accurately by the instruments employed. In connection with this run it was noted that the sheet iron casing became quite warm to the hand in a few minutes, thus indicating a transformation of dynamic energy into heat energy of considerable amount. In this run the work of the fan was utilized simply in moving the particles of air within the space occupied by the fan, and doubtless these particles were projected with considerable force against the peripheral casing.

The next three runs were made with the same casings, except that an exit passage was provided 8 feet long, 18½ inches wide and in height 6, 12 and 18 inches respectively. The construction of the casings for the different runs may be followed from Figure 1. The results corresponding with the positions of the casings may be seen in graphical form in Figures 2 and 3. One shows the relation between the revolutions per minute and the horse-power required to drive the fan under a given condition; the other collection of curves gives for the different conditions the cubic feet of discharge per minute corresponding to any speed. A combination of the two will obviously enable of determining the horse-power required by the fan for a certain quantity of air delivered. A comparison of curves for runs 4, 5 and 6, shows an advantage in enlarging the exit passage.

Three more runs were made with reference to the best form of case. The exit passage was left 18 x 18½ inches in cross section, as in run 6, but the peripheral casing was expanded. The positions of this for the separate runs are designated as A, B and C in Figure 1. Each is an involute of a circle with a different initial point, and was described by unwinding a cord, with pencil attached, from small circular blocks placed in the line of the shaft. The results of the runs are given as before in Figures 2 and 3, and as the author pointed out, show an increase in speed of the fan per horse-power applied at the engine, and also an increase in quantity of air delivered per revolution and per unit of power, and consequently an increase in efficiency for each of the runs as compared with number 6. The results were also thought to show that beyond a certain point, a change in the casing would appear to make but little difference in the results, and that it was probable a position might be reached where further increase in clearance would be harmful instead of beneficial, although such a position was not reached in the experiments quoted. It was noted, however, that the difference in efficiencies between runs 8 and 9 was much less than between runs 6 and 7, which would indicate that the improvement to be obtained by increasing the diameter of the peripheral casing further would be exceedingly small. In run 9 the fan was said to run much more quietly at high speeds than in the other runs, which was probably due to the fact that the point at the inner end of the spiral was much further from the tips of the rotating blades.

The author believed that the first investigation established the following propositions, which were advanced some years ago by Murgue: First, the volume of air delivered varies with the speed of rotation; second, difference of pressure varies as the square of the speed; and third, the power required varies with the cube of the speed.

In the later experiments the form of the peripheral casing was left in the condition found to give best results in the previous tests. For the purpose of testing fans with differently shaped blades, the radial blades were removed and bent blades substituted. These were radial for a distance of 7 inches, then curved in an easy bend in a direction approximating the tangential at the outer extremities. The bent blades were arranged so that they could be used with the curved end run in a backward or forward direction. The area of the plane blades in the direction of the radius was 1.5 square feet; the projected area of the curved blades on a radial plane was 1.37 square feet. As compared with the radial blades, there was found to be a loss in quantity of air delivered for a given rotative speed of nearly 25 per cent. when the blades were bent backward, and but little loss when the blades were bent forward. As normally constructed there was but one inlet to the fan, which was 22 inches in diameter.

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NOTE.—*In Fig. 2, Run 1 is for the fan in free air, 2 is for the fan with sides in place, 3 for the fan entirely enclosed, and 4-9 for conditions shown in Fig. 1.*

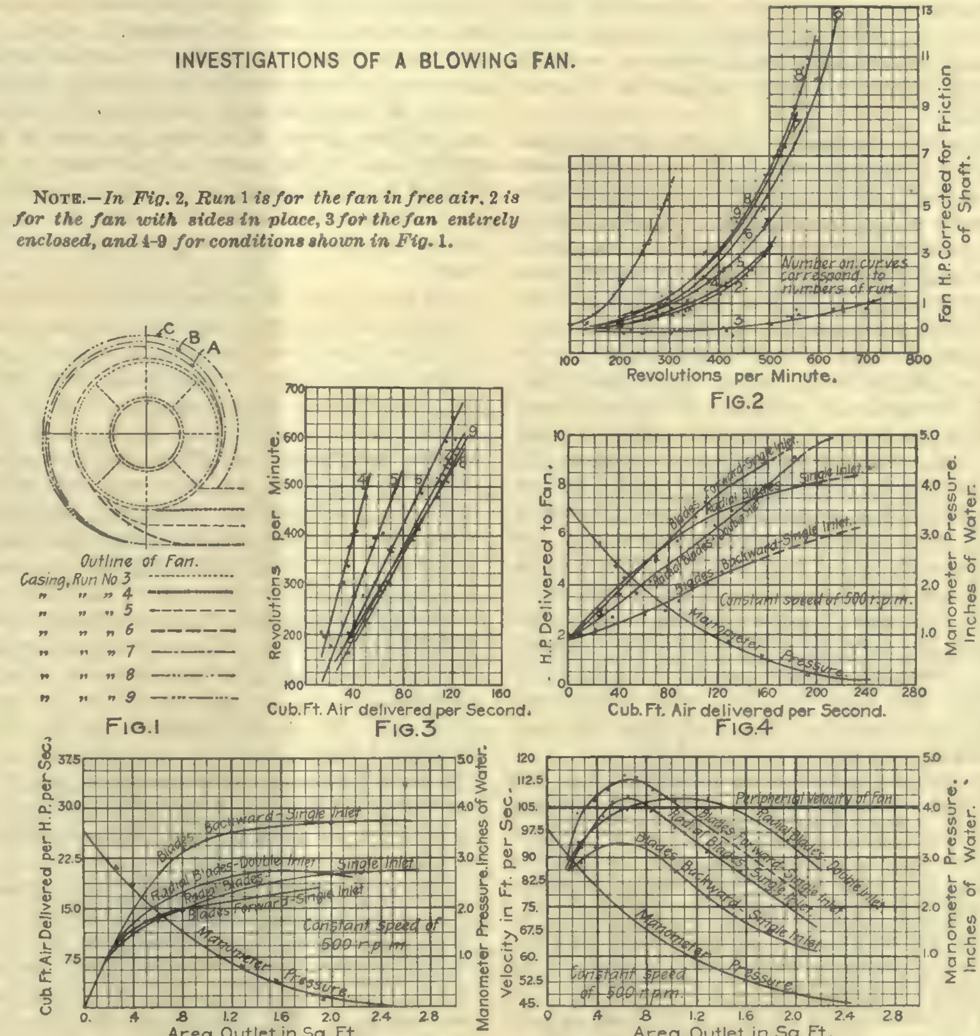

FIG.1 FIG.2 FIG.3 FIG.4 FIG.5 FIG.6

For a portion of the experiments a second inlet of the same size was constructed on the opposite side, so that data were obtained for radial blades with two inlets.

The top of the delivery tube was constructed in two pieces and hinged at a point 3 feet from the outer end; the hinged portion could be raised or lowered, thus changing the area of the delivery tube as desired. The form of delivery tube was convergent in all cases, excepting one, and of the same width as the fan; in one run a partition with a 22-inch circular opening was substituted.

A comparison of the three different shapes of blades was made by a study of the various relations of the variable quantities at a constant fan speed of 500 revolutions per minute. A consideration of the relation between horse-power delivered to fan and the outlet area was first taken up. It was found that the blades bent backward took the smallest amount of power for a given outlet; the radial blades, an intermediate amount; and the blades bent forward, the greatest amount. The power required for the radial type of blades for very small openings was decreased, but for larger openings was increased by doubling the inlet opening, which effect was accounted for by noting that the quantity of air delivered was greatly increased for the larger openings.

The relation between the quantity of air delivered in cubic feet per second, and the area of outlet opening for a constant speed of 500 revolutions per minute showed that with a single inlet opening, the greatest quantity of air for a given outlet area was obtained with the fan which had the blades bent forward, the amount delivered by the radial blade being intermediate, that by the blades bent backward the least. The effect of doubling inlet area was to increase the quantity of air delivered by the radial fan very materially for the larger openings.

The relation between horse-power delivered to fan and the quantity of air delivered in cubic feet per second, the speed being constant at 500 revolutions per minute, is shown in Figure 4. This is a combination at the relation of the horse-power required to the outlet area, and of the relation of quantity of air to outlet area and hence shows how the discharge varies with the horse-power applied when the back-pressure is varied by changing the outlet area. A curve showing the pressure in the delivery box in inches of water for the fan with the blades bent backward is also shown. The pressures were obtained by a U-shaped manometer.

Figure 5 shows the variation in the quantity of air delivered per horse-power in cubic feet per second due to changing area of the outlet, and consequently the back pressure. In this case it will be noticed that the best results are obtained from the fan with blades bent backward. From Figure 4 it may be noted that the rounding off of the tips of the blades and bending them backward decreases the

amount of air delivered, but less power is required to drive the fan, as compared with the other conditions. It is shown in Figure 5 that the power required to drive the fan is reduced more than the delivery of air, consequently the air delivered per horse-power is the greatest, or in other words, the efficiency of this type of fan is the greatest of the types compared under the same condition of inlet. Comparing the effect of doubling the area of the inlet, for the fan with radial blades, it was noted that for a small area of outlet or for back pressures much exceeding 1 inch of water, there was no special change in the results, but for large area openings or when the pressure was less than about 1 inch of water, much more air was delivered. Much more power is required by the fan with the double inlet, however, as shown in Figure 5, but the fan is fully as efficient as the fan with the single inlet for openings somewhat greater than the area of the fan blade or when the back pressure is reduced to about ½ inch or less. It should be noted that numerical references to back pressures or areas of outlet apply only when the speed of fan is as given.

Figure 6 shows the relation between the velocity of air delivered in feet per second and the area of outlet in square feet, and the back pressure of the fan with blades bent backward. The peripheral velocity of the fan is shown on this drawing by a straight line. The curves on this plate show an interesting relation between the velocity of delivery, the back pressure and the area of outlet. It will be noted that for the two conditions of the radial blades and blades bent forward, the velocity of the discharge exceeds the peripheral velocity of the fan when the back pressure corresponds to about 1.6 inches for the case considered. For a higher or a lower back pressure the velocity becomes less, which action is doubtless explained, the author said, by the fact that at a certain point the energy stored in the air is partly utilized in producing velocity; for different peripheral speeds this condition would occur at different back pressures, but he thought the case interesting since it showed that under some conditions the velocity of the discharged air may exceed the peripheral velocity of the fan.

By comparing the curves of Figures 4, 5 and 6, it will be clearly seen, as noted by the author, that the type of blade which had the lowest velocity gave the best results as to the quantity of air per horse-power, from which it would appear that the most effective fan is the one which delivers the air at the lowest velocity. He thought that the reason why the blades bent backward did not give so high a velocity was due to the slipping of the air over the tips of the blades. This plate was also thought to show an interesting fact in relation to the action of the double inlet. In this case the velocity does not reach its maximum until a larger outlet area is reached, so that by increasing the inlet opening, the fan at a given opening, except a very small one, is, in the author's mind, enabled to keep up the quantity of air delivered without bringing down the velocity, or in other words without lowering the pressure against which the fan works. This meant, he said, that with a larger opening, the doubling of the inlet area acted to increase the quantity of air delivered, but to do this for any given opening required an increase in power and in the velocity of the fan. The general effect of enlarging the inlet tended to raise the velocity and back pressure for a given outlet, which if carried beyond certain limits might act against the effectiveness of the fan by sacrificing the quantity of air per horse-power.

In regard to the efficiencies of the fans, which, the author stated, were obtained by the ratios of the energy of the discharged air to the energy delivered at the fan shaft in horse-power, it was found that the maximum efficiency for the fan with blades bent backward was about 43.5 per cent., for that with blades bent forward, 37 per cent., and for the fans with radial blades, 33.6 per cent. The maximum efficiency occurred for the three fans when the back pressure was about 1.4, 1.7 and 1.5 inches of water respectively.

It was also noted that the fan with blades bent forward gave the highest pressure, and the fan with blades bent backward, the lowest pressure, but for openings of the delivery tube much in excess of area of the blade, the fan with the double inlet showed the greatest pressures. It was also noticed that in all cases the pressure was greatest when the delivery of air was least. The author then mentioned Buckle, who gave as the results of his experiments a formula for expressing the relation between pressure and peripheral speed, which formula as reduced by Kent in his "Pocket Book for Mechanical Engineers," is

$$v = 60 \sqrt{p}$$

in which p is the pressure expressed in inches of water and v is the peripheral velocity of the fan in feet per second. The author found that the pressure deduced by Buckle's formula would be obtained under conditions like those in the experiments cited when the area of discharge opening expressed in percentage of the area of the blade was 15 per cent. for the blades bent backward, 18 per cent. for the radial blades and 25 per cent. for the blades bent forward.

He also found by a comparison of Buckle's formula with actual tests that the maximum pressure which was produced by a given peripheral velocity was greater than that stated by Buckle by an amount which varied in different conditions from 1 to 15 per cent. The author thought the maximum pressure which might be produced was the only one which could be considered as positively depending upon the peripheral velocity, since the actual pressure in any given case depended very largely upon the resistances to a free discharge corresponding in the case of the experiments cited to the area of outlet. The more freely the air was discharged, or in other words, the less resistance, the less, he said, would be the pressure that would be produced by the fans. Buckle's formula, however, was usually a safe one to employ, he continued, since the pressure given by it was less than could be realized in practice, provided the resistance to the flow of air was at a maximum.

Professor Carpenter also gave two practical rules, one for capacity and one for power. The rules were obtained by substitution in the results of a theoretical discussion from measurements, which the author made of several commercial fans. The dimensions of these fans, which were taken as representing the proportions for ventilating purposes, are expressed in fractions of the diameter of the fan wheel and are as follows: Width of vane at outlet, 0.3; width of vane at inlet, 0.4; diameter of inlet, ⅝; length of vane, 3/16; all of the fan-wheel diameter.

The capacity rule is: The capacity of fans, expressed in cubic feet of air per minute, is equal to the cube of the diameter of the fan-wheel in feet, multiplied by the number of revolutions, multiplied by a coefficient having the following approximate value. For fan with single inlet delivering air without pressure, 0.6; air with pressure of 1 inch, 0.5; air with pressure of 1 ounce, 0.4. For fans with double inlets, the coefficient should be increased 50 per cent.

The rule for power is: The delivered horse-power required for a given fan or blower is equal to the fifth power of the diameter in feet, multiplied by the cube of the number of revolutions per second, divided by one million, and multiplied by one of the following coefficients: for free delivery 30, for delivery against 1 ounce of pressure, 20, for delivery against 2 ounces of pressure 10.

PLUMBING AND DRAIN LAYING RULES, PROVIDENCE.

A number of rules have recently been put in force by Mr. R. S. Bemis, inspector of plumbing, of Providence, which are intended to prevent misunderstanding of the conditions governing both plumbing and drain laying in that city. It will be noticed from several sections that the ordinances apparently allow earthenware drains in buildings, something now permitted in few large cities.

1. No connection of soil or waste pipe with any drains will be allowed until such drain shall have passed the water test, and a certificate to that effect has been issued to the drain layer by the Inspector of Plumbing.

2. The lower end of all soil and waste pipes must be inserted into drain at cellar bottom, the connecting joint (whether calked or cemented) be made and the water test then applied to the upright work. Testing fittings can be inserted at foot of upright lines to make this test practicable.

3. When the water closets are located in basements the lead bend or other fitting receiving the closet must be in place at the time the drain receives the water test. This is necessary in order that all work which comes under the cellar bottom may be known to conform to the law. The lead connection receiving basement water closet must in no case be directly cemented into an earthen drain, but must have brass ferrule and short piece of iron soil pipe attached before connecting to earthen drain.

4. The plumber will be held responsible for all cement joints where the soil or waste pipes connect with an earthen drain.

5. When the main drain trap is located within the walls of a building it must in all cases be provided with a fresh air inlet pipe leading to the outer air. When the trap is located under the cellar bottom the drain layer must see that provisions are made for the construction of this fresh air inlet pipe, and it must receive a water test and be in position at the time the drain is inspected and tested. Suitable perforated cap to be placed in end of pipe where it opens to the outer air.

6. When the first water closet is to be added to the plumbing of a building which has sinks or other fixtures in use, the plumber must, before filing plan, ascertain if such fixtures are trapped, and if so, are they so trapped as to resist syphonage; if lacking or faulty in either of the above mentioned conditions they must be corrected to the satisfaction of the Inspector of Plumbing at the time the water closet is put in.

When water closets of the anti-freezing pattern, located in a separate building, are connected to a drain which receives the drainage of other buildings, the same rules shall apply in regard to the trapping of fixtures, repair of leaks, etc., as if the closets were of the ordinary pattern and located in the house or houses proper.

When wooden spouts receive the waste from sinks or other fixtures the water closet cannot be added unless the waste pipes are reconstructed or the wooden spouts cut off from the main drain by separate traps, located as near as possible to the foot of spouts and out of danger from frost.

7. All rain water conductors which open below windows or within ten feet of them must be trapped. When possible the drain layer should place these traps in drain under the ground or cellar bottom.

8. All iron pipes under ground must be of the weight specified in Section 6 of the ordinances.

9. When the trap to a fixture becomes in a leaky condition and is not vented, it may be renewed by placing an approved non-syphoning trap in its place. Plan to be filed in all cases.

RECENT TECHNICAL BOOKS.

It is not in the power of all engineers and managers of water-works to obtain a practical working knowledge of the nature of the micro-organisms in the supplies under their care. The limited number of hours in a day and the varied demands upon each one of them leave little opportunity for the study of such a subject. Yet its importance is now everywhere acknowledged, and there has been a long-felt want of a book on the nature, life-conditions and influence on the quality of water of these minute plants and animals. There has grown up a fairly good literature for the biologist and microscopist, but the unfortunate man in charge of the water-works plant has been practically neglected. Hence it is a pleasure to announce a work by one of the foremost American students of this subject, Mr. G. C. Whipple, now the biologist of the Brooklyn water-works, and formerly director of the biological work of the Boston water supply. It is entitled "The Microscopy of Drinking Water," and is published at $3.50 by John Wiley & Sons, New York.

In the first two chapters the author gives an outline of the history of the subject, and an introductory statement of the purposes and value of a microscopical examination of water. Then comes a chapter on the means employed in making such an investigation, and the Sedgwick-Rafter, plankton net, plankton pump and planktonokrit methods of obtaining, concentrating and enumerating the organisms are explained. An important feature of the discussion is an enumeration of the sources of error in each of these methods.

In studying the organic life in different water supplies, it is desirable to adopt the old classification of the chemists and consider rain water, ground water, and surface water separately. In the chapter on this subject the author makes many interesting statements. The organisms found in rain water, for example, are those of the air, which have been taken up by the drops, and sometimes occur in considerable quantities. "It has been noticed frequently that vigorous growths of algæ have appeared in ponds and reservoirs immediately after a rainstorm, the growth occurring suddenly and simultaneously throughout the whole body of water. It is possible that these sudden growths may be caused by the dried spores of the algæ being lifted from the shores of the ponds and scattered through the air by the wind, and then washed into the water by the rain. This supposition is in harmony with the theory that in the case of certain algæ sporadic development occurs only after the desiccation of the spores." The microscopy of ground waters is of interest from the fact that such supplies contain very few organisms as they emerge from the rock or earth, but, on account of the food material for plant life which they carry, they soon become more than well supplied. In fact, it is not until the ground water becomes surface water that its micro-organisms become many and varied. It is well known that the physical condition of lakes and ponds has a marked influence on the organic life in them, and Mr. Whipple has quite a long chapter on limnology, introductory to three on the geographical, seasonal, horizontal and vertical distribution of micro-organisms. These are followed by a long chapter on the odors in water supplies, which will be worth the price of the work to many managers of water-works. Many commonly accepted beliefs are here rejected. The famous cucumber-odor investigation in Boston in 1881, which resulted in the naming of the fresh-water sponge as the source of the trouble, is now declared to have been in error. Mr. Whipple attributes the odor to Synura, which was proved to be the cause of the same odor in the Boston water eleven years later.

The three succeeding chapters show the result of the author's long connection with well-managed and large water-works. The first of these opens with the rule: "To obtain a permanently safe and satisfactory surface-water supply without filtration, the rainfall must be collected quickly from a clean watershed and stored in a clean reservoir." The discussion on this topic is a very important one to engineers, and the following extract from it is merely a hint at the valuable material it contains:

"As far as possible a watershed should be self-draining. It may be added that the storage reservoir also should be self-draining. It often happens, when the bottom of a reservoir is uneven, that water is left in small pools as the reservoir is drawn down. These pools are usually shallow and the water becomes warm and stagnant. They often become filled with rich cultures of organisms, and when they overflow the organisms are scattered through the reservoir. Such pools or pockets should be provided with an outlet. If this is impossible it may be advisable to fill them up. The author once observed a pocket in a reservoir that was excavated to a considerable depth for the sake of removing all the organic matter at the bottom. This pocket could not be drained, and during the summer it became the breeding place of Synura and other protozoa. It would have been better to have removed a portion of the organic matter and to have covered the remainder with clean material."

The chapter discussing the storage of ground water also has a now well-recognized engineering precept as a caption: "Ground water must be stored in the dark in order to prevent the growth of micro-organisms." In this portion of the book the author states that water which has been filtered is practically a ground supply, and filter beds should be covered in order to prevent growths on the surface as well as to guard against freezing in winter. Sometimes a growth of organisms on a sand bed has its advantages, as in a case described as follows: "On the filter beds at Far Rockaway, N. Y., where a ground water supply is aerated and filtered for the sake of removing the iron, an extensive growth of confervoid algæ and filamentous diatoms develops during warm weather. When the water is drawn off preparatory to scraping the filter, these algæ growths form a fibrous layer on the surface of the sand. This matting is so tough that it may be rolled up in sheets, and as it contains a large percentage of the iron removed from the water, it materially reduces the labor of scraping the sand, and has the further advantage that it removes comparatively little sand." The growth of organisms in water pipes is another subject on which novel statements are made, such as the following note of an interesting experience with pipe moss in Brooklyn: "In November, 1897, the water in the Mt. Prospect reservoir became so filled with Asterionella that it was deemed advisable to shut off the reservoir and pump directly into the pipes. This action was followed by the appearance of brown fibrous masses in the tap water. In a number of instances this fibrous matting stopped up the taps and even large pipes were choked. The water at the same time had a distinctly moldy and unpleasant odor. The fibrous matting proved to be Paludicella. It had been growing on the inner walls of the pipes, and the change of currents and the pulsations of the pump, due to the direct pumping into the pipes, had dislodged it. Systematic and thorough flushing of the pipes materially improved the conditions."

The remaining chapters of the book present a brief description of the genera of organisms most common in drinking water, and is intended as an introduction to practical work with the microscope. The letterpress is illustrated by 19 half-tone plates of excellent wash drawings by the author.

Ten years ago Prof. W. C. Unwin wrote a hand-book entitled "The Testing of Materials of Construction," which was not only a description of the apparatus for such work and the methods of using it, but also a general outline of the theory of the strength of materials and their physical properties as determined by reliable experiment. This book had an extensive use, but some portions are no longer up to date, so the author has brought out a new and greatly enlarged edition, which is published as an octavo volume of about 450 pages, by Longmans, Green & Company, New York. The original work is so well and favorably known that but a brief notice of the new edition is needed. The treatise is in three parts. The first is an explanation of the mechanical properties of materials; that is, the phenomena of elasticity and plasticity, and the relations between stress and deformation so far as they have been ascertained scientifically. The second part is a description of the apparatus used in engineering laboratories. The third part contains a collection of the most complete and trustworthy results of testing of the ordinary materials of construction, of which section the author says: "The mass of data accumulated in the last forty years is enormous, and in the selection of results of testing for the present work some definite principles have been kept steadily in view. Where laws were established first by careful and adequate experiment, it seems historically just to reproduce the original investigation. When, as in some of the Hodgkinson's experiments, very simple means of measurement were used, accurate enough for the purpose in view, this adds value to these early results. But beyond question more recent investigations have, on the whole, been carried out with better appliances, and with greater skill and knowledge. In selecting amongst these, the point of greatest importance seemed to be that the investigation should be complete. That is, that all the facts useful to observe about a material should have been ascertained. If the tenacity of one sample of a material is determined, the shearing strength of a second and the crushing strength of a third, these results are less instructive than when one sample of material is tested in all three ways."

A small volume of 135 pages, entitled "Examination of Water, Chemical and Bacteriological," has been written by Prof. William P. Mason, and published by John Wiley & Sons, of New York. It assumes that the reader has a knowledge of ordinary quantitative analysis, and merely suggests the methods of determining the mineral matters in a water, most of the book being given to subjects more within the scope of sanitary analyses.

Some time ago Mr. W. L. Saunders, M. Am. Soc. C. E., wrote a series of valuable papers for "Compressed Air," on the principles involved in compressing air and the machinery for this purpose. His experience as an engineer in charge of large undertakings carried on with such machinery and afterward as secretary of the Ingersoll-Sergeant Drill Company enabled him to bring together in these papers a valuable collection of practical data, supplementing the theoretical discussion. The articles have recently been printed in a book of 58 pages, bound in cloth, which is sold at $1 by the journal mentioned, which has its offices at 26 Cortlandt Street, New York.

For a number of years the German Society of Gas and Water Engineers has published an annual summary of water-works statistics, but there has been no work describing the works of the empire in a thoroughly comprehensive way. So the society made arrangements with Mr. E. Grahn, of Hanover, to collect and compile a general report on these plants in Germany and neighboring countries. The work has been laborious, but, judging from the first volume, just published, a highly creditable and import-

ant one. The volume is published by the society's printer, R. Oldenbourg, Munich, and is devoted solely to the water-works of Prussia. The general title of the work is "Die Städtische Wasserversorgung im Deutschen Reiche," and the volume under review is sold at $7. It is a cloth-bound book of about 550 pages, measuring 11½ x 9 inches, and presents a mass of information concerning Prussian water-works which will be invaluable to those studying the subject. A good idea of the nature of the contents may be obtained from the following glance at the treatment of the first plant mentioned in the book, that at Königsberg.

The history of the works is reviewed at the outset, and the old works are then described in detail. The various projects to improve the water supply are next discussed, and the new water-works are described quite elaborately, their cost given, and the expense of running them each year reported. The figures concerning the bacterial efficiency of the filter beds, the rate of filtration, and the chemical analyses of the water are of great value. This same method of treatment is followed in the case of all other cities and towns of the kingdom, although naturally much less fully for the simple gravity works of small communities.

JOHN KREUSI.

John Kreusi, the chief mechanical engineer of the General Electric Company, died on February 22 at his home in Schenectady. His death, which resulted from an attack of grip, occurred quite suddenly, after an illness of only three or four days. The funeral services were held on February 25, and were very largely attended, not only by the officers, heads of departments and employees of the General Electric Company and by residents of Schenectady generally, but also by many of Mr. Kreusi's old associates in the early Edison days of Newark and Menlo Park. Among those who came long distances specially to attend the funeral were Messrs. Thomas A. Edison, Chas. A. Coffin, president of the General Electric Company; Samuel Insull, president of the Chicago Edison Company; Charles A. Batchelor, of New York; Sigismund Bergmann, of New York; F. P. Fish, general counsel of the General Electric Company; J. W. Lieb, Jr., general manager of the Edison Electric Illuminating Company, of New York; W. S. Barstow, of the Brooklyn Edison Company; S. Dana Greene, general sales manager of the General Electric Company; C. T. Hughes, manager of the New York office of the General Electric Company; W. E. Gilmore, of Orange, N. J.; Wilson Howell, of Harrison, N. J., John Langton, of New York; F. R. Upton, of Orange, N. J.; and Martin Insull, of Chicago.

John Kreusi was born in Spercher, Canton Appenzell, Switzerland, in 1843, and went to work in a machine shop at an early age. He found his way to Paris in 1867, the year of the exposition, and remained there, working in various mechanical industries until the outbreak of the Franco-German war in 1870. He then went to London, where he stayed for some months, and finally resolved to make his home in the United States, which he reached in December, 1870.

An old acquaintance of his, August Weber, a fellow countryman whom he had met at the Paris Exposition, was then working for the Singer Sewing Machine Company, at Elizabeth, N. J., and it was with the same company that Mr. Kreusi first found employment. During the two years that he stayed in Elizabeth, he showed that he had a firm grasp of mechanical problems and their solution, and in 1872 he had full charge of a new automatic machine for making needles.

At this time Mr. Thomas A. Edison, in partnership with Mr. Unger, was manufacturing stock-exchange tickers and telegraph instruments, upon which he had taken out patents, in Ward Street, Newark, and in June, 1872, Mr. Kreusi began to work for him. The panic of 1873 kept Mr. Edison and his employees hard at work to make a living between 1873 and 1875, but in the latter year Mr. Edison felt strong enough financially to open a second shop for purely experimental work in Green Street, Newark. One of the first men whose services he was able to utilize in this field was John Kreusi, and for the next five or six years, either in the Green Street shop or at Menlo Park, Mr. Kreusi was practically Mr. Edison's machine foreman, not only designing and making special apparatus to fit the conditions which Mr. Edison required, but also often making the special tools necessary for newly invented apparatus.

During this five years—from 1876 to 1881—Mr. Edison was busy with the phonograph, improvements on the Bell telephone, incandescent electric lighting, electric railway experiments, and, above all, the subdivision of the electric current necessary to make incandescent lighting successful as a commercial venture. During this period Mr. Edison's power of doing without sleep and of working day and night for several days in succession tried the endurance of the strongest of his associates. Mr. Charles A. Batchelor, who was closely connected with Mr. Edison at this time, says that of all the group of men who worked at Menlo Park, Mr. Kreusi was the most tireless, as well as being one of the most fertile in suggestions to overcome the difficult obstacles to success which were constantly arising.

The first phonograph was made by Mr. Kreusi in Menlo Park, in 1877, from a rough sketch made by Mr. Edison, who is authority for the statement that neither he nor Mr. Kreusi had any great expectation of a successful result, and that both were utterly astounded when the tinfoil gave out audible words. This phonograph is now in the patent section of the South Kensington Museum, London.

In 1881, incandescent electric lighting had passed beyond the stage of experiment, and the Electrical Tube Company was formed, with Mr. Edison as president, Mr. Samuel Insull as secretary, and Mr. Kreusi as treasurer and general manager, to make and lay down underground electric conduits in New York city and elsewhere. The first shops of this company were in Washington Street, New York city, and there Mr. Kreusi, often with his own hands, turned out the early conduits which were laid down in the lower part of New York city—the first two-wire conduits for lighting or power to be placed in service in any part of the world. Nearly all the early patents for improvements in underground conduits bear Mr. Kreusi's name as inventor.

The Electrical Tube Company, after moving its shops to Bridge Street, Brooklyn, for a short time, was finally absorbed by the Edison Machine Works, whose shops were then in Goerck Street, New York, in 1883. Mr. Charles A. Batchelor was then general manager of these works, and Mr. Kreusi became his assistant. In 1886 the Edison Machine Works were removed to Schenectady, Mr. Samuel Insull becoming the general manager, and Mr. Kreusi retaining his place as assistant general manager. Mr. Insull himself gives Mr. Kreusi credit for having designed and constructed all the shops, which were erected while he was general manager—that is, from 1886 to 1892. "When we went to Schenectady," said Mr. Insull, "we had only 200 employees, and in 1892 when the General Electric Company was formed by the union of the Edison and Thomson-Houston companies, we had 4,000 employees, so that Mr. Kreusi had to make provision for this large increase in the comparatively short space of six years." In fact, the works, as they now stand, are Mr. Kreusi's monument.

In 1892 Mr. Kreusi succeeded Mr. Insull as general manager, and in this capacity had charge of the Schenectady works until 1896, when he was appointed chief mechanical engineer to the company. During his long connection with Mr. Edison and the various companies which were his successors, Mr. Kreusi made many important improvements and inventions in machine tools. He was also, from his thorough understanding of the strong and weak points of apparatus, a salesman of more than average ability, when his services were wanted in this capacity. He had a large and varied electrical knowledge, particularly in his keen recollection of numerous experiments which had turned out failures, and of the reason why success along some particular line could not be achieved. Most of all, he was prized by troops of friends—friends for the absolute honesty of every side of his character.

PERSONAL AND OBITUARY NOTES.

Mr. A. T. Bell has been re-elected city engineer of Memphis, Tenn.

Mr. William F. Keene has been re-elected city engineer of Central Falls, R. I.

Mr. J. C. Allen has been elected superintendent of the Alexandria, La., water-works and electric light station.

Mr. Patrick J. Flannery has been appointed water commissioner of Yonkers, N. Y., succeeding Mr. Jacob Reid, who recently died.

Capt. William E. Craighill, Corps of Engineers, U. S. A., has been assigned to duty as assistant to the Engineer Commissioner of the District of Columbia.

Mr. George E. Gifford, M. Am. Soc. C. E., has resumed his former connection with the King Bridge Company, and again taken the management of its New York office.

Mr. Walter B. Snow delivered a lecture on the influence of Mechanical draft on the ultimate efficiency of steam boilers before the students of the Rensselaer Polytechnic Institute on February 24.

Mr. C. A. Alderman has resigned the office of city engineer of Eau Claire, Wis., to become engineer of construction of the Dayton, Springfield & Urbana Electric Railway. His headquarters for the present will be at Springfield, Ohio.

Mr. Daniel W. Mead, M. Am. Soc. C. E., has opened an office at 605 First National Bank Building, Chicago. He will make a specialty of the design and improvement of water and sewerage works, electric and power plant, hydraulic works and the transmission of power.

Mr. Frank T. Reynolds has been appointed superintendent of the Bureau of Buildings of Buffalo, succeeding Mr. John Reimann, and Mr. S. Douglass Cornell has been appointed structural engineer of the bureau, succeeding Mr. William G. Hanck.

Mr. Nicholas S. Hill, Jr., whose appointment as chief engineer and general manager of the Charleston, S. C., Consolidated Railway, Gas & Electric Company, was recently mentioned in these columns, will continue his consulting practice in Baltimore. Mr. B. C. Howard has withdrawn from the firm of Hill & Howard, and Mr. Hill now has Mr. Alfred M. Quick, Assoc. M. Am. Soc. C. E., associated with him, the firm name being changed to Hill & Quick.

Mr. Alexander Potter, consulting engineer, New York, has been retained by the city of Houston, Tex., on the recommendation of the mayor, city engineer and the chairmen of the finance and sewer committees, to report on a method of keeping the sewage out of the bay and to design improvements of the existing sewerage system. He is also to report on electric light and garbage disposal works, and to appraise the present water-works plant.

Mr. Hugh Ryan, one of the leading contractors of Canada, died in Toronto February 12. He was born in Limerick, Ireland, in 1833, but spent most of his life in Canada. He was engaged on the construction of the Intercolonial,

Brockville & Ottawa and Canadian Pacific railways, building for the last the difficult line between Port Arthur and English River. His last great work was the construction of the new Canadian canal at Sault Ste. Marie, for which he was the leading contractor.

Mr. Stephen E. Babcock has resigned the office of city engineer of Little Falls, N. Y., in order to devote his entire attention to private practice, and has been succeeded by Mr. John McComb, recently connected with the Deep Water-Ways Survey. Mr. Babcock is chief engineer of the improvements of the Amsterdam water-works and of the Herkimer & Utica Electric Street Railway, and is engaged on several expert cases, a specialty with which his name has become prominently identified of late years.

New members recently elected to various grades of membership in the American Society of Civil Engineers were announced as follows at the meeting of March 1: Members: H. J. Cole, 50 Wall Street, New York; C. H. Cooke, chief engineer, Richmond & Potomac Construction Company, New York; A. B. Corthell, principal assistant engineer, Boston Terminal Company, Boston, Mass.; J. C. Ostrop, Boston Elevated Railway Company, Boston, Mass.; D. W. Ross, manager, Pioneerville Gravel Gold Company, Boise, Ida.; R. M. Shankland, Chicago, Ill.; W. D. Taylor, chief engineer, Laclede Construction Company, Baton Rouge, La. Associate Members: S. P. Baird, Portsmouth, Ohio; W. P. Boright, Massena Springs, N. Y.; H. L. Cleverdon, assistant engineer, Chicago & West Michigan Railway, Grand Rapids, Mich.; P. D. Cunningham, Washington, D. C.; G. W. Fuller, chief chemist and bacteriologist, Water-Works Commission, Cincinnati, Ohio; C. Olds, Commissioner of Water-Works, Erie, Pa.; N. B. Sweitzer, examiner of surveys, Olympia, Wash.; S. R. Thomas, engineer, Ironton Railroad, Hokendauqua, Pa. Juniors: A. B. Ilsley, New York, New Haven & Hartford Railroad, New Haven, Conn.; F. S. Senior, Montgomery, N. Y.; H. F. Taylor, Kansas City & Northern Connecting Railway, Mena, Ark.

TRADE PUBLICATIONS.

The Chicago Fire Proof Covering Company, Chicago, Ill., has issued two pamphlets describing two series of tests; the first of paints applied to plates and immersed in water, and the second of boiler laggings.

The Bates Machine Company, Joliet, Ill., has issued a handsome lithograph of the Cookson feed-water heater, which it wishes to place in every engine room in the United States. Engineers are requested to write for same.

The Ball Engine Company, Erie, Pa., has issued a catalogue of its automatic cut-off engines, which contains a very readable description of their general design and details. Many of the illustrations are of the highest grade of process work, and so well printed as to merit framing them for the office.

Mechanical draft is the subject of Bulletin J, just issued by the B. F. Sturtevant Company, Boston, Mass., and in it is given some data regarding the saving in fuel in several steam plants that was due to the change to a cheap grade of fuel, that change being made possible by the introduction of mechanical draft. One or two typical plants are described, and the advantages of mechanical draft are pointed out.

Fraser & Chalmers, Chicago, have issued a catalogue describing the construction of the Sederholm boiler, which, they state, "has been designed to meet the growing demand for a high-class steam generator, capable of working up to the highest pressures used in these days, while still retaining the well-known advantages of the standard horizontal tubular boiler." The construction of the Sederholm boiler is explained at length in the catalogue, which is well illustrated and contains a number of standard tables for steam engineers.

CONTRACTING NEWS

OF SPECIAL INTEREST TO
CONTRACTORS, BUILDERS, ENGINEERS, AND MANUFACTURERS
OF ENGINEERING AND BUILDING SUPPLIES.

For Proposals see pages xi and xii.

WATER.

Jackson, O.—The Council has passed an ordinance authorizing S. C. Boyer, Jr., and James Kinney, Jr., to construct a system of water-works. M. D. Jones, City Clk., writes that an election will be held on March 6 to ratify this contract.

Cullman, Ala.—The House has passed the bill authorizing Cullman to issue $35,000 bonds for water-works, electric lights, etc.

Kankakee, Ill.—The water-works plant has, according to local press reports, been sold to W. G. Maxcy, of Oshkosh, Wis. It is stated that about $20,000 will be expended on improvements.

Idaho Falls, Idaho.—It was voted on Feb. 15 to issue $30,000 bonds for water-works.

Camden, N. J.—City Comptroller Hufty recommends the construction of a reservoir, subsiding basin or filtration plant at Morris Station. The estimated cost will be $200,000 to $250,000.

Albuquerque, N. M.—Press reports state that the Shutt Improvement Co., of Pueblo, Colo., has secured the contract for constructing about 25 miles of irrigation canal for the Albuquerque Land & Irrigation Co. for $49,091.

Allen, Neb.—It is stated that the question of water-works construction is under consideration.

Port Austin, Mich.—The citizens have voted to issue $4,000 water-works bonds.

Alexandria, Va.—The Council has directed the City Engineer to report as to the cost of boring four artesian wells.

Lindsey, Pa.—The Lindsey Water Co. has been chartered, with a capital stock of $30,000. Directors: Edward J. Robinson, John L. Wentz and Cyrus D. Jones, of Scranton, and others.

Durand, Mich.—The city has petitioned for authority to borrow $30,000 for the construction of a system of water-works.

Moorhead, Minn.—O. G. F. Markhus, Supt. of Water-Works, writes that on Feb. 20 the contract for furnishing and setting a 66-in. x 18-ft. boiler for the water-works and electric lighting plant, was awarded to Kenny Bros., of St. Paul, for $1,725.

Evanston, Ill.—Sam'l. G. Artingstall, C. E., of 240 Rialto Bldg., Chicago, has been appointed to prepare plans and specifications for a water intake tunnel 6 ft. in diam., and about 2 miles long, under the bed of Lake Michigan, with suitable crib lighthouse and appurtenances.

Alexandria, Ind.—Bids will probably soon be asked for a new air compressor, capacity 400 gallons per minute. W. T. Baker, Chmn. Com. on Water-Works.

Woodsfield, O.—It is stated that James Kinney, of Bellaire, O., has received the contract for a water-works system having a daily capacity of 3,000,000 gallons.

Auburn, N, Y.—J. Lewis Grant, Supt. of Water-Works, writes that 20,000 ft. of 6 and 8-in. cast-iron pipe will be laid this season. Probable cost, $15,000.

Dyersburg, Tenn.—A bill has passed the House authorizing the issue of $50,000 water-works bonds.

Massena, N. Y.—The Massena Water Co. has been incorporated with a capital of $5,000. Directors, D. W. Smith, Elmira; W. B. Berry and P. J. Berry, Massena.

Montgomery, Ala.—Bids are wanted March 11 for the enlargement and extension of the air lift pumping plant, as advertised in "The Engineering Record."

Marion, Ind.—It is stated that bids are wanted for a 5,000,000-gal. pumping engine. E. Hully, Supt.

Prescott, Ariz.—Bids are wanted March 14 for $70,000 water and sewerage bonds. John P. Bander, City Clk.

Lakewood, O.—Bids are wanted March 9 for a 6-in. water main in Cove Ave. U. W. Hird, Clk of Lakewood Hamlet.

Oakland, Cal.—Bids are wanted March 15 for gates, culverts and canalways across the 12th St. dam. H. W. Thomas, Secy. Bd. Pub. Wks.

Hillsboro, N. C.—The proposition to construct water-works and electric lights is under consideration.

Reno, Nev.—Bids are wanted March 13 (change of date) for $130,000 water-works bonds. F. B. Porter, City Clk.

Lexington, Ky.—Bids are wanted March 14 for water-works, sewage, electric lighting, including dynamo, hot and cold water and sanitary plumbing, boilers and steam fitting, etc., for the equipment of the boiler house and manual training buildings. W. P. Walton, Secy. Bd. of Trustees of the Kentucky Houses of Reform.

Antelope, Ore.—It is stated that bids are wanted March 12 for repairing and cementing the reservoir. Max Lueddemann, Recorder.

Northbend, Neb.—The question of water-works construction is said to be under consideration.

St. Joseph, Mo.—At the special election held Feb. 25 it was voted to grant the water-works franchise, and to enter into a 20-year contract with the new company.

Delhi, N. Y.—Local press reports state that the Water Commissioners are preparing plans and a proposition for improvements to the water-works to submit to the voters at the next election.

Sherman, Tex.—The Council is stated to have appropriated $22,000 for the improvements of the water and light system.

San Francisco, Cal.—Local press reports state that the Spring Valley Water Co., which owns the water rights in Alameda creek, extending from Niles to Sunol, has in contemplation a scheme to construct a filter to clarify the water before it is pumped to San Francisco. The cost would be about $450,000.

Nashua, N. H.—Local press reports state that the Pennichuck Water-Works Co. has recently awarded contracts amounting to $75,000 for improvements to reservoirs, etc.

Oakland, Ill.—It is stated that the construction of water-works and paved streets is under consideration.

Kaysville, Utah.—The Haight's Creek Irrigation District Co. is about to be incorporated with a capital of about $40,000. John G. M. Barnes, John W. Gailey and Peter Barton are interested.

Cleveland, O.—Director Warden has been authorized to advertise for bids for the new Kirtland St. pumping station, engine house, coal storage, etc. Probable cost, $150,000.

Conneautville, Pa.—It was voted on Feb. 21 to issue $10,500 bonds for the erection of a water-works plant.

Irvington, N. Y.—The question of bonding to the amount of $75,000 for a storage reservoir will be voted upon at the coming election.

Sheboygan, Wis.—The city is considering the proposition to purchase the water-works plant.

Media, Pa.—It was voted at an election held Feb. 21 to issue $25,000 bonds for water-works improvements.

Williamstown, Pa.—The citizens of this place are discussing the questions of building a water plant and electric light system.

Forestport, N. Y.—Bids are wanted about April 15 for constructing water-works at a probable cost of $10,000. C. E. Phelps, Engr. in charge, Alden Creek, N. Y.

Avondale, Ala.—The Governor has approved the bill authorizing Avondale to use the water of Park Springs and to sink wells in or near the park for additional sources of supply, and to erect the necessary buildings and machinery for a system of water-works.

Minneapolis, Minn.—It is stated that bids are wanted March 10 for furnishing 10 16-in. valves for the Water Department. L. A. Lydiard, City Clk.

Cedar Rapids, Ia.—The City Council has passed a resolution authorizing the Committee on Light and Water to investigate the cost of constructing a system of water-works, such as the present water company operates.

Jacksonville, Fla.—The Council has been asked to appropriate $5,000 for an increased water supply.

Bloomington, Ind.—Bids are wanted March 23 for the reconstruction and extension of the water-works. James D. Showers, Secy. City Water-Works Co.

Abbeville, Ala.—The bill authorizing the issue of water bonds has been approved by the Governor.

Brownsville, Tenn.—The House has passed the bill authorizing the issue of $40,000 bonds for water-works.

Springford, Pa.—At the election held Feb. 21 it was voted to bond for a water plant.

Salt Lake City, Utah.—The Thistle Reservoir and Irrigation Co. has been incorporated with a capital of $30,000 for the purpose of establishing and constructing a reservoir with dams, etc., for the storing of water for irrigation. The incorporators are: Hugh M. Dougall, Springville; Benjamin F. Smith, Thistle, and others.

Valley Junction, Ia.—A vote will be taken March 27 on the proposition to grant a franchise for the construction of water-works and an electric light plant for a period of 25 years.

Humboldt, Tenn.—Water-works extension bonds to the amount of $5,000 were sold Feb. 23.

Dubuque, Ia.—Bids are wanted for pumps, pumping station and filter houses at Eagle Point. W. W. Bonson, Secy. Dubuque Water Co.

Boston, Mass.—The following bids for furnishing water pipe, with flexible joints, were opened Feb. 24 by the Water Commissioners: Camden Iron Wks., Philadelphia, Pa., *a*, 120 tons 24-in., price per 2,000 lbs., $27.60; *b*, 41 tons 12-in., price per 2,000 lbs., $29.60; *c*, total, *$4,525.60. Warren Foundry & Machine Co., 160 B'way., N. Y. City, *a*, $29.00; *b*, $29.00; *c*, $4,669.
*Contract awarded.

Whitehall, Ill.—The following bids for water system, including reservoir, dam, tower, pumping machinery, power house and pipe system, together with proposition to supply city with water for period of 10 years, were opened Feb. 25 by Engineer T. A. Chapin: Ruemmeli & Siebert Refrigerating Machine Co., St. Louis, Mo., $11,000 cash and $190 per month; Whitehall Electric Co., Whitehall, $11,000 cash and $155 per month.

St. Paul, Minn.—John Caulfield, Secy. of the Water Board, writes that contracts have been awarded as follows for supplies for 1899: To Ohio Pipe Co., Columbus, O., for iron pipe; price per ton of 2,000 lbs. $19.74 for 6-in. and $18.95 for 12 and 16-in. To St. Paul Foundry Co., St. Paul, for manhole covers, $6 each, and for street sprinkling hydrants $11.50 each. To South Park Foundry & Machine Co., St. Paul, for specials, $34 per ton of 2,000 lbs. To Western Supply Co., St. Paul for 8 tons of pig lead, $4.44 per 100 lbs. To Windsor Mfg. Co., Milwaukee, Wis., for 20 tons of lead pipe, $5.10 per 100 lbs., and for 500 lbs. of block tin at $26 per 100 lbs. To R. D. Wood & Co., Philadelphia, Pa., for hydrants at $26.90 and $31.90.

SEWERAGE AND SEWAGE DISPOSAL.

Valdosta, Ga.—We are informed that estimates are wanted at once for the construction of a system of sewers.

Ottawa, Ont.—Local press reports state that Laverdure & Laflamme, having decided not to sign the contract awarded them for the third section of the sewerage system, it has been voted to award the contract to Joseph Bourque, of Hull, for $127,225. For list of bids received see our issue of Feb. 18.

Saratoga Springs, N. Y.—The Village Trustees have under advisement different methods of sewage disposal.

Youngstown, O.—The Council has passed an ordinance to build a storm sewer.

Atlanta, Ga.—Local press reports state that W. H. Hancock has received the contract for constructing sewers for the next year, for $25,000. The contract for furnishing pipe has been awarded to Sciple Sons, of Atlanta, for $9,000.

Sacramento, Cal.—Press reports state that the City Surveyor's estimate of $120,000 for completing the sewer system has been adopted.

Olympia, Wash.—See "Public Buildings."

York, Pa.—The Board of Trade has received a report on the question of city sewerage from its committee, in which Henry Birkinbine, Supt. of the York Water Co., estimates the cost of a separate sewerage plant, 30 miles long, at $200,000.

Greenville, Pa.—J. N. Vaughn, Burgess, writes that bids are about to be asked for sewer work, to cost $6,000.

Prescott, Ariz.—See "Water."

Asbury Park, N. J.—David Harvey, Jr., writes that an effort is being made to secure legislation to permit the issue of bonds for the purchase of the sewer system.

Warsaw, Ind.—The city contemplates constructing a sewer system in the near future, at a probable cost of $50,000. R. W. Nelson, City Clk.

Buffalo, N. Y.—Bids are wanted March 8 for 12, 15, 18 and 20-in. tile sewers and 27, 30, 45 and 54-in. brick and 16-in. iron pipe sewers; also for sand, paving stone, curbing, etc., for 1899. R. G. Parsons, Secy. Bd. of Pub. Wks.

St. Paul, Minn.—City Clerk has been authorized to advertise for bids for sewer pipe to be used in the maintenance and repair of the sewer system during the present year.

Toledo, O.—Bids are wanted March 13 for a 24 and 30-in. cylindrical brick sewer and for a 15-in. cylindrical pipe sewer. Wm. O. Holst, City Clk.

Mt. Vernon, N. Y.—The Aldermen on Feb. 27 sold $30,000 sewerage bonds to E. H. Gay & Co.

Marshall, Mich.—At the coming spring election a vote will be taken on the proposition to issue $25,000 bonds for a sewerage system.

Ashland, O.—Plans for a sewerage system are being prepared by Engineer J. B. Weddell, and the proposition to construct sewers will probably be voted upon at the spring election.

Laurium, Mich.—Bids are wanted March 14 for a system of sanitary and storm water sewers. Joseph R. Murphy, Village Clk.

Pontiac, Mich.—Bids are wanted March 24 for 1,200 ft. of 10-in. and 500 ft. of 12-in. main sewers. Wm. J. Fisher, City Engr.

Easton, Pa.—It is stated that bids are wanted March 9 for a brick sewer in Nevin Park. H. R. Fehr, City Engr.

Detroit, Mich.—Bids are wanted March 7 for extending First St. sewer outlet. D. W. H. Moreland, Pres. Bd. Pub. Wks.

Terre Haute, Ind.—It is stated that bids are wanted March 7 by the Sewer Committee for pipe sewers.

Minneapolis, Minn.—The Council Committee on Sewers has decided to recommend the construction of sewers this season in numerous streets at a total estimated cost of $63,497.

Auburn, Ind.—The City Council has acted favorably on the petition of taxpayers calling for a sewerage system, the estimated cost of which is $50,000.

Folsom, Cal.—An amended bill has been introduced in the Legislature appropriating $15,000 for the construction of a sewerage plant at the state prison.

Valley Junction, Ia.—Press reports state that a sewer system is to be built.

Prospect Park, Delaware Co., Pa.—At an election held Feb. 21 the borough voted to issue $10,000 bonds for the completion of the main sanitary sewer.

Plainfield, N. J.—Bids are wanted March 13 for a sewerage system. J. T. MacMurray, City Clk.

East Grand Forks, Minn.—Bids are wanted March 7 for a sewer. Henry Harm, City Recorder.

Lexington, Ky.—See "Water."

Milwaukee, Wis.—The Board of Public Works has prepared, to send to the Common Council, a list of sewers which it proposes to build during 1899. The estimated cost is as follows: West sewerage district, $25,709.60; south sewerage district, $1,974; Bay View sewerage district, $4,999.80; east sewerage district, $5,404.60.

Allegheny, Pa.—Bids are wanted March 7 for a lateral sewer on Anna St. and Shady Ave. Robert McAfee, Dir. Dept. Pub. Wks.

Demopolis, Ala.—The Governor has approved the bill authorizing the issue of $25,000 bonds for sewers.

Salem, O.—Ordinances have passed the Council for sewers in two streets. George Holmes, City Clk.

Steelton, Pa.—Alexander Potter, Cons. Engr., states that the contract for 13 miles of sewers, advertised in "The Engineering Record," has been awarded to Irwin Bros., Greenville, O., at $33,258.34. The pipe and other material are furnished by the city. The other bidders were: A. H. Coon & Sons, Kingston, Pa., $34,624.56; John Jacoby, Wilmington, Del., $37,929.90; R. A. Malone, Lancaster, Pa., $42,366.04; J. S. Sibile, Harrisburg, Pa., $43,630.90; Callery, Murphy & Berkery, Weehawken, N. J., $44,489.50; Girard Construction Co., Philadelphia, $49,251.78; Geo. R. Alleman, Steelton, $49,690.35; W. H. H. Achuff, Philadelphia, $63,227.25.

Cumberland, Md.—Local press reports state that the contract for a sewer system in South Cumberland has been awarded to Thomas S. Kean for $5,997.

BRIDGES.

New Whatcom, Wash.—B. W. Huntoon, Co. Surveyor, writes that about April 1 bids will be received for a 120-ft. combination span, on pile foundations, across the south fork of the Nooksack River.

The contract for rebuilding the Everson bridge has been let to Savage & Schofield, of Olympia, Wash., for $2,536.

Macon, Ga.—There is talk of the renewing of Fifth St. bridge between Macon and East Macon. The City Council has authorized Mayor S. B. Price to look into the cost and report.

Leroy, N. Y.—Bids are wanted March 15 for a 100-ft. steel bridge with masonry abutments over the tracks of the Buffalo, Rochester and Pittsburg, Ry.; also for grading the approaches. W. E. Hoyt, Ch. Engr., Rochester, N. Y.

Norwalk, O.—The Council's Committee on the High Bridge matter recommends that the question of issuing $11,000 bridge bonds be submitted to the people at the municipal election.

Kansas City, Mo.—Press reports state that the Kansas City, Lawrence & Topeka Electrical Railway & Power Co. has petitioned the Kansas Legislature for permission to construct a bridge across the Kaw River, near Osage Ave.

Madison, Wis.—A bill passed the Assembly authorizing the Menasha Wooden Ware Co. to build a bridge across Fox River.

Rupert, Pa.—Press reports state that the Reading Railway Co. will replace the wooden bridge across the Susquehanna River by an iron structure, with 9 spans of 158 ft. each, at a cost of $85,000.

East Hampton, Conn.—It is stated that plans have been prepared by the New York, New Haven & Hartford R. R. Co. for a plain girder railroad bridge.

Biloxi, Miss.—It is stated that the City Council will issue $15,000 bonds for constructing a bridge across Back Bay.

Providence, R. I.—A bill passed the Senate authorizing the issue of $320,000 bridge bonds.

Sioux Falls, S. D.—Geo. C. Wise & Co., Council Bluffs, Ia., are stated to have received the contract for constructing a steel bridge across James River, at $2,480.

Streator, Ill.—The Massillon Bridge Co., Massillon, O., is stated to have secured the contract for constructing a bridge over the Vermilion River, in Reading township, at $4,450.

Denver, Colo.—Local press reports state that bids will soon be asked for constructing a bridge across the Platte River, at Mississippi St., at a cost of $2,000.

Brewton, Ala.—A bill passed the Senate, authorizing the construction of 3 bridges across Conecuh River.

Urbana, Ill.—It is stated that bids are wanted March 7 for 4 bridges. Ira O. Baker, Engr., 702 West University Ave., Champaign.

Lorain, O.—Bids are wanted March 10 for the substructure of the Black river bridge. G. H. Lewis, Co. Aud. and Secy. Bd. Co. Commrs., Elyria.

Gonzales, Tex.—Plans and bids are wanted March 9 for 2 steel or iron bridges, one across Sandies creek, the other across Peach creek. W. W. Glass, Co. Judge.

Newport, R. I.—It is stated that bids are wanted March 10 for a steel bridge over the railroad at Van Zandt Ave. Wm. Hamilton, Commr. Pub. Wks.

Algoma, Wis.—The following bids for building a steel drawbridge were opened Feb. 21 by George O. McCosky, City Clk.: Milwaukee Bridge & Iron Wks., Milwaukee, Wis., $7,100; Clinton Bridge & Iron Wks., Clinton, Ia., $7,249; M. C. Connors, Kaukauna, Wis., $7,300; Lafayette Bridge Co., Lafayette, Ind., $7,410; L. H. Johnson, Minneapolis, Minn., $7,585; Wisconsin Bridge & Iron Wks., Milwaukee, Wis., $7,600.

PAVING AND ROADMAKING.

Meriden, Conn.—N. S. Clark, City Engr., writes that it is proposed to lay new pavements (probably asphalt), at an estimated cost of $11,000.

Greenville, Pa.—We are informed that bids are about to be asked for 5,000 lin. ft. of grading, paving and curbing. J. W. Vaughn, Burgess.

Buffalo, N. Y.—See "Sewers and Sewage Disposal."

Washington, D. C.—Bids are wanted March 18 for improving L St. John B. White, Chmn. Commrs., D. C.

Sioux City, Ia.—Bids are wanted March 14 for 7,500 sq. yds. of asphalt pavement on 5th St. J. M. Lewis, Acting City Engr.

Jersey City, N. J.—Bids are wanted March 7 for improving Garfield Ave., work to include 7,000 cu. yds. earth excavation, 300 cu. yds. rock excavation, 10,650 cu. yds. earth filling, etc. Geo. T. Bouton, Clk. Bd. Street & Water Commrs.

St. Louis, Mo.—It is stated that bids are wanted March 10 for improving portions of several streets. Robt. E. McMath, Pres. Bd. Pub. Wks.

Toledo, O.—It is stated that bids are wanted March 27 for asphalt paving on Woodruff Ave. and 23d St. Wm. O. Hoist, City Clk.

Champaign, Ill.—Bids are wanted March 9 for paving and curbing Second, South and Washington Sts. Jas. R. Scott, Chmn. Bd. Local Improvement.

Easton, Pa.—Bids are wanted March 9 for paving about 1,185 sq. yds. on Washington St. with brick. H. R. Fehr, City Engr.

New Orleans, La.—Local press reports state that the following bids were opened Feb. 27 for paving Ursulines Ave. with asphalt: The Barber Asphalt Co., $2.30 per sq. yd.; Ayres Co., $2.16; Louisiana Improvement Co., $2.04; General Asphalt Co., $2.87.

Morris, Ill. — Saratoga township, Grundy County, has voted to issue $15,000 bonds for good roads.

Gainesville, Fla.—The Council has under consideration the purchase of road machinery.

Celina, O.—March 6 the city will vote on the question of issuing $75,000 street improvement bonds. J. S. Metzner, Mayor.

Kewanee, Ill.—The City Engineer estimates the cost of paving the principal streets at $49,870.

Toledo, O.—Local press reports state that paving contracts have been awarded as follows: To Harry Jennison, for Monroe St., at $13,315; and to George H. Bodette, for Milburn Ave., at $9,223.

Alma, Mich.—It is stated that a stone crusher and steam roller are to be purchased. About $4,000 is to be expended for street improvements.

Pueblo, Colo.—The bill providing for street paving in this city has passed the Legislature.

Topeka, Kan.—The Council has decided in favor of paving Huntoon St.

Lexington, Ky.—Local press reports state that the Council has under consideration the construction of asphalt pavements in several streets.

Boston, Mass.—The Committee on Metropolitan Affairs has given a hearing on the petition to authorize the Metropolitan Park Commission to construct a boulevard between Dedham and the Stony Brook Reservation. Estimated cost of work, $30,000.

Biloxi, Miss.—The Council has given notice of its intention to issue $25,000 bonds for the purpose of constructing brick pavements.

Anderson, Ind.—Press reports state that the City Council has authorized the construction of 2 miles of paved streets (probably brick), at an estimated cost of $100,000.

Athens, Ga.—W. W. Turner, City Clk., writes that it was voted on Feb. 27 to issue $100,000 street improvement bonds.

Bethlehem, Pa.—It is stated that the Street Commissioners propose to expend $30,000 this summer in macadamizing.

New Orleans, La.—See "Miscellaneous."

Joliet, Ill.—Bids are wanted March 6 for improving several streets, avenues and alleys. Sebastian Legger, Pres. Bd. Local Improvements.

Nashville, Tenn.—The Board of Public Works is about to ask for an appropriation of $20,000 to pave the Public Square with brick.

Salem, O.—The Council has passed an ordinance providing for the paving of East School St. with brick. George Holmes, City Clk.

Denver, Colo.—Local press reports state that the contract for repairing asphalt streets has been awarded to the Colorado Paving Co. at $1.70 a sq. yd. for 2½-in. wearing surface and $1.50 a sq. yd. for 2-in. wearing surface.

Schenectady, N.Y.—The Common Council has been petitioned to pave upper State St. with vitrified brick or block on a 6-in. concrete foundation, cost not to exceed $1.65 per yd., and for curbing with Medina sandstone or granite, cost not to exceed 70 cts. a yd.

St. Louis, Mo.—We are informed that brick paving contracts have been awarded as follows: To the Skrainka Construction Co., 2 streets, for $8,639; to Gilsonite Roofing & Paving Co., 3 streets, for $16,065; to Stifel & Ruckert, 5 streets, for $26,771; to J. E. Perkinson, 2 streets, for $3,898; to H. Ruebing & Co., 1 street, for $4,057; to Herman Construction Co., 1 street, for $15,363.90, and to S. M. Rich, 1 street, $3,896.75. Successful bidders all of St. Louis.

POWER PLANTS, GAS AND ELECTRICITY.

Knoxville, Ill.—Fred. Seacord is stated to have applied for a franchise for an electric plant.

Duluth, Minn.—The Burntside River Water Power & Improvement Co. has been incorporated to construct and operate canals, dams and develop and create water supply and power for public use, etc. The water power to be developed is from the Burntside River, in St. Louis County. Capital, $25,000. Incorporators: Louis J. Hopkins and Henry S. Mahon, Duluth; E. A. White, Ely; Geo. C. Swallow, Milwaukee, and Saml. Simpson, Minneapolis.

Lonaconing, Md.—It is stated that the Home Electric Co. is being organized, with a capital of $7,000, to put in an electric plant.

Pittston, Pa.—The People's Light Co. has been incorporated; capital, $150,000. Directors: E. W. Mulligan, of Wilkesbarre; Abram Nesbitt, of Kingston, and others.

Astoria, Ore.—The Council is said to be considering the matter of putting in an electric light plant, in connection with the waterworks.

Ann Arbor, Mich.—It is stated that the Ann Arbor Gas Co. will construct a new generating plant.

Livingston, Mont.—J. S. Thompson is stated to have applied for permission to construct an electric light plant.

Sturgeon Falls, Ont.—The Sturgeon Falls Electric Light & Power Co. has been incorporated; capital, $20,000. Incorporators: Ernest A. Bremner, London, England; Wm. G. Finley, Sturgeon Falls, and Harold Patriarche, Elec. Engr., Toronto.

Litchfield, Ky.—The Union Electric Light Co., Schenectady, N. Y., is stated to have received a franchise for furnishing electric lights here.

Wappingers Falls, N. Y.—An election will be held March 14 to vote on issuing $15,000 bonds for an electric light system.

Harrisonburg, Va.—C. F. Thomasson, Secy. Merchants' Light & Power Co., writes that bids will be received at once for the construction of a plant, at an estimated cost of $7,000.

Joliet, Ill.—It is stated that the Joliet Gas Light Co. will expend about $100,000 in improvements.

San Diego, Cal.—Bids are wanted March 20 for lighting the streets with electricity for a period of one year. W. J. Davis, Chmn. Commrs. Bd. Pub. Wks.

Baltimore, Md.—It is stated that the newly consolidated electric light companies, the Northern, Brush and Edison, will shortly make extensive improvements and build a central station.

Marshfield, Wis.—John A. Thomas, City Clk., writes that the contract for lighting the streets with electricity for a period of 5 years has been awarded to Marshfield W. E. L. and P. Co., Marshfield, at $90 per lamp per year, 2,000 c. p.; moonlight schedule.

Greenville, Miss.—The Greenville Light & Car Co. is stated to have received the contract for lighting the city for 10 years from Nov. 1 on condition that they have in operation an electric street car service over the business streets before that time. J. A. Gaboury, Pres.

Valley Junction, Ia.—See "Water."

Canajoharie, N. Y.—The Montgomery Electric Light and Power Co. has been incorporated, to operate in this place and Palatine Bridge; capital $25,000. Directors: Adelbert G. Richmond, Edward B. Burnap and James H. Cook, of Canajoharie.

Bowling Green, O.—The Yaryan Construction Co. of Toledo is stated to have applied for a franchise for electric lighting and heating.

Brockton, Mass.—The Committee on Street Lighting is said to be investigating the cost of a city lighting plant.

Indianapolis, Ind.—The Chenoweth Light & Power Co. is stated to have received a franchise to operate in the southeastern part of the city.

Chicago, Ill.—see "Public Buildings."

Downers Grove, Ill.—The Village Board is said to be considering the matter of lighting the village by electricity.

Sherman, Tex.—See "Water."

Columbus, Wis.—It is stated that an election will be held April 4 to vote on issuing bonds for an electric light plant.

Lexington, Ky.—See "Water."

Fonda, Ia.—It is stated that bids are wanted in March for a plant to cost about $6,000. R. F. Beswick, Chmn. Com.

Augusta, Me.—It is stated that plans are being prepared for a power station for the Kennebec Light & Heat Co.

New York, N. Y.—See "Public Buildings."

Cazenovia, N. Y.—The Union Electric Co., of Cazenovia, has been incorporated; capital, $25,000. Directors: John O'Donnell, Cazenovia; David O'Connell, Marathon, and others.

Williamstown, Pa.—See "Water."

Visalia, Cal.—The contract for constructing a long-distance transmission electric light and power line, 62 miles long, is reported to have been let to G. S. Young and W. A. Burkholder, of San Francisco; contract price of entire plant said to be $200,000.

Massena, N. Y.—The Massena Electric Light & Power Co. is stated to have received the contract for lighting the village, at $65 per arc light per yr., 1,600 c. p.

Cullman, Ala.—See "Water."

Newark, N. J.—A. L. Foote writes that the Newark Light, Heat & Power Co. has been incorporated, and will ask for bids at once for the construction of a plant, to cost about $30,000. The directors are: Frank and Abram Garlock, D. P. Smith, John Sheffield and W. A. Roe.

Pittsburg, Pa.—We are informed that the Westinghouse Electric & Mfg. Co., of Pittsburg, is receiving bids for constructing a fuel gas plant for experimental purposes.

Eau Claire, Wis.—David Douglas, Pres. Eau Claire Gas Light Co., writes as follows: "This company has purchased a new site of 3 acres in the center of the city. In 1900 we propose to erect an entirely new plant."

Nashville, Tenn.—A charter has been granted to the Tennessee Gas Co., with a capital of $1,000,000, to build and operate a gas plant in Nashville and Davidson County. Incorporators: Robt. M. Snyder, Michael M. Sweetman, Wm. L. Dudley and others.

Sweetwater, Tenn.—The Sweetwater Telephone & Improvement Co. is said to have received the contract for lighting the town by electricity.

Dayton, O.—Bids are wanted April 10 for furnishing 300 arc lights of 2,000 c. p. for 5 years, as advertised in "The Engineering Record."

ELECTRIC RAILWAYS.

Washington, D. C.—The plans of the Columbia Railway for replacing its cable system by the underground electric motive power are stated to have been approved by the District Commissioners. T. J. King, Secy. and Gen. Mgr.

Bedford, Mass.—A franchise is stated to have been granted to a company to operate an electric road in the town forming a connecting link between Billerica and Lexington.

Philadelphia, Pa.—A charter has been granted to the Philadelphia, Morton & Swarthmore St. Ry. Co. to construct a trolley line 1¾ miles long; capital, $100,000. Stockholders: J. Pareton Lance, Philadelphia; Ashley R. Whiteyn, of Haddonfield, N. J., and others.

Mankato, Minn.—The citizens are said to be agitating the construction of an electric street railway.

Neemah, Wis.—The Citizens' Traction Co. is stated to have received a franchise.

Port Huron, Mich.—It is stated that the City Electric Ry. Co. will build a 3-mile extension.

Buffalo, N. Y.—The Continental Construction Co., of Boston, is stated to have received the contract for constructing the trolley line of the Buffalo, Hamburg & Aurora Electric Ry. Co.

Bridgeport, Conn.—Blakeslee & Son, of New Haven, and the Berlin Iron Bridge Co., East Berlin, Conn., are stated to have received the contract for constructing the Shelton line.

Evanston, Ill.—The Chicago & Milwaukee Electric Railway Co. is stated to have applied for a franchise.

Hempstead (L. I.), N. Y.—The Mineola, Hempstead & Freeport Traction Co. has been incorporated to construct and operate a street railway 11 miles long; capital, $125,000. Directors: Wm. J. Newton, B. F. Hamilton, of New York City; Jas. A. Stiles, of Hempstead, and others.

Westfield, N. J.—The Westfield & Elizabeth Ry. Co. is stated to have received a franchise through Clark township.

Lowell, Mass.—Wm. H. Anderson writes that a charter has been granted by the Legislature for an electric road from Derry, N. H., to the State line between New Hampshire and Massachusetts. Frank M. Woodbury, of Pelham, N. H., is interested.

Niagara Falls, Ont.—The Niagara Falls, Weston Park & Clifton Tramway Co. is said to be considering the matter of changing the motive power of its line between this place and Niagara Falls South from horse power to electricity. J. N. Mooney, Pres.

Jacksonville, Fla.—The Main St. Ry. Co. is said to be considering the matter of extending and improving its line.

Circleville, O.—Alex. Renick and T. King Wilson, of Chillicothe, are said to be interested in the construction of an electric railway here.

Gales Creek, Ore.—John Heisler, of Gales Creek, is stated to have applied for a charter to build an electric line from Gales Creek to Portland, a distance of about 25 miles.

Stillwater, Minn.—M. J. Mandelbaum is stated to have received a franchise.

Pittsfield, Mass.—There is said to be a movement on foot to build an electric line between Pittsfield and North Adams.

Fond du Lac, Wis.—Mr. Grover, of the Fond du Lac Electric Co. is said to be considering the matter of constructing an electric railway.

Lebanon, Pa.—It is reported that the Lebanon & Meyerstown and the Lebanon & Annville street railways are to be consolidated and extended to Palmyra and Womelsdorf. About $200,000 will be spent on improvements. S. P. Light, Pres.

Kingston, Mass.—The Brockton & Plymouth St. Ry. Co. has applied for a franchise. J. H. Flint, Pres.

Geneva, Minn.—O. R. Pickering, C. B. Wheeler and others are said to be interested in the construction of a trolley line between this place and Owatonna and Albert Lea.

Smith Falls, Ont.—It is reported that the Smith Falls, Rideau & Southern Ry. Co., recently incorporated, will construct about 110 miles of electric railway. J. M. Clark, Pres.; R. A. Bennett, Secy.

St. Louis, Mo.—A charter is stated to have been granted to the Missouri Terminal Ry. Co., with a capital of $75,000. The road is to extend 7½ miles in St. Louis. Incorporators: Valle Reyburn, Henry Vierling, L. E. Anderson and others.

Richmond, Ind.—The County Commissioners on Feb. 22 granted the Richmond Traction Co. permission to construct its line from the eastern corporation line to the fair grounds.

New York, N. Y.—The State Railroad Commission on March 1 approved of the increase in the capital stock of the Manhattan R.R. Co. from $30,000,000 to $48,000,000. It is stated the proposed increase is to provide for the necessary plant and equipment involved in a change of motive power from steam to electricity.

Cherryvale, Kan.—C. J. Corbin is stated to have received a franchise.

Trenton, N. J.—The Trenton, Lawrenceville & Princeton R.R. has been incorporated to operate a railroad in Mercer county 9½ miles long; capital $200,000. Directors: Wallace Buckman of Trenton, Henry C. Parry of Langhorne, Pa.; Edw. C. Williamson of Morrisville, and others.

Greenville, Miss.—See "Power Plants, Gas and Electricity."

Raquette Lake, N. Y.—The Raquette Lake R. R. Co. has been incorporated to build and operate an electric railroad from Clearwater to Raquette Lake. The directors are said to be J. Pierpont Morgan, Chauncey M. Depew and others.

Elyria, O.—The Lorain County Ry. Co. is stated to have received a franchise from the County Commissioners for the use of roads between Lorain and North Amherst for an electric road.

Shanghai, China.—It is stated that bids are wanted June 30 (change of date) for a franchise for constructing about 23 miles of electric tramways. Plans may be obtained from Blackall & Baldwin, 39 Cortlandt St., N. Y., upon a deposit of $500. J. O. P. Bland, Secy., Shanghai.

RAILROADS.

New Orleans, La.—The Illinois Central R.R. Co. is stated to have received permission to build about 5½ miles of tracks along the river front.

Columbus, Ind.—It is stated that a preliminary survey is about to be made for the proposed Columbus, Bloomington & Terre Haute Railroad. Wm. Right, Ch. Engr., Columbus.

Dardanelle, Ark.—A charter has been granted to the Dardanelle & Oklahoma R.R. Co. to construct a railroad 18 miles long; capital $100,000. Directors: John H. Hope, T. E. Wilson and others.

Rutland, Vt.—John W. Burke, Ch. Engr. of the Rutland-Canadian Railroad Co., writes that the contract for about 50 miles of railroad construction has been awarded to O'Brien & Sheehan, New York City. For list of bids received see our issue of Feb. 18.

Wallula, Wash.—The Columbia Valley R. R. Co. has been incorporated, to build, equip, operate and acquire the following railroad and telegraph line: From Wallula to a point in the State of Washington, on the Columbia; capital $3,000,000. Incorporators: L. Gerlinger, Vancouver, Wash.; Geo. W. Stapleton, Portland, Ore., and others.

Vanceburg, Ky.—The Indian Run Ry. Co. of Lewis county has been incorporated to build a road between Lewis and Greenup; capital $5,000. Incorporators: J. W. Riggs and J. L. Watkins.

Chicago, Ill.—The Aurora & Chicago Ry. Co. has been incorporated, with a capital of $300,000, to construct a railroad from Aurora, through Kane, Du Page and Cook counties to Chicago. The Elgin and Chicago road, with a capital of $300,000, was also incorporated. The incorporators of both companies are Henry A. Everett and B. Mahler, Cleveland, O.; Edw. Dickinson, Chicago, and others. The principal offices to be located here.

Centralia, Wash.—Geo. E. Birge, A. C. Shaw and others are stated to be interested in the construction of a standard gauge railroad from this city to Salzer Valley.

Virgilina, Va.—A charter is stated to have been granted to the North & South Carolina Ry. Co. to construct a railroad from this place to Columbia, S. C.

NEW INDUSTRIAL PLANTS.

M. R. Kennedy, Dansville, N. Y., writes that the main mill of the Montana Pulp & Paper Co. at Manhattan, Mont., will be 225 x 90 ft., with 14-ft. basement, 17 1/3-ft. main floor and 10-ft. second story. There will also be a 45 x 55-ft. straw room and a 50 x 55-ft. boiler house. The boiler plant will be of 500 H.-P. capacity, and there will be two engines, of 125 and 300 H.-P. respectively.

The West Virginia Brewing Co., Central City, W. Va., has purchased the plant of the American Brewing & Ice Co., and will spend $40,000 for new machinery and a bottling house. Mr. J. F. Weiss is the manager of the company.

The Mena, Ark., Ice & Cold Storage Co., which was recently incorporated with a capital stock of $20,000, will put up a plant costing about $20,000. The company is controlled by Mr. W. J. Lemp, of St. Louis, Mo., and Mr. A. Ruemmeli of the Ruemmeli & Siebert Refrigerating Machine Co., of the same city, is president.

Adkinson Bros., Carrollton, Ky., will put up a 2-story 54 x 90-ft. saw and planing mill. No new power plant is wanted, but they will buy mill machinery.

The Structural Iron Company, Baltimore, Md., will shortly begin the erection of a 200 x 136-ft. bridge shop. The power plant will require new boilers, and an engine dynamo and motors for driving the tools with electricity. The capacity will be about 60 K. W. Some bridge shop machinery will also be required. Thomas G. Basshoe, of Baltimore, has rented the old shop of the Structural Iron Company, and will turn it into a boiler shop.

BUSINESS NOTES.

The Compagnie Generale des Asphaltes de France, Ld., 32 Broadway, New York, has awarded the contract for the erection of a new pier on its property at the foot of Seventh Street, Borough of Queens, city of New York, to James I. Leary, 22 State Street, New York city, at a cost of about $10,000.

The Tyler Tube & Pipe Co., Washington, Pa., is erecting an 18-in. train of rolls, made by the A. Garrison Foundry Co., Pittsburg, Pa. A 500-H.-P. engine has been ordered from the Bass Foundry & Machine Co., Ft. Wayne, Ind., and waste heat stack boilers from the Babcock & Wilcox Co., New York. The iron building is being erected by the Fort Pitt Bridge Works, Canonsburg, Pa. Contracts for a pair of shears and some steam pumps have not been placed.

The American Impulse Wheel Co., New York, reports some large electric transmission work on hand, and an encouraging outlook for the future.

The West Penn Foundry & Machine Co., Avonmore, Pa., manufacturers of engines, rolling mills and glass and hydraulic machinery, has nearly finished a new 32 x 48-ft. pattern shop to replace one recently burned.

J. G. Speidel, 233 South 8th St., Reading, Pa., is putting up a 3-story building for the manufacture of hand and power elevators, cranes, safety hoists and traveling bridges. No new power plant will be needed.

The Buffalo Forge Company., Buffalo, N. Y., has been awarded a gold medal by the judges of the Omaha Exposition for its high-speed engine. The points of special mention were: "Refinement of regulation, exceptional economy, uniform smoothness of operation, simplicity of design, handsome outlines, large bearing surfaces, great stability, unique oiling system with incidental ingenious devices, special adaptation for direct connection to generators."

The Board of Water Commissioners of St. Paul, Minn., has contracted with the Pittsburg Meter Co., East Pittsburg, Pa., for the water meters to be used in that city during 1899. This is the third successive annual contract awarded the company by the board.

The Fowler Radiator & Manufacturing Co., Johnstown, Pa., will double the capacity of its plant. No considerable addition to the power plant will be made, but a number of automatic boring machines and like tools will be installed.

BUILDING INTELLIGENCE.

Omaha, Neb.—It is stated that a freight depot will be erected here jointly by the Illinois Central, the Milwaukee and Rock Island roads.

Ft. Worth, Tex.—The Thompson Construction Co., of St. Louis, is stated to have received the contract to build the station for the Texas & Pacific Ry. Co.; estimated cost, $125,000.

Kansas City, Mo.—It is stated that work will probably begin in April on the new freight depot, improving round houses, yards, etc., for the Chicago, Burlington & Quincy R.R. Co. L. F. Goodale, Ch. Engr., St. Joseph, Mo.

Fort Worth, Tex.—Bids are wanted March 15 for a stone and brick union depot. C. F. W. Felt, Ch. Engr. Gulf, Colorado & Santa Fe Ry., Galveston.

Cleveland, O.—Bids are wanted March 11 for a church. Fugman & Uhlrich, Archts., 89 Euclid Ave.

Olympia, Wash.—The Senate is stated to have passed a bill authorizing the University of Washington to build two dormitories, to cost $25,000 each, and equip the university buildings with a $5,000 sewerage system; also a bill authorizing the Agricultural College to rebuild the boys' dormitory, at a cost of $40,000.

South Omaha, Neb.—George A. Kennedy, Mgr. of the Construction Department of Armour & Co., Chicago, Ill., is stated to have completed plans for a 10-story warehouse to be built here, to cost about $175,000.

Bloomington, Wis.—Bids are wanted March 20 for a church. Wm. D. Ryan, Secy. Bldg. Com., North Andover, Wis.

New York, N. Y.—Robt. A. Chesebrough, Pres. Chesebrough Mfg. Co., is stated to have completed arrangements for the erection of a 12-story fireproof office building on State St.; estimated cost, $600,000.

Providence, R. I.—It is stated that plans are being prepared for a $17,000 edifice for the Globe Congregational Church. E. O. Ronian, Chmn. Bldg. Com.

Iowa City, Ia.—H. H. Jones, City Clk., writes that it was voted Feb. 21 to erect a $90,000 court house and $10,000 jail.

Portland, Ind.—It is stated that bids are wanted in March for a jail, to cost $23,000. Wing & Machurin, Archts., Ft. Wayne.

Mansfield, O.—Bids are wanted March 28 for completing the roof of the east cell and lateral wing of the Ohio State Reformatory. F. M. Marriott, Chmn. Bd. of Mgrs.

Eau Claire, Wis.—It is stated that the Eau Claire Grocer Co. will erect a business building, to cost about $50,000.

Appleton, Wis.—M. K. Gochnauer, City Clk., writes bids will probably be received about March 20 for a public library, to cost $25,000.

La Crosse, Wis.—The Pamperin & Wiggenhorn Cigar Co. proposes to build a brick factory, 50x100, with electric elevator, etc.

Toledo, O.—The directors of the Y. M. C. A. are said to be considering the matter of erecting a new building. T. H. Walbridge, Chmn. Bldg. Com.

Evergreen, Ala.—The House is stated to have passed a bill authorizing Conecuh County to issue bonds to erect a court house and repair the jail.

Covington, Ky.—The plans of B. T. Wisenall, 75 Blymer Bldg., Cincinnati, O., are stated to have been accepted for a court house.

Cedar Rapids, Ia.—S. L. Dows will build a $100,000 fireproof addition to the Auditorium.

Maynardville, Tenn.—The House is said to have passed a bill authorizing Union County to issue $12,000 bonds for a court house.

Binghamton, N. Y.—Bids are wanted March 9 for additions, alterations and repairs to the north building of the Binghamton State Hospital, as advertised in "The Engineering Record."

Lawrence, Kan.—The County Commissioners are stated to have decided to build a court house.

Chicago, Ill.—It is stated that the Wesley Hospital Association will erect a $200,000 hospital on Dearborn and 25th Sts. R. D. Sheppard, Pres.

Roseburg, Ore.—It is stated that bids are wanted March 9 for a court house. J. Lyons, Co. Judge.

Mobile, Ala.—Architect Sully, of New Orleans, is said to be preparing plans for a theater to be erected here by Mr. Pollock.

Montgomery, Tex.—Bids are wanted March 23 for a 2-story steel fire proof vault. M. S. Cooper, Co. Judge.

Bismarck, N. D.—The Governor is stated to have approved the bill authorizing the issue of $50,000 bonds for the erection of additional buildings at the State Insane Asylum.

Anderson, Ind.—It is stated that the M. E. Society proposes to build a $30,000 church. A. A. Small and C. S. Henry are said to be interested.

New York, N. Y.—Bids are wanted March 13 for alterations, repairs, electric work, plumbing, heating, steam fitting, gas fitting, etc., in the insane pavilion, Bellevue hospital. John W. Keller, Pres. Dept. Pub. Charities.

Chicago, Ill.—It is stated that about $50,000 will be expended on improving the Michael Reese Hospital. New heating and lighting plant will be added.

Lowville, N. Y.—The Governor is stated to have signed a bill authorizing the town to construct a $20,000 town hall.

Dallas, Ore.—Bids are wanted March 22 for a court house. Eugene Hayler, Clk. Co. Bd.

Santa Fe., N. M.—The U. S. Senate is stated to have passed a bill authorizing the Legislative Assembly of New Mexico to issue $60,000 bonds to complete the capitol.

Passaic, N. J.—It is stated that bids are wanted March 10 for an engine house. E. W. Gardner, Chmn. Com.

Boise City, Idaho.—H. B. Eastman is said to be interested in the erection of a $60,000 hotel.

Boston, Mass.—W. L. Morrison, 70 Kilby St., is to prepare plans for 38 single dwellings on Beacon and St. Mary's Sts.

Birmingham, Ala.—Plans and specifications are wanted April 15 by the Board of Managers of the Hillman Hospital for a hospital.

Detroit, Mich.—The following contracts are said to have been awarded for the interior work of the new county building: Carpenter work to G. J. Vinton, Detroit, $110,900. Marble work to Davison Bros., Chicago, $211,000. Plastering to Lennox & Haldeman, Chicago, $54,944 to $60,000. For marble and marble mosaic floors, Sherman & Flavin, Chicago, were the lowest bidders, $45,514 to $47,838.

Holyoke, Mass.—The Windsor Hotel block is stated to have been destroyed by fire; loss, about $275,000.

Washington, D. C.—The following bids are stated to have been opened by the District Commissioners Feb. 25 for constructing an isolating building on the grounds of the Providence Hospital: Chas. S. Denham, 820 19 St. N. W., $24,960; Henry F. Getz, 802 F. St. N. W., $23,997; Andrew Gleeson, $23,600, and Pavarini & Greer, 814 18 St. N. W., $23,575.

Junction City, Kan.—It is stated that at the election April 4 the citizens will probably be asked to vote on the question of erecting a $40,000 court house.

NEW YORK, N. Y.

Birmingham st, n w cor Madison st, br stores and flat; cost, $25,000; o, Abelman & Rosenblum; a, M Bernstein.

51 St Mark's pl, br flat; cost, $23,000; o, Gustav Dohrenwend; a, Schneider & Herter.

105 and 107 E 10th st, 2 br flats; cost, $88,000 all; o, P Kotlowsky & B Levy; a, Schneider & Herter.

10 and 12 Attorney st, br flat; cost, $42,000; o, Abram Silverson; a, Schneider & Herter.

319 to 325 E 8th st, 3 br flats; cost, $101,000 all; o, Geo Hoffmann; a, Schneider & Herter.

137 and 139 Broome st, br store and tenem't; cost, $30,000; o, Julius & Max Weinstein; a, G. F. Pelham.

W s ave D, 27 n 5th st, 2 br tenem'ts; cost, $51,000 all; o, Morris Jacobson; a, Fred Ebeling.

51 Norfolk st, br tenem't; cost, $30,000; o, Leon & Jacob Pizer; a, G F Pelham.

N s 108th st, 100 e 2d ave, s s 109th st, 150 e 2d ave, br and stone school; cost, $125,000; o, City of New York; a, C B J Snyder.

100th st, n e cor Park ave, 13 br stores and flats; cost, $237,000 all; o, Morris Mandelstein; a, Thomas Granam.

S s 114th st, 205 w 2d av, 2 br flats; cost, $44,000 all; o, Henry Brown; a, Franklin Baylies.

232 E 76th st, br store and flat; cost, $28,500; o, Moses K Wallach; a, G F Pelham.

N s 108th st, 100 e Riverside Drive, 7 br dwell'gs; cost, $179,000 all; o, Wm Van Wyck Graham; a, Thomas Graham.

202 and 204 W 102d st, br flat; cost, $25,000; o, James Bradley; a, Horgan & Sattery.

S s 76th st, 200 w Central Park West, 3 stone dwell'gs; cost, $120,000 all; o, James Carlew; a, Cleverdon & Putzel.

32 W 66th st, stone tenem't; cost, $23,000; o, Franz Fohr; a, G F Pelham.

S s 105th st, 215 w West End ave, 4 br and stone dwell'gs; $100,000 all; o, J C Umberfield; a, Janes & Leo.

S s 113th st, 200 w 7th ave, br flat; cost, $75,000; o, Geo T Arnoux; a, C Steinmetz.

N s 112th st, 300 e 8th ave, 2 br flats; cost, $80,000 all; o, Carribelle D Lauchautin; a, L F J Weiher, Jr.

Boulevard, bt 148th and 149th sts, 6 br flats; cost, $325,000 all; o, J Bartscherer; a, Buchman & Deisler.

N s 146th st, 150 w College ave, br flat; cost, $26,000; o, Ragette & Wolf; a, Edw Wenz.

S s 134th st, 337 e Cypress ave, br flat; cost, $20,000; o, Theobald J Dengler; a, Gustav Schwarz.

178th st, n w cor Webster ave, br flat; cost, $30,000; o, C J Singhi; a, Henry Andersen.

W s Beach ave, 50 n Dawson st, 3 br flats; cost, $33,000 all; o, Louis Curtis; a, W S Banderson.

Elton ave, n e cor 160th st, 2 br flats; cost, $76,000 all; o, Geo A Macdonald; a, Edw Wenz.

Eagle ave, s w cor Westchester ave, br flat; cost, $30,000; o and a, Albert Rothermel.

BROOKLYN.

S s Gates ave, 62 e Ralph ave, br stable and milk depot; cost, $49,000; o, Anglo-Swiss Milk Co; b, F J Ashfield.

N s Parkway and s s Degraw st, 100 w New York ave, 6 br dwell'gs; cost, $120,000; o and a, F L Hine.

W s Albany ave, 30 s Bergen st, 5 br flats; cost, $70,000 all; o, a and b, John Potts.

S s N 12th st, 144 w Berry st, br factory; cost, $20,000; o, McKesson & Robbins; a, J Ireland; b, Burton & Nickle.

Albany ave, s w cor Bergen st, br flat; cost, $20,000; o and a, John Potts; b, Potts & Partridge.

MISCELLANEOUS.

Bailey, Colo.—Two sty frame hotel, 40x120; cost, $12,000; o, Colo & Southern R R; a, Varion & Sterner.

Denver, Colo.—15th and Cleveland pl, 2 sty brk stores and offices, 75x100; cost, $19,000; o, Arlington Imp Co; a, Terry Boal. Colfax and Clarkson, 2 sty br flats; cost, $18,000; o, J H Drinkwater; a, Merean & Norton.

Fitchburg, Mass.—21 to 25 Blossom st, br theatre; cost, $30,000; o, L W Cumings & Son.

Macon, Ga.—358 to 360 3d st, stores; cost, $12,000; o, T C Burke; a, D B Woodruff.

Slaghts, Colo.—2½ sty frame hotel, 45x140; cost, $15,000; o, Colo & Southern R R; a, Varion & Sterner.

Toledo, O.—Superior st, store bldg and traveling men's club room; cost, $50,000; o, A Chesebrough; a, Wachter & Hudson.

PROPOSALS OPEN.

Bids Close. — See Eng. Record.

WATER-WORKS.

Mar. 6. Jamesburg, N. J .... Feb. 11
Adv., Eng. RECORD, Feb. 11, 18.
Mar. 6. Bonds, Windsor, N. Y .... Feb. 25
Mar. 7. Pipe, etc., Everett, Mass .... Feb. 11
Adv., Eng. RECORD, Feb. 11.
Mar. 7. Allison, Ia .... Feb. 18
Mar. 8. Bonds, McConnellsville, O .... Feb. 11
Mar. 9. Atlanta, Ga .... Feb. 18
Mar. 9. Lakewood, O .... Mar 4
Mar. 10. Valves, Minneapolis, Minn .... Mar. 4
Mar. 11. Washington, D. C .... Feb. 18
Adv., Eng. RECORD, Feb. 18.
Mar. 11. Washington, D. C .... Feb. 11
Adv., Eng. RECORD, Feb 11.
Mar. 11. Montgomery, Ala .... Mar. 4
Adv., Eng. RECORD, Mar. 4.
Mar. 12. Antelope, Ore .... Mar. 4
Mar. 13. Bonds, Reno, Nev .... Mar. 4
Mar. 14. Lexington, Ky .... Mar. 4
Mar. 14. Bonds, Prescott, Ariz .... Mar. 4
Mar. 15. Gates, etc., Oakland, Cal .... Mar. 4
Mar. 15. Belem, Para, Brazil .... Nov. 26
Mar. 15. Pipe, etc., Fayetteville, Ten .... Feb. 11
Adv., Eng. RECORD, Feb. 18.
Mar. 16. Cleveland, O .... Feb. 25
Mar. 21. St. Louis, Mo .... Feb. 25
Mar. 23. Bloomington, Ind .... Mar. 4
Apr. 3. Winnepeg, Man .... Feb. 4
Adv., Eng. RECORD, Feb. 4 to 18.
Apr. 11. Lakeport, Cal .... Feb. 25
Apr. 15. Forestport, N. Y .... Mar. 4
—— Engine, Marion, Ind .... Mar. 4
—— Pumps, etc., Dubuque, Ia .... Mar. 4

SEWERAGE AND SEWAGE DISPOSAL.

Mar. 6. Woonsocket, R. I .... Feb. 4
Adv., Eng. RECORD, Feb. 4, 11.
Mar. 6. Virginia City, Nev .... Feb. 25
Mar. 7. Niles, O .... Feb. 11
Adv., Eng. RECORD, Feb. 18.
Mar. 7. Detroit, Mich .... Mar. 4
Mar. 7. Allegheny, Pa .... Mar. 4
Mar. 7. East Grand Forks, Minn .... Mar. 4
Mar. 7. Terre Haute, Ind .... Mar. 4
Mar. 8. Buffalo, N. Y .... Mar. 4
Mar. 9. Easton, Pa .... Mar. 4
Mar. 9. Norfolk, Va .... Feb. 11
Adv., Eng. RECORD, Feb. 11 to 25.
Mar. 10. Cleveland, O .... Feb. 18
Mar. 11. Cleveland, O .... Feb. 18
Mar. 13. Toledo, O .... Mar. 4
Mar. 13. Plainfield, N. J .... Mar. 4
Mar 14. Bonds, Prescott, Ariz .... Mar 4
Mar. 14. Ponca, Neb .... Feb. 25
Mar 14. Lexington, Ky .... Mar. 4
Mar. 14. Laurium, Mich .... Mar. 4
Mar. 15. Cleveland, O .... Feb. 18
Adv., Eng. RECORD, Feb. 18, 25.
Mar 16. Cleveland, O .... Feb. 18
Mar. 17. Cleveland, O .... Feb. 25
Mar. 24. Pontiac, Mich .... Mar. 4
Apr. 15. Honolulu, H. I .... Feb. 25
Adv., Eng. RECORD, Feb. 25, Mar. 4.

BRIDGES.

Mar. 7. Virginia City, Mont .... Feb. 25
Mar. 7. Suisun City, Cal .... Feb. 25
Mar. 7. Urbana, Ill .... Mar. 4
Mar. 9. Shreveport, La .... Feb. 11
Mar. 9. Plans, etc, Gonzales, Tex .... Mar. 4
Mar. 10. Substructure, Lorain, O .... Mar. 4
Mar. 10. Newport, R I .... Mar. 4
Mar. 10. Cleveland, O .... Feb. 18
Mar. 11. Carrollton, Mo .... Feb. 25
Mar 14. Macon, Ga .... Feb. 25
Mar. 15. Chicago, Ill .... Jan. 21
Adv., Eng. RECORD, Jan. 21.
Mar. 15. Leroy, N. Y .... Mar. 4
Apr. 1. Substructure, St. Joseph, Mo .... Jan. 7
Apr. 10. Chicago, Ill .... Feb. 18
Adv., Eng. RECORD, Feb. 18.
Mar. 21. Superstructure, Bellefontaine, O .... Feb. 25
—— Quincy, Ill .... Feb. 25
Adv., Eng. RECORD, Feb. 25.
Apr. 1. New Whatcom, Wash .... Mar. 4

PAVING AND ROADMAKING.

Mar. 6. Brighton, N. Y .... Feb. 25
Mar. 6. Joliet, Ill .... Mar. 4
Mar. 7. Joplin, Mo .... Feb. 4
Mar. 7. Cleveland, O .... Feb. 15
Mar. 7. Brooklyn, N. Y .... Feb. 21
Mar. 7. Jersey City, N. J .... Mar. 4
Mar. 8. Sand, etc., Buffalo, N. Y .... Mar. 4
Mar. 9. Easton, Pa .... Mar. 4
Mar. 9. Champaign, Ill .... Mar. 4
Mar. 10. St. Louis, Mo .... Mar. 4
Mar. 10. Brownstown, Ind .... Feb. 11
Mar. 11. Woodbury, N. J .... Feb. 52
Mar. 13. Kokomo, Ind .... Feb. 25
Mar. 14. Cleveland, O .... Feb. 18
Mar. 14. Georgetown, O .... Feb. 25
Mar. 14. Sioux City, Ia .... Mar. 4
Mar. 15. Georgetown, O .... Feb. 25
Mar. 16. Lebanon, Ind .... Feb. 18
Mar. 18. New Orleans, La .... Mar. 4
Mar. 18. Washington, D. C .... Mar. 4
Mar 27. Toledo, O .... Mar. 4

POWER, GAS AND ELECTRICITY

Mar. 6. Cambridge, O .... Feb. 18
Mar. 6. Portland, Me .... Feb. 4
Adv., Eng. RECORD, Feb. 4.
Mar. 6. Elizabethtown, Ky .... Feb. 25
Mar. 6. New Rochelle, N. Y .... Feb. 25
Mar. 7. Centralia, Ill .... Feb. 25
Mar. 7. Williamstown, Ky .... Feb. 25
Mar. 8. Halifax, N S .... Feb, 11
Adv., Eng. RECORD, Feb. 11, 18.
Mar. 13. New York, N. Y .... Mar.
Mar. 14. Lexington, Ky .... Mar.

Mar. 20. San Diego, Cal. ....Mar. 4
Mar. 31. Telephone, Shanghai, China........Nov. 19
Mar. — Fonda, Ia........................Mar. 4
Apr. 10. Dayton, O.........................Mar. 4
Adv., Eng. Record, Mar. 4.
—— Pleasantville, O.....................Dec. 24

GOVERNMENT WORK.

Mar. 6. Portland, Me....................... Feb. 4
Adv., Eng. Record, Feb. 4 to 25.
Mar. 7. Camden, N. J.......................Feb. 11
Adv., Eng. Record, Feb. 11 to 25.
Mar. 8. Wharf, Rockpoint, Md............. Feb. 11
Mar. 8. New York, N. Y....................Feb. 11
Adv., Eng. Record, Feb. 11 to Mar. 4.
Mar. 10. New York City.....................Feb. 11
Adv. Eng. Record, Feb. 11 to Mar. 4.
Mar. 10. Baltimore, Md......................Feb. 11
Adv., Eng. Record, Feb. 11 to Mar. 4.
Mar. 10. New York City.....................Feb. 18
Adv., Eng. Record, Feb. 18 to Mar. 4.
Mar. 14. Plumbing, New York, N. Y....... Feb. 18
Mar. 14. San Francisco, Cal.................Mar. 4
Mar. 15. Rock Island, Ill....................Feb. 18
Adv., Eng. Record, Feb. 18 to Mar. 4.
Mar. 15. Baltimore, Md......................Feb. 18
Adv., Eng. Record, Feb. 25, Mar. 4.
Mar. 15. San Francisco, Cal.................Feb. 11
Mar. 23. Kansas City, Mo...................Feb. 25
Adv., Eng. Record, Feb. 25, Mar. 4.
Mar. 28. Chicago, Ill.........................Mar. 4
Adv., Eng. Record, Mar. 4.
Mar. 30. San Francisco, Cal.................Mar. 4
Adv., Eng. Record, Mar. 4.
Apr. 5. Vicksburg, Miss......................Mar. 4
Adv., Eng. Record, Mar. 4.

Apr. 6. New Orleans, La....................Feb. 11
Adv., Eng. Record, Feb. 11 to 25.

BUILDINGS.

Mar. 6. School, Eau Claire, Wis............Jan. 28
Mar. 6. School, Madelia, Minn..............Feb. 25
Mar. 6. Shepherdsville, Ky...................Feb. 25
Mar. 6. Steel ceilings, New York, N. Y....Feb. 25
Mar. 6. Schools, New York, N. Y...........Feb. 25
Mar. 6. School, Jacksonville, Ill............Mar. 4
Mar. 6. Sanitary work in school, New York, N. Y.........................Mar. 4
Mar. 6. Vent. & htg. school, Boston, Mass..Mar. 4
Mar. 7. Northfield, Minn.....................Feb. 25
Mar. 8. Aberdeen, S. Dak....................Jan. 28
Mar. 9. Dartford, Wis.........................Feb. 25
Mar. 9. Philadelphia, Pa......................Feb. 25
Mar. 9. School, New York, N. Y..............Mar. 4
Mar. 9. Binghamton, N. Y....................Mar. 4
Adv., Eng. Record, Mar. 4.
Mar. 9. Roseburg, Ore.........................Mar. 4
Mar. 10. Passaic, N. J.........................Mar. 4
Mar. 10. Ventilating, etc., Cleveland, O....Feb. 18
Mar. 11. School, Wheaton, Minn.............Feb. 18
Mar. 11. School, Washington, D. C..........Mar. 4
Mar. 11. Cleveland, O..........................Mar. 4
Mar. 13. School, Kansas City, Kan..........Mar. 4
Mar. 13. School, New York, N. Y............Mar. 4
Mar. 13. New York, N. Y......................Mar. 4
Mar. 14. School, Algona, Ia...................Feb. 25
Mar. 15. Lancaster, Wis.......................Feb. 25
Mar. 15. Mankato, Minn.......................Feb. 25
Mar. 15. School, Louisville, Ky..............Feb. 25
Mar. 15. Canton, S. D..........................Feb. 25
Mar. 15. Plans, Wilkesbarre, Pa..............Jan. 28

Mar. 15. Depot, Fort Worth, Tex............Mar. 4
Mar. 15. School, Sioux Falls, S. D..........Mar. 4
Mar. 18. School, Chester, Ill.................Mar. 4
Mar. 20. Vent. and htg. school, Lima, O....Mar. 4
Mar. 20. Bloomington, Wis....................Mar. 4
Mar. 20. Appleton, Miss.......................Mar. 4
Mar. 22. Dallas, Ore...........................Mar. 4
Mar. 23. Vault, Montgomery, Tex.............Mar. 4
Mar. 25. School, Cleveland, O................Mar. 4
Mar. 25. School, York, N. D...................Mar. 4
Mar. 28. Mansfield, O..........................Mar. 4
Mar. 30. Iowa City, Ia.........................Feb. 18
Mar. — Portland, Ind........................Mar. 4
Apr. 1. School, Hannaford, N. D............Mar. 4
Apr. 3. Many, La...............................Jan. 21
Apr. 14. Plans, Bradford, England...........Jan. 21
Apr. 15. Plans, etc., Birmingham, Ala......Mar. 4

MISCELLANEOUS.

Mar. 7. Street cleaning, Cleveland O........Feb. 4
Mar. 6. Boston, Mass...........................Mar. 4
Mar. 8. Williamsport, Pa......................Feb. 25
Adv., Eng. Record, Feb. 25.
Mar. 10. Garbage disposal, Brooklyn, N. Y..Feb. 18
Mar. 10. Piers, etc., Brooklyn, N. Y.........Mar. 4
Mar. 10. Dredging, New York, N. Y..........Mar. 4
Mar. 11. Washington, D. C....................Feb. 18
Adv., Eng. Record, Feb. 18.
Mar. 13. Dredging, New York, N. Y.........Mar. 4
Mar. 13. Eng'rs' supplies, New York, N. Y. Mar. 4
Mar. 18. Park work, New Orleans, La.......Mar. 4
Mar. 31. Garbage disposal, Rochester, N. Y. Mar. 4
Apr. 10. Ditch, etc., Fremont, Neb...........Mar. 4
June 30. El. Ry., Shanghai, China............Mar. 4
Oct. 1. Railroad, Moscow, Russia............Feb. 25

NEW SCHOOLS.

Dayton, O.—The Board of Education is stated to have decided to erect a 16-room school, also an 8-room addition.

Racine, Wis.—Plans are stated to have been adopted for a $20,000 school, also a $14,000 addition to the 6th ward school.

Daleville, Ind.—The School Board is stated to have decided to build a $15,000 school. C. Holinger, Trustee.

Deerfield, O.—It is stated that a $10,000 school will be erected.

Toledo, O.—The congregation of St. Anthony's Church is stated to have decided to erect a $20,000 school.

Pittsburg, Pa.—The School Directors of the 27th Ward are stated to have accepted plans for a $50,000 school, to replace the Brashear School, recently burned.

Jersey City, N. J.—The Board of Education is considering the matter of erecting two schools, one to cost $100,000, the other $48,000.

Sioux Falls, S. D.—Bids are wanted March 15 by the Superintendent of Schools for a school in Dist. No. 88.

Hannaford, N. D.—Bids are wanted April 1 for a school in Broadview District. Henry Curtis, Dist. Clk.

Detroit, Mich.—We are informed that two 12-room schools are to be built; cost, $35,000 each.

Norristown, Pa.—There is talk of erecting a high school here.

North Washington, Pa.—It is stated that a $20,000 school will be erected here.

Chester, Ill.—Bids are wanted March 18 by the Board of Education for an addition to the high school.

Bloomfield, N. J.—Peter Vanderhoof & Son of Newark are stated to have received the contract for 2 schools here, at $53,646.

Kansas City, Kan.—Bids are wanted March 13 for a high school. M. G. Jones, Clk. Bd. Educ.

Fostoria, O.—The citizens will soon be asked to vote on issuing $25,000 bonds for a high school.

Long Branch, N. J.—It is stated that a new parochial school will soon be built here by the Star of the Sea Church, at a cost of $30,000.

Monroe, La.—The plans of J. W. Gaddis of Vincennes, Ind., are stated to have been accepted for a high school, to cost about $25,000.

Jacksonville, Ill.—Bids are wanted March 6 for a high school. N. Buckingham & Son, Archts., Alexander Bldg.; Sam'l B. Stewart, Clk. Bd. of Educ.

Lima, O.—It is stated that bids are wanted March 20 for a mechanical ventilating and heating system in the proposed East High St. school. A. J. Morris, Clk. Bd. Educ.

McKeesport, Pa.—All bids received Feb. 27 for the high school are stated to have been rejected as being in excess of the appropriation, $80,000. New bids will be asked.

Elgin, Ill.—The citizens are stated to have voted to issue $30,000 school bonds.

York, N. D.—Bids are wanted March 25 for 2 schools in school district No. 8. J. L. Johnson, Clk.

Burlington, Vt.—Buckley & Co., of Burlington, are stated to have received the contract for heating and ventilating the high school at $9,100.

Cleveland, O.—Bids are wanted March 25 for an addition to the Sowinski School. H. Q. Sargent, School Dir., 190 Euclid Ave.

Mattoon, Ill.—D. W. Ferguson, Secy. of the School Board, writes that it was voted on Feb. 11 to issue $28,000 bonds; plans for the building have been prepared and bids are now being received.

Boston, Mass.—Bids are wanted March 6 for a ventilating and heating system in the East Boston high school. Edw. I. Aldrich, Chmn. Com. on New Bldgs. of School Com.

New York, N. Y.—Bids are wanted March 9 and 13 for schools Nos. 171 and 172. Richard H. Adams, Chmn. Com. on Bldgs., Bd. of Educ.

San Luis Obispo, Cal.—The Senate is stated to have passed a bill providing for establishing the California Polytechnic School in San Luis Obispo County and appropriating $100,000 for the construction of buildings.

Washington, D. C.—Bids are wanted March 11 for a school. John B. Wight, Chmn. Commrs. D. C.

Boston, Mass.—The Board of Estimate and Apportionment has set aside $500,000 of the borrowing capacity of the city of Boston, within the debt limit, for new primary and grammar school houses to be designated by the School Board.

The School Committee has voted $250,000 for school house repairs, etc., for the current financial year.

New York, N. Y.—The following bids were opened Feb. 27 by the Committee on Buildings, Board of Education, for Public School 119: P. J. Walsh, 503 5th Ave., $291,000; Luke A. Burke, 401 West 59th St., $302,500; Mapes-Reeve Construction Co., 150 Nassau St., $309,831; P. Gallagher, 150 5th Ave., *$289,300; Harry McNally, 287 4th Ave., $293,700; John J. Hopper, 217 West 125th St., $312,903; Thos. Cockerill & Sons, 550 West 51st St., $314,900; Murphy Bros., 407 East 101st St., $303,000.

Bids opened March 2 for Public School 174 were as follows: H. Probst, 1180 B'way, $149,900; Luke A. Burke, $139,000; Henry Booth, 137 East 122d St., $173,725; Alfred Nugent & Son, 41 Columbia St., $159,400; P. Gallagher, $149,443; P. J. Brennan, 63 West 22d St., $146,000; Thos. Cockerill & Son, $148,900; Mapes-Reeve Construction Co., $149,465; John H. Parker Co., 256 B'way, $146,300; Murphy Brothers, $144,896; Jas. J. Loonie, 287 4th Ave., $147,750; Colonial Construction Works, B'way and 26th St., $164,240.

*Contract awarded.

STREET CLEANING AND GARBAGE DISPOSAL.

Camden, N. J.—The City Council on Feb. 23 accepted a proposition from Benjamin F. Howland of Philadelphia to erect a reduction plant on city property and dispose of all the city garbage for $150 per month. At the end of 5 years the city is to have the option of purchasing the plant or renewing the contract.

Rochester, N. Y.—It is stated that bids are wanted March 31 by the Board of Health for the collection and disposal of garbage for one year.

Greenville, Miss.—Press reports state that the town contemplates building a garbage crematory.

Chester, Pa.—The city officials have under consideration the construction of an incinerating plant for the disposal of garbage.

GOVERNMENT WORK.

Chicago, Ill.—Bids are wanted at the U. S. Engineer Office until March 28 for dredging and constructing docks in Chicago River, as advertised in "The Engineering Record."

San Francisco, Cal.—Bids are wanted March 30 by the Superv. Archt., Treas. Dept., Washington, D. C., for masonry work, roof covering, etc., for the U. S. Post Office and Court House, as advertised in "The Engineering Record."

New York, N. Y.—The bill providing for the construction of a Custom House in New York City passed the House on Feb. 28. It authorizes building on the Bowling Green site, at a cost not to exceed $3,000,000.

San Francisco, Cal.—The Washington Star states that the Navy Department is about to ask for bids for a new timber dry dock at the Mare Island Navy Yard; length, 750 ft., draft, 30 ft.; width at the bottom, 80 ft.

Vicksburg, Miss.—Bids are wanted April 5 for excavating 7,500,000 cu. yds. of earth, as advertised in "The Engineering Record."

Savannah, Ga.—Press reports state that Bowe & McKenzie, of Augusta, Ga., have secured the contract for furnishing crushed rock for government work at Savannah for $30,558.

MISCELLANEOUS.

Boston, Mass.—Bids are wanted March 6 for building the Blue Hills parkway from Brook Road to Canton Ave., Milton; included in the approximate estimates are the following: 29,000 cu. yds. earth grading, 1,000 cu. yds. rock grading, 50,000 cu. yds. filling material, and 9,600 lin. ft. of 8 to 18 in. pipe drain. William B. De Las Casas, Chmn. Metropolitan Park Commrs.

Louisville, Ky.—Local press reports state that the Board of Park Commissioners propose to expend about $37,000 this summer for park improvements.

Newport News, Va.—Press reports state that the Old Dominion Land Co. proposes to construct 20 new piers for the accommodation of small boats.

New York, N. Y.—The Empire Contracting Co. of New York City has been incorporated, to do all kinds of contracting work; capital stock, $25,000. Directors: John J. Gifford, H. P. Johnson and Charles J. Campbell, N. Y. City.

New York, N. Y.—Hogan & Slattery, consulting architects on the construction of the North Second St. recreation pier, have submitted plans to the Department of Docks and Ferries. The plans show a frontage of 50 ft., with a distance of 21 ft. from the centre of the floor to the ridgepole and a slant of 8½ ft. at the eaves.

New York, N. Y.—Bids are wanted March 10 for dredging the North River from the Battery to 34th St. J. Sergeant Cram, Chmn. Commrs. of Docks.

Brooklyn, N. Y.—Bids are wanted March 10 for 2 new wooden piers with appurtenances, repairing and extending platform, repairing bulkhead, and removing 2 piers at the Wallabout basin. J. Sergeant Cram, Chmn. Commrs. of Docks, New York City.

New Orleans, La.—Bids are wanted March 18 for digging artificial lakes, grading their banks and building a drive in the City Park. Excavation, about 130,000 cu. yds. Paul Capdevielle, Pres. of the Association, 622 Canal St.

New York, N. Y.—Bids are wanted March 13 for dredging near the foot of Rutgers Slip, on the East River. J. Sergeant Cram, Chmn. Commrs. of Docks.

Pueblo, Colo.—The contract for 1,600 ft. of levee work has been awarded to C. I. Manners for $21,930.

New York, N. Y.—Bids are wanted March 13 for engineers' supplies. John W. Keller, Pres. Dept. Pub. Charities.

Little Rock, Ark.—The House has passed a bill authorizing the St. Francis levee district to issue bonds to the amount of $750,000 for improvement purposes.*

Fremont, Neb.—It is stated that bids are wanted April 10 for 350 ft. of piling and riprap work on the Platte River and for digging a ditch 700 ft. long near Crowell. C. A. Manville, Co. Clk.

Toledo, O.—The Council Committee on Ways and Means has approved an ordinance for the issue of $150,000 bonds for improvements at Bayview Park.

Cleveland, O.—Local press reports state that the contract for dredging and removing docks for the section of the river widening between Main St. and the old river bed has been awarded to L. P. & J. A. Smith Co., of Cleveland; estimated cost, $12,000.

THE ENGINEERING RECORD.

Volume XXXIX. Number 15

TABLE OF LEADING ARTICLES.

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THE BUREAU OF YARDS AND DOCKS.

It will be recalled by all civil engineers interested in the welfare of the profession that about a year ago Secretary Long of the Navy Department broke all precedent and appointed Mr. M. T. Endicott, a member of the civil engineer corps of the department, as chief of the bureau of yards and docks. Mr. Long has always been considered by those who know him best as more than usually gifted with the ability to see through a business proposition, and his assignment of a civil engineer to the head of a naval bureau was an instance of this clear sight. For many years the position afforded a comfortable shore berth for a line officer. As a rule he never assumed to have more than a superficial knowledge of the work of the bureau, and relied on the guidance of the regular staff. Naturally the civil engineers wished to have one of their own number as their chief, and for years they tried to obtain this end. Their number was small, however; the vital importance of their work was unappreciated by the successive Secretaries, who communicated with them through a line officer, and their struggle for proper recognition roused the ire of some of the line, who did not care to see the non-combatant staff fighting for anything whatever, least of all a nice bureau office which was considered one of their pet perquisites.

Finally the possibility of war with Spain sent a shock through the department. The Secretary made haste to find out the real condition of the yards, stations and docks, and what he learned must have been a sad blow. Under his predecessor the chief of the bureau was an officer who had no use for a civil engineer. As a consequence the approaching conflict saw the country without a single good dry-dock for battleships; the staff officers in charge of the work of the bureau were nearly disheartened by a vain attempt to keep in repair the property worth millions of dollars, which was in their charge; and the country had the mortification of seeing the department ask as a favor of Great Britain the privilege of cleaning the Indiana in the dry-dock at Halifax. It was fortunate that a man of Mr. Long's caliber was then Secretary, for instead of allowing others to manufacture his opinions for him he does this work himself. He saw there was something wrong, and concluded that the best remedy was to get in personal touch with the men who really did the work of the Bureau of Yards and Docks by appointing one of their number as chief. For that appointment he deserves the thanks of every one, for it was made in the face of strong opposition from sources of much influence.

It would do little good to bring this subject to the surface again, were it not that another attack on the civil engineers of the Bureau was made recently in a particular contemptible, because anonymous, manner. Senator Chandler in a quiet, unobtrusive way which had attracted little attention, attempted to tack a little amendment to a recent bill, as it was passing through the Senate, which provided that there should be no more appointments to the corps. It was passed without opposition, as was to be expected for an amendment advocated by an ex-Secretary of Navy. No public intimation has yet been made as to who was behind this attempt, but whoever it was met with defeat at the hands of Mr. Long. How many secrets concerning the former management of the Bureau were revealed in his arguments against the passage of the amendment is unknown, but he certainly prevented this stab in the dark at the life of a bureau he has had the sagacity and backbone to put on a satisfactory working basis.

THE CANCELED SEATTLE WATER-WORKS CONTRACT.

A few months ago the City of Seattle, Wash., advertised for bids for constructing a water-works system to cost considerably over a million dollars. But one bid was received, although many contractors examined the plans and specifications, and after the contract had been awarded to the solitary bidder it was set aside by the Supreme Court of Washington. Throughout the whole affair there was no charge of fraud on the part of the proposed contractors or of favoritism on the part of city officials. The transaction was characterized by the courts as marked by good faith on the part of all parties concerned. It is well worth a brief review, however, because of the magnitude of the interests at stake, and the proof it offers that the best of intentions must be carried out in conformity with the laws if success is to be insured. The full report of the final decision will be found in 56 Pac. Rep. 29 under the head of Moran v. Thompson et al.

In October, 1895, the City Council passed ordinance 3990, providing for new water-works. In December of the same year, a popular election authorized the construction of this plant. The Board of Public Works afterward prepared plans, and called for bids in September, 1898. The ordinance formed part of the specifications and provided for the payment for the work by 5 per cent. warrants bearing interest from the acceptance of the new plant. The only tender submitted was from the well-known firm of Gahan & Byrne, of Chicago, whose bid amounted to about $1,239,000. A proviso was attached to this bid, and the Board of Public Works submitted the entire matter, without any recommendation, to the City Council. This step, according to the Supreme Court, was in violation of the city charter. The Board of Public Works has sole charge of advertising for bids for public improvements, and of opening them, and is required to let contracts to the lowest bidder; the City Council has no authority to instruct the Board to enter into a contract or to interfere with its discretion in such matters.

The tender of Messrs. Gahan & Byrne was sent to the Council in this illegal manner in November, 1898. The contractors afterward submitted to the Council an explanation of the proviso attached to their bid, and, later in the month, a new ordinance, amending the early one and known as ordinance 5128, was passed. This act of the Council violated a number of the provisions of the city charter, as well as the State constitution.

It provided that the warrants should bear 5 per cent. interest from the date they were issued, the interest to be returned to the city by the contractors before the final settlement. Such a provision was held by the courts to contravene the section of the State constitution, which reads: "No county, city, town or other municipal corporation shall hereafter give any money or property or loan its money or credit to or in aid of any individual, association, company or corporation."

The ordinance violated the city charter in directing the Board of Public Works to let the contract to the firm mentioned, for discretion in such matters is vested in the Board exclusively, as before stated. It also violated the charter by providing that 30 per cent. of the contract price should be withheld until the acceptance of the work in order to secure workmen, supply men, claims for royalties, replacing defective work and the repayment of interest, for the charter allows this sum to be retained for the benefit of laborers and material men solely.

This case has been referred to mainly for the purpose of pointing out to municipal officers the importance of making each of their official deeds correspond to the laws governing their actions. In this case it is easy to understand that the Board of Public Works, which consists of the city engineer, the superintendent of streets and the superintendent of lighting and water-works, did not care to assume the responsibility of awarding such an important contract under the peculiar attendant conditions. The law, however, was plain, and it now appears that the course which should have been followed was to ask the advice of the City Council, not its directions, and then accept or reject the tender as made, without allowing the modifications the bidders desired. If the Seattle authorities were the only ones to overstep the official limitations of their duties, it would not be worth the while to refer to this case. But the same thing is occurring frequently elsewhere and it is to be hoped the lesson will be taken to heart generally and lead to the compilation by each city for its officials of the laws governing their duties. Ignorance of the law is no excuse in the courts.

THAWING FROZEN PIPES BY ELECTRICITY.

In "The Engineering Record" of March 4, 1899, an account was given of the thawing of frozen water pipes by means of electricity. This method has been used quite extensively in thawing out service pipes, and in some cases the main pipes in the streets. It is stated that service pipes have been successfully thawed at Marquette, Bay City, and Saginaw, Mich.; at La Crosse, Reedsburg, Watertown, Sheboygan, Janesville and Milwaukee, Wis.; and at Rockford, Ill. Reports indicate that at Keokuk, Ia., the harmful effects of using too much electricity have been demonstrated. The water-works company is reported to have had considerable trouble from leakage in one of the street mains. On digging a trench and exposing the main, a service pipe leading to a nearby store was found melted into a matrix for the adjoining gravel. Electricity had been used to thaw pipes in this vicinity, and this trouble is laid to the use of too strong a current. The service pipe was melted at the wiped joint adjacent to the corporation connection with the main. A portion of the brass connection is also said to have been melted.

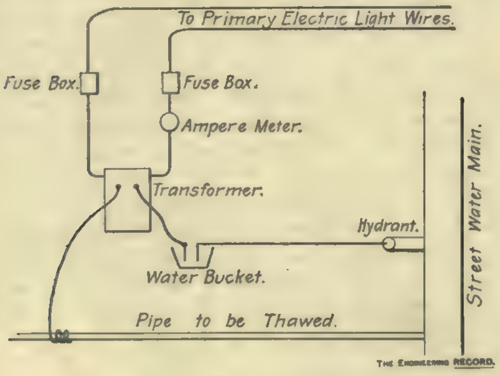
It is stated that at Marquette, Mich., the results have been so favorable that the Electric Light & Power Commission has established a rate of $4 in advance for thawing out a service pipe.

A 4-inch cast-iron water main at Ithaca, N. Y., was successfully thawed by electricity, under the direction of Professors G. S. Moler and F. Bedell, of Cornell University. Attachment

was made in the dynamo laboratory and in the chemical building, and a current of 160 amperes was maintained. A little over 100 feet of main was thawed in 5 hours and 40 minutes. The current was carried by a No. 2 copper wire, and a pressure of 9 volts was used at the terminals of the water pipe. The power taken was accordingly 1,440 watts, or about two horse-power.

At Watertown, Wis., 320 feet of 6-inch main were thawed under the direction of Mr. R. W. Wood and Professor D. C. Jackson, of the University of Wisconsin. A current of 350 amperes at 100 volts was used, and the pipe was thawed in about two hours. The wires from two 25-kilowatt transformers, in parallel, were connected to two hydrants a block apart. Mr. Wood states that a current of 800 amperes would have been better. The following directions for thawing pipes have been issued by the University of Wisconsin, with which he is connected:

"The current which is required for satisfactorily thawing service pipes up to 1½ inches in diameter is from 200 to 300 amperes. The source of current should have a pressure of not less than 50 volts. Where electric light lines carrying alternating currents are available, a transformer or transformers in parallel may be used as a source of current. It is very important that direct connection of pipes to house lines be avoided on account of danger of fire, in which the house is placed by such connection. Where alternating currents are not available continuous current feeder lines may be used, but these should be entirely separated from the distributing network of conductors.



"The accompanying sketch will show the way in which the appliances should be connected when an alternating current is used with transformer. The secondary leads from the transformer should be quite large, such as No. 3 B. & S. gauge, or larger. In making connection to the pipes, one of the secondary leads should be taken into the house to which the frozen service pipe leads, and contact made at that point by some form of metallic clamp or by simply giving the conductor two or three tight twists about the pipe at any point where the pipe is exposed or at a faucet in the house. The other secondary lead should be put in contact with the water system outside of the house, and in a similar manner. This contact may be made at a hydrant or at an adjoining service box, or pipes in a neighboring house. When there are two houses near together, each with frozen service pipes, the two secondary leads may be connected to the pipes within these houses and both frozen service pipes thawed out at once.

"While the thawing process is going on, the faucet should be open in the house to which the service pipe leads. In one of the secondary leads should be inserted a water resistance which consists, for convenience of a bucket of water containing a bowlful of salt, and two sheet-iron or copper plates, to which the ends of the severed lead are attached. This serves to control the current. In the primary leads from the electric light line to the transformer it is highly desirable to have a fuse in each lead, and an ampere meter. When all connections are made, the plates are placed in the bucket and are then moved towards each other until the ampere meter records a proper current. If the primary pressure is 1,000 volts and the secondary pressure 50 volts, the current should ordinarily approach 15 amperes. If the primary pressure is 2,000 volts and the secondary pressure 50 volts, the ampere meter reading should ordinarily approach 7.5 amperes.

"Water ordinarily begins to flow in a time not much less than 10 minutes or not greater than one hour. If the secondary current is quite close to 300 amperes the period seldom exceeds one-half hour. The frozen pipes are often split by the action of the frozen water, and these at once begin to leak when the ice is thawed away. For this reason it is desirable to have a plumber where he may be readily called to care for the leaky pipe.

"The electric current when properly used will not damage the pipes. It is desirable to watch brass and iron connections to lead or iron service pipes, as they sometimes heat on account of poor contact. If such heating appears to be excessive, the current may be reduced with a resulting increase in the duration of time for thawing.

"After the pipe has been thawed it is desirable to let the water run continuously for a considerable time, inasmuch as the ground all around the pipe is frozen and the pipe is liable to freeze again unless the water circulates.

"For larger service pipes and mains the amount of power involved and the difficulties to be overcome make it desirable that special information regarding their size, material and location be furnished before instructions are sent out. The plan will serve excellently to thaw frozen hydrants and hydrant leads, of which there is complaint from a large number of towns."

WATER CONSUMPTION IN GREATER NEW YORK.

[By Francis L. Pruyn.]

That there is grave cause for alarm in the water supply problem which confronts the citizens of Greater New York is made plain by the curves that accompany this paper. It was believed by the writer that an ocular demonstration of the conditions taking place daily in New York and Brooklyn in regard to water supply and water consumption, would be of service in convincing many of the urgent need of additional sources of supply, while the conditions met in the past and those likely to be encountered in the future would serve as an unfailing guide to judgment. The data here graphically presented were obtained from the current technical papers, and, while possibly not as authentic as those issuing from the department of water supply, they are still sufficiently accurate for practical purposes, especially when future water consumption is considered, when necessarily entirely unknown conditions are encountered.

Two sets of curves are shown, one for New York and one for Brooklyn, and, beginning with the year 1870, each curve is plotted from actual data to the year 1899. Beyond 1899 each curve is extended in the general direction indicated by the plotted points. The curves plotted for each city are daily consumption per capita, average daily consumption and population. The other curves are derived directly from these.

Figure 1 contains curves of water consumption for New York city. Curve No. 1 is that of daily consumption per capita, in gallons. It is noticed that, starting with 82 gallons per capita in 1870, it varies above and below this amount until 1885 is reached, about which time the Bronx River supply was opened. After 1885 the curve jumps suddenly upward at an astounding rate of increase until, in the year 1899, the high figure of 119 gallons per capita is reached. When it is remembered that this curve should, theoretically, be almost a horizontal line, the manner in which it approaches the vertical is entirely unexplainable and almost beyond belief.

In other words, New York in 1880, with a population of about one million, consumed 77 gallons of water per capita per day; that is, each person was charged with a certain amount for actual domestic use and with a certain percentage of the total water consumed by public uses, manufacturers' uses, and wastes. In 1899 the population of New York is about two million, and there is no good reason to suppose that each person now uses much more water for domestic purposes than they did in 1880; the percentage charged to each person for public use should not have increased at all, and that for use by manufacturers but a little, which leaves the only unknown quantity that of wastes. We know that in 1899 the per capita consumption is 119 gallons; and assuming that a daily increase of 10 gallons per capita, or 20,000,000 a day, has become necessary by legitimate needs during the last twenty years, we still have 32 gallons per capita, or 62,000,000 gallons a day, unaccounted for except by wastes. In short, we waste an amount of water sufficient for an abundent supply for a European city of equal size.

Curve No. 2 represents the growth of population in New York. Curve No. 3 represents the daily consumption, in gallons, of New York.

It is stated that the maximum daily capacity of the Croton water shed is 280,000,000 gallons, and a dotted horizontal line has been drawn at this point. It is seen that curve No. 3 cuts this line in the year 1902, which means that, at the present rate of increase of population and consumption per capita New York city will be using 280,000,000 gallons a day in 1902.

The Croton water supply has a storage reservoir supply of 39,000,000,000 gallons, and, by use of this surplus, the system can be made to meet the city's demands for several years beyond 1902; but it is clearly indicated that with the present conditions in use the present water supply will, in a very few years, not be equal to the demands upon it, and other sources of supply should be secured immediately.

Mr. George W. Birdsall, Chief Engineer of the Department of Water Supply, says, in a report of the present year upon the increase in the consumption of water in the boroughs of Manhattan and the Bronx, that if the present rate of increase were to continue, even the great re-

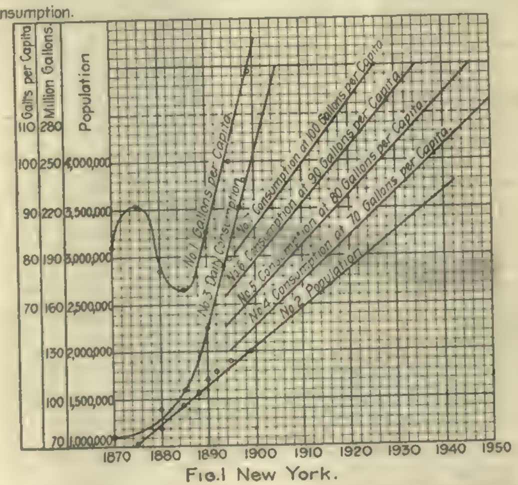


Fig.1 New York.

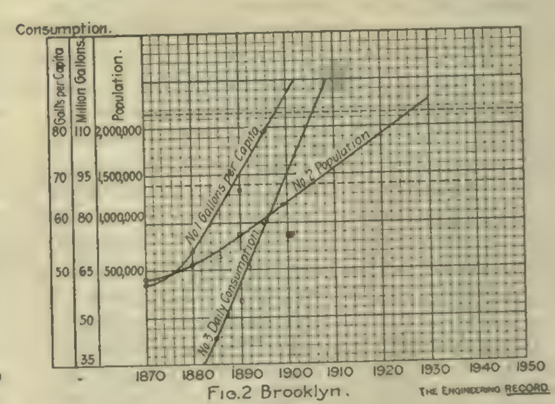


Fig.2 Brooklyn.

CONSUMPTION OF WATER IN NEW YORK AND BROOKLYN.

sources of the Croton, Bronx and Byram watersheds would be exhausted or exceeded in less than ten years.

Curves Nos. 4, 5, 6 and 7 are derived directly from curve No. 2, which is the curve of population, by assuming the daily consumption per capita to remain constant for each curve, and to be respectively 70, 80, 90 and 100 gallons. Each curve, therefore, varies directly with the population. It will be seen that with a daily consumption per capita of 70 gallons, and remaining constant, the present maximum daily supply of 280,000,000 gallons would be sufficient for the city's needs until the year 1947; with 80 gallons per capita until the year 1936; with 90 gallons per capita until the year 1926, and with 100 gallons per capita until the year 1918. These curves bring out clearly in contrast the effect on the longevity of a water supply of constant rates of consumption per capita as compared with the constantly increasing consumption per capita, as in curve No. 3.

In Figure 2 are shown some curves of water consumption in Brooklyn. Curve No. 1 represents the daiy consumption per capita in gallons; and, while the rate of increase is not so rapid as in New York, it is still far from the theoretical horizontal line, and leaves much to be desired. Curve No. 2 is the curve of population. Curve No. 3 is the curve showing daily consumption in gallons.

It is stated that the maximum daily supply of Brooklyn is 92,000,000 gallons, and, from this curve, it will be seen that the consumption will equal the supply in 1899. It is also stated that, by some additions to driven wells, pumps, reservoirs and conduits, Brooklyn's supply can be increased from its present sources to 115,000,000 gallons per day, which quantity would suffice for the city's needs till 1906. After this date new sources of supply must be found, since it is not to be expected that the consumption per capita can be reduced below the present figure of 79 gallons.

While it is self-evident, from the above curves, that something must be done in the immediate future to augment the available water supplies of Brooklyn and New York unless a water famine is desired, it is also made clear that excessive wastes are taking place in both cities, more especially in New York. Any provision for additional supplies that does not take cognizance of this fact and tend to check and diminish such wastes, will not be along the lines of good engineering practice. Mr. Dexter Brackett, M. Am. S. C. E., in an article in the "Transactions" of that society in 1895, states that for the City of Boston the consumption per capita should not be greater than 90 gallons per capita, which he divides up as follows, from statistics prepared from the metered service of the city:

Public buildings, hospitals, street sprinkling, sewer flushing, fountains, fires, etc..	5 gals.
Mechanical trades and manufacturing purposes	30 "
Domestic use....................................	40 "
Unavoidable wastes with street and house meters	15 "
Total gallons per capita......................	90 gals.

The allowances seem liberal, the conditions met with in Boston are very similar to those in New York, and there is no reason to suppose that these figures could not be duplicated in New York, with proper waste prevention.

Mr. Trautwine has aptly said that selling a man water at an annual rate varying with the size of attachment is about as scientific as selling a man groceries at an annual rate varying with the size of the door through which they are carried out, and, he might have added, when one-half the groceries was lost on the way. The only proper system of water-waste prevention consists of the combination of meters for each consumer, Deacon or Venturi meters for the branch mains whenever practicable, supplemented by a house to house inspection whenever readings indicate leaky fixtures or mains. Water meters put in by the city would net a profit to the city by the detection of leaky fixtures, while, by the arrangement of a fair minimum rate charge, be a saving to the consumer. Proper readings on the Deacon or Venturi meters in the mains at times during the night, when water consumption is practically zero, would show up leaky mains, and the combination of the two would produce a saving in water that would surprise the uninitiated.

THE CINCINNATI FILTRATION EXPERIMENTS.

About three years ago a commission appointed to investigate the general subject of the improvement of the water supply of Cincinnati reported in favor of clarifying the Ohio River water by subsidence for several days and then filtering it through sand beds. Owing to the difference in the character of this water from season to season, especially in the amount of suspended material it carries, it was considered desirable to obtain further data on the subject before undertaking the construction of a filter plant costing about $1,000,000, in round figures. Accordingly, the Board of Trustees of the new water-works, acting on the advice of Mr. G. Bouscaren, M. Am. Soc. C. E., retained Mr. George W. Fuller, Assoc. M. Am. Soc. C. E., to conduct a series of experiments which would furnish all the necessary information for a correct judgment on this subject. Mr. Fuller was at the time the chief chemist and bacteriologist of the Louisville experiments, reviewed at length in "The Engineering Record" of December 3, and his experience with the Ohio River water at the Kentucky city enabled him to carry out the Cincinnati investigations under particularly good auspices.

The plant was completed in March, 1898, and used continuously for ten months. It included four steel tanks of 100,000 gallons capacity each for the preliminary clarification of the water by subsidence, fifteen experimental filters having an area of 0.0025 acre each, and a laboratory for carrying on chemical and bacterial analyses in the most approved manner. Early in August seven of the original filters were stopped permanently, and two new filters constructed in old tanks, so as to be used in conjunction with a coagulating and subsiding basin holding about ten hours' supply. In September two new filters were constructed in old tanks to investigate the advisability of washing the local sand before placing it in a filter, and a small mechanical filter with coagulating basins was placed in service. The total cost of the investigation was $38,260, and it involved about 1,200 chemical and 9,800 bacterial analyses, besides several hundred minor determinations. The leading results of the studies are summarized substantially as follows by Mr. Fuller in his report:

Eliminating from consideration for the most part those points of a purely technical nature which are discussed at length earlier in this report, the facts of practical significance learned during these investigations may be summed up as follows:

Inapplicability of English Filters to the Clarification and Purification of the Unsubsided Ohio River Water at Cincinnati.—In the purification of those classes of water for which the English type of filters is strictly applicable, the available evidence indicates clearly that this method is a satisfactory one when the filters are properly constructed and operated. Further, so far as present knowledge goes, this method is ordinarily somewhat more efficient and more economical for water for which it is readily applicable than any other process of purification which has received serious attention. But in the consideration of this method of purification with reference to the river waters of the Central West, where frequent freshets cause the water to be laden with comparatively large amounts of silt and clay, it is found that English filters have decided limitations in their applicability.

At the outset of these investigations the position was taken that the Ohio River water at Cincinnati should receive a preliminary treatment by plain subsidence to prepare the water for clarification and purification by English filters. Experience in the operation of the fifteen original experimental filters of the English type showed the wisdom of this step, because the suspended matter in the river water would increase materially the cost of treatment, and, of still greater importance, would preclude at times the possibility of securing filtered water of satisfactory appearance and character.

For the sake of explicitness it is desired to show, with the data of the fairly normal year of 1898, the proportion of the time when English filters would be inapplicable in the purification of the unsubsided Ohio River water at Cincinnati. This necessitates fixing an average limit of permissible suspended matter in this river water, and is a difficult matter from present evidence. In part this is due to variations in the character and in the relative amounts of the suspended silt, clay and organic matter; and in part it is due to different amounts of clay stored in the sand layer, which affects materially the capacity of the filter to retain the clay of the applied water. During these investigations the unsubsided river water was not regularly applied to filters; and, with the exception of the results of tests for a few days only, it is necessary to depend upon general information obtained with reference to this point. So far as the information goes, it appears that an average of 125 parts per million is a conservative estimate of the amount of suspended matters in the unsubsided river water, which could be regularly and fairly satisfactorily handled by English filters. But at times this estimated average would be too low, and at other times too high. Mr. Fuller's table of the amounts of suspended matter in the unsubsided river water for 1898 is too elaborate for reproduction here. It shows that in 30 days in January, 23 in February, 22 in March, 19 in April, 26 in May, 13 in June, 15 in July, 31 in August, 2 in September, 8 in October, 20 in November and 20 in December, this limit is exceeded.

On the above stated basis of differentiation between waters for which English filters are applicable or inapplicable, it is found that during the year 1898 these filters could have been used satisfactorily without preliminary subsidence of the local river water on only 132 days, or 36 per cent. of the total time. In the light of this evidence it goes without saying that English filters would be a failure in the treatment of the unsubsided water of the Ohio River at Cincinnati. It is instructive to note in this connection that, owing to the variations in the composition of the river water, English filters without subsidence would be applicable to the local river water only for short periods of time. In fact, they could not have been used with success for ten days at a time in 1898, except during the months of June, July, September and October.

Inapplicability of English Filters in the Clarification and Purification of the Ohio River Water at Cincinnati After Plain Subsidence for Three Days.—Plain subsidence for three days causes on an average a removal of practically 75 per cent. of the suspended matters present in the local river water. Accordingly, a system of purification comprising plain subsidence for three days and English filtration is applicable for water containing more suspended matter than is the case with English filters without subsidence. The efficiency of plain subsidence in the preparation of very turbid waters for satisfactory filtration through filters of the English type, however, is not so great as would appear at first sight. The reason of this is that the clay particles remaining in the turbid subsided water are more difficult to handle than an equal weight of the mixed silt and clay of the original river water.

While English filters are able to remove satisfactorily on an average about 125 parts of silt

and clay of the unsubsided water, actual experience shows that they can regularly handle suspended clay in subsided water in amounts ranging only as high as from 30 to 70 parts (depending largely upon the amount of the clay stored in the sand layer), and averaging about 50 parts per million. But it is true that for two or three days on short rises in the river, or at the beginning of long freshets, the retentive capacity of the sand layer allows of satisfactory results with the clay in the applied water considerably in excess of 70 parts. If this capacity is greatly overtaxed, however, the advantage is merely temporary, as the stored clay is washed out later, producing markedly turbid effluents.

Taking an average amount of 50 parts of suspended clay in the subsided water as the basis of differentiating those days in 1898 when English filters could have satisfactorily clarified and purified the local water after plain subsidence for three days, it is found that these days amount to 197, or 54 per cent. of the total time. But, practically speaking, English filters would have been satisfactory in the treatment of the subsided water on more than 197 days in 1898, because the capacity of the sand layer to hold back the applied clay would cause the elimination from the days of failure of those occasions when there were freshets of short duration in the river; that is to say, the capacity of the filters to store clay within the sand layer would allow for a short time applications of clay much in excess of the amounts which could be regularly handled. Based on actual results of operation of the experimental filters, it is estimated that during the year 1898 English filters could have been used with satisfaction in the clarification and purification of the subsided water on 231 days, or 64 per cent. of the total time.

While in some instances it is true that the decision as to whether or not the effluent was satisfactory might not coincide with the views of every one, yet, as a rule, the conditions were such as to preclude differences of opinion. In unqualified terms it can be stated that plain subsidence for three days is insufficient to prepare uniformly the Ohio River water at Cincinnati for successful clarification and purification by means of filters of the English type.

Specific Difficulties in Treating River Water by Plain Subsidence and English Filtration.—It is necessary in this review to call attention to several abnormal characteristics of importance which appeared in the study of the local water, as follows:

1. The comparative absence of organic matter in the water capable of forming gelatinous films around the sand grains at times when it was needed most. This was apparently due in part to the removal of the organic matter by attachment to sand and silt deposited in the river, and in part to further removal in the subsiding tank.

2. The minuteness of the clay particles in the subsided water, and difficulties in retaining them at and near the surface of the sand layer, especially in the comparative absence of organic matter adapted to increasing the retentive capacity of the sand.

3. The disturbances of the surface of the sand layers, and consequent irregularities in the rate of filtration, due to fishes, earth-worms, and other forms of animal life.

Of these three objectionable features, which, so far as Mr. Fuller's knowledge goes, are not met to any corresponding degree in water actually treated with success by this system of purification, the first two are inherent ones, incapable of ready correction by artificial means, while the third one can be controlled more or less by a proper use of screens. It is by no means certain, however, that screens would remove sufficiently the spawn of fishes or the eggs of angle-worms.

Features Wherein Plain Subsidence and English Filtration Failed.—The system of purification under consideration was unsatisfactory along three lines, as follows:

1. At times of prolonged freshets the turbidity of the filtered water was so great that it had the brownish appearance of the unfiltered water, frequently containing over 30 parts per million of suspended clay, an amount and of a character which makes it doubtful whether it could be removed by a second filtration.

2. At times of freshets the penetration and retention of the clay within the main body of the sand layer would make the cost of scraping greater and would apparently necessitate the reconstruction of the entire sand layer at much more frequent intervals, than is normally the case in present practice with this type of filter.

3. When the filtered water was turbid and brownish for some little time there was a marked tendency towards a diminution in the bacterial efficiency of the filters. During the long freshets frequently occurring during the winter the evidence points to the matter as one of serious significance.

The second of these points might be tolerated, if no way could be found to obviate it; but the first and third of these points may be safely stated as prohibitive, in the absence of any practicable means of assisting the filters at such times.

As these investigations showed that English filters are a failure locally, owing chiefly to insufficient preparation of the river water at times of freshets, the next logical step is to consider the best means of securing more efficient preliminary treatment of the river water. To obtain this by extending the average period of plain subsidence beyond about three days would not be practicable, on the ground of cost, for the following reasons:

1. Experience shows that the fine clay particles, remaining in water which has been subsided for three days, subside very slowly, and the increase in the percentage of suspended matters removed is seldom more than 5 for any day beyond the third, and decreases steadily as the period of subsidence is extended.

2. The cost of adequate preliminary treatment of the water by this procedure would be disproportionately high, because this amount of preparatory treatment would be required less than half of the time, while the fixed charges for the interest and sinking fund on the cost of constructing the required subsiding reservoirs would be constant.

Under these circumstances economy demands the consideration of other preparatory methods, to be used either with or without the assistance of plain subsidence.

Need for Coagulants.—The present evidence is conclusive that the large quantities of very minute clay particles, present in the local river water for periods ranging probably from three to six months in different years (and averaging about four months), cannot be removed in a practicable manner in their original condition by subsidence and by filtration through English filters. So far as present knowledge upon this subject goes, there is only one way in which these clay particles can be removed, and that is to apply a chemical which shall aggregate them into flakes or masses, so that it is practicable to remove them subsequently by subsidence and filtration.

In the light of these facts it can be stated in unqualified terms that, for the practical clarification and purification of the local river water, it is imperative at certain seasons of the year to make use of a chemical having the power to aggregate the clay particles.

Practicability of Coagulants.—In connection with the satisfactory treatment of the local water the use of coagulants is practicable for the following reasons:

1. Coagulants are capable of affording the water a safe and satisfactory preparation prior to subsidence or filtration, or both, with a comparatively small expense for chemical devices.

2. Coagulation may be secured with comparatively inexpensive chemicals.

3. The total cost of coagulation in the modified English system comes within reasonable limits, because the principal item of cost, the coagulating chemical, is a prime factor only when the character of the water requires its use. That is to say, during half of the year and more, when coagulation is not imperative with this system, the cost would be merely nominal for fixed charges on the required portion of the plant devoted to chemical devices; and with the American system the advent of very turbid and difficult water to handle means simply an increase, practically speaking, in the amount of chemical.

The Most Suitable Coagulant.—The use of coagulants does not involve the employment of any particular chemical; in fact, there is quite a variety of chemicals capable of coagulating the clay in this river water, and it is possible to change from one to another without expense, or at a merely nominal cost, provided such a step seemed advisable.

Taking everything into consideration, it is Mr. Fuller's judgment that sulphate of alumina is the most suitable coagulating chemical now on the market. It is fairly cheap (about 1.4 cents per pound), and serves to coagulate the clay in the water under proper care, with no serious detriment to the filtered water.

When sulphate of alumina is applied in the required amounts to the local water, it is decomposed by the carbonates and bi-carbonates naturally present in the water. With suitable supervision and attendance for a plant, the inadmissible state of affairs of having undecomposed chemical pass into the filtered water would be entirely unnecessary and inexcusable.

Upon the decomposition of the sulphate of alumina there is formed in the water aluminum hydrate a white, gelatinous solid, which coagulates the clay, and is subsequently removed by subsidence or by filtration.

The only changes in the filtered water are that carbonic acid is set free, and the carbonates of lime and magnesia are converted into the form of the soluble sulphates of these bases in quantities substantially proportional to the amount of sulphate of alumina applied to the water. While these changes are undesirable, it can be positively stated that, in the quantities required for the treatment of this water, they are not injurious to health, and cannot be regarded as seriously objectionable.

In the filtered water at Cincinnati, obtained with the aid of sulphate of alumina, the amount of carbonic acid would be only about one half of that naturally present in the Ohio River water at Louisville, and, while it would be somewhat of a factor in the corrosion of uncoated iron pipe, etc., there is no reason for believing that this is an important factor, practically speaking. With regard to its action on lead pipe, the filtered water would quickly form a protective coating on the pipe.

With reference to the conversion of lime and magnesia salts from carbonates to sulphates, it is very doubtful whether steam raisers could detect the change in the filtered water, as judged by incrustations in steam boilers. At times of long freshets, when the amount of applied chemical would be greatest, the total amount of incrusting constituents in the filtered water would hardly exceed the amount naturally present in the river water during low stages of the river; and at times of low and fairly clear water in the river, the application of chemicals, if used, would make but little difference in the total quantity in the filtered water, from a practical standpoint. In fact, there is considerable probability that the elimination of silt and clay would make the filtered water (obtained with the assistance of coagu-

lation) a more desirable boiler water than the unclarified river water now in use.

There are two methods by which use may be made of coagulation in the clarification and purification of the local river water. In brief, the two methods, called the modified English system and the American system, may be outlined as follows:

The Modified English System.—In this system or method a coagulant is used only at those times when economical provisions for plain subsidence are incapable of preparing the turbid river water adequately for filtration, and in such amounts that the water going upon the English filters may be properly and readily filtered. It is essential in this method that provisions be made to allow the coagulated suspended matters in the water to subside, so that they will not rapidly close up the pores of the sand layer at the surface. That is to say, the water applied to the English filters must be substantially free of coagulated masses of clay.

There were investigated two procedures for the application of the chemical when required, as follows:

1. Applying the chemical to the plain subsided water when its condition demanded it, and then allowing the coagulated portions in suspension to subside in a relatively small basin interposed between the plain subsiding reservoirs and the filters.

2. Applying the chemical to the river water, when required, before the water entered the plain subsiding reservoirs, and allowing the supplementary clarification to take place in the main subsiding reservoirs, thus dispensing with the small intermediate basin.

Each of these procedures has its advantages, but experience indicated that for economical reasons the second one would be preferable. After getting the applied water uniformly prepared for filtration, the English type of filters can complete the clarification and purification in a satisfactory manner, and with a smaller area of filters than is conventionally considered to be necessary.

The American System.—With this system the chemical is uniformly applied to the water after it leaves the plain subsiding reservoirs, the amount of chemical varying with the amount of suspended matter in the water. To facilitate the operation of the plant and to lessen the total cost of the filtered water, the water should be given an intermediate subsidence after the application of the chemical. This period of coagulation and intermediate subsidence can be varied to advantage according to the turbidity of the subsided water from about 0.5 to 6 hours, as shown by the results of these investigations. As the water reaches the filters, it must contain a certain amount of coagulant, either left from a primary application or provided by a secondary application, so that the water may be successfully filtered through American (so-called mechanical) filters at a rate from 30 to 40 times as fast as in the case of English filters.

Economical Limit of Plain Subsidence.—Taking into consideration the fact that for a portion of the year the use of coagulants is imperative, the evidence shows that on an average plain subsidence cannot be economically carried beyond about 24 hours, when viewed from a theoretical and absolute standpoint. The reason of this is that the removal of suspended matters effected by plain subsidence beyond this period can be more economically accomplished by the use of coagulants. However, from a practical point of view, it is necessary to consider other factors in connection with the best period to provide for plain subsidence. At times of very muddy water in the river, the removal during the second day of plain subsidence would be very considerable. This would be of value in reducing the amount of required coagulant, and in maintaining a safe margin against the passage of undecomposed chemical into the filtered water. It would also permit, by virtue of the storage capacity of the subsiding reservoirs, the stopping of the river water pumps for a day or more at a time when the river water was most difficult and expensive to purify. Further, the mixing of the water in the reservoirs of this size should eliminate in a measure the variability in the composition of the water.

During all times of very turbid water, a period of 48 hours for plain subsidence would be a marked advantage in the management of a purification plant. This is because it would allow advantage to be taken of analytical evidence as to the character of the water and the best way of treating it with chemicals in the American system; and in the modified English system it would insure the removal of coagulated clay with moderate applications of chemical, and thus avoid clogging the filters unnecessarily on the one hand, and a needlessly large amount of chemical on the other.

Taking into consideration the evidence from these tests, it appears that it would be an advantage to provide for an average period of about 48 hours of plain subsidence. Beyond this period it would not be wise to go, except in so far as convenience and economy in construction and reasonable provisions for the future would warrant.

Comparative Difficulties of the Two Methods.—Owing to the great variability in the composition of the Ohio River water at Cincinnati, it is not an easy matter to manage a large plant in an economical and efficient manner, and both safety and economy demand that the management of a plant, independent of the method adopted, should be in the hands of men thoroughly familiar with this line of work. Relative to the comparative difficulties in the management of plants of the two methods under consideration at times of muddy water, the evidence shows that the American system would be materially easier to handle. There are a number of reasons for this, among which are the following:

1. It is less difficult to adjust the proper amount of coagulating chemical to the subsided water than to the much more variable river water.

2. If the amount of applied chemical should happen to be too low, there is an opportunity of correcting this promptly and satisfactorily in the American method, by a secondary application at or near the filters; whereas this procedure, if needed, is impossible in the other method, because the chemical would quickly clog the filter.

To provide an ample margin in the application of chemical in the modified English method to prevent, uniformly, the occurrence of "undertreatment" would be prohibitive, on the ground of cost alone.

3. There would be experienced more or less difficulties in scraping English filters at times during winter weather, due to the formation of ice and the danger of freezing the sand layer, in the case of filters without covers; and it is not unlikely that ultimately it would be found more advantageous to cover the filters, rather than allow the cold weather to reduce the net capacity of the filters to materially less than the rated capacity.

The Efficiency of the Two Methods.—Making the necessary assumption that both plants would be well managed, the evidence shows that the bacterial efficiency of the modified English system would probably be slightly greater at times than with the other method. On the basis of annual averages the difference would be almost inappreciable, and in each case the removal would amount to more than 99 per cent. of the river water bacteria. In neither case would the filters be germ proof, although, practically speaking, they would be very nearly so, if they were well managed.

In the removal of the organic matter and clay both methods should give perfectly satisfactory results.

Cost of the Two Systems.—In these comparisons, both in the modified English and the American systems, the factors of cost begin with the discharge of the river water into the subsiding reservoir, and end with the discharge of the filtered water from a clear well into a gravity conduit leading to the city. Exclusive of the cost of the land, which is included in a tract now owned by the city, the estimates of cost of purification by the two systems cover all items of practical significance, independent of the maintenance of the grounds. These estimates are based for convenience on a daily capacity of 80,000,000 gallons. In some of its parts the actual purification works would be larger than this (owing to economy in providing for the future), and in other parts they would perhaps be a little smaller at the beginning.

Relative to these estimates, it is to be clearly understood that they are made for the purpose of comparison only. While they are based on the best evidence now available, and it is believed that they are substantially correct, yet for construction work they do not represent actual cost as determined from complete plans.

In the case of both systems the depreciation of the plant, independent of general repairs and the replacement of machinery, is provided for by the sinking fund.

The estimates for the modified English system are based on the decision that it would be more practicable to apply the chemical when needed to the river water as it entered the reservoirs, and do away with an intermediate basin for supplementary subsidence, at the entrance to which the chemical would be applied. The subsiding reservoirs in each case give 48 hours' subsidence.

Cost of Plant Per Million Gallons.

	English.	American.
Reservoirs	$16,000	$16,000
Pipe line	500	500
Filter plant	16,667*	9,000*
Clear well	1,250	1,250
	$34,417	$26,750
Fixed charges, at 5%	$4.72	$3.67
Operating Costs, Per Million Gallons.		
Salary account	$0.72	$1.17
Chemicals, washing sand, etc.	4.44	4.10
Repairs	0.47†	1.02†
Total cost	$10.35	$9.96

* In the English plant the cost of filters is figured on the basis of $50,000 per acre and 3,000,000 gallons per acre daily. In the American plant it includes the cost of a 20,000,000-gallon coagulating and subsiding basin and a filter plant working at 125,000,000 gallons per acre daily.

† The repair item for English filters is 0.5 per cent. annually. For the American system it is 10 per cent. on the machinery and chemical devices and 0.5 per cent. on the remainder.

In this connection it is to be stated that consideration was given to the advisability in the American system of enlarging the coagulating basin from a capacity of 6 hours to a 12 hours' flow; eliminating the plain subsiding reservoirs and the pipe lines to and from the location of the coagulating basin to the reservoirs; and removing the cost of pumping the water to the 30 feet in elevation thus eliminated. Were it not for the very muddy condition of the river water, amounting to about two to six weeks in different years, it would clearly be cheaper and better to adopt this procedure rather than the one considered in these estimates. As the local conditions actually exist, the cost of this procedure would not probably for any year exceed the one considered by more than 15 to 20 per cent., and during some years it would probably be a little cheaper; but it would be more difficult to operate at times of very muddy river water; the limited storage facilities would demand the treatment of the most difficult grades of river water; the amount of required chemical would be high at times of heavy freshets, reaching even 10 grains per gallon in some instances; it would be necessary to apply alkali to decompose such an amount of chemical; and the larger amounts of wash water used at such times would call for filters of greater total area.

Taking everything into consideration, this procedure is dismissed from further attention in connection with the local problem.

Final Comparison.—While the above comparisons show that the modified English system would be somewhat more expensive than the American system, it is to be stated further that, owing to the topography of the ground at California, it is doubtful whether English filters having a total capacity of more than 60,000,000 gallons daily could be built at the rate of $50,000 per acre. In fact, for a plant materially larger than this, the cost per acre would be much in excess of the estimated cost, owing to the large amount of grading which would be required. Furthermore, the estimates ignore the open question as to the ultimate advisability of covering the filters, to prevent marked decreases in the capacity of the filters during cold weather. If the evidence available at this time allowed these factors to be taken into consideration in definite terms, it is plainly seen that the increase in cost of the modified English system over the American system would be greater than is given above.

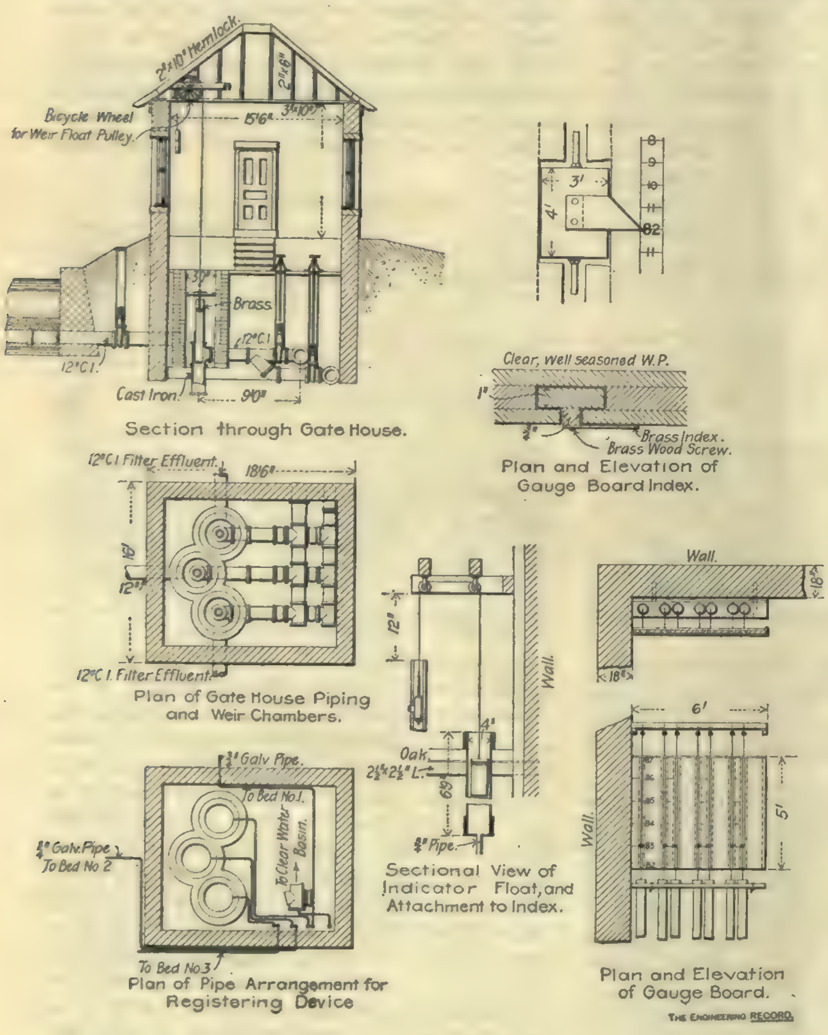
The evidence obtained during these investigations shows that it is practicable to clarify and purify the Ohio River water in a satisfactory manner by either the modified English system or by the American system. Of these two systems, the experience and data indicate clearly that the American system would be the less difficult to operate; would be somewhat cheaper; would give substantially the same satisfactory quality of filtered water; and could be much more readily and cheaply enlarged for future requirement. It is therefore considered that the American system of clarification and purification would be the more advantageous to adopt for the local water supply.

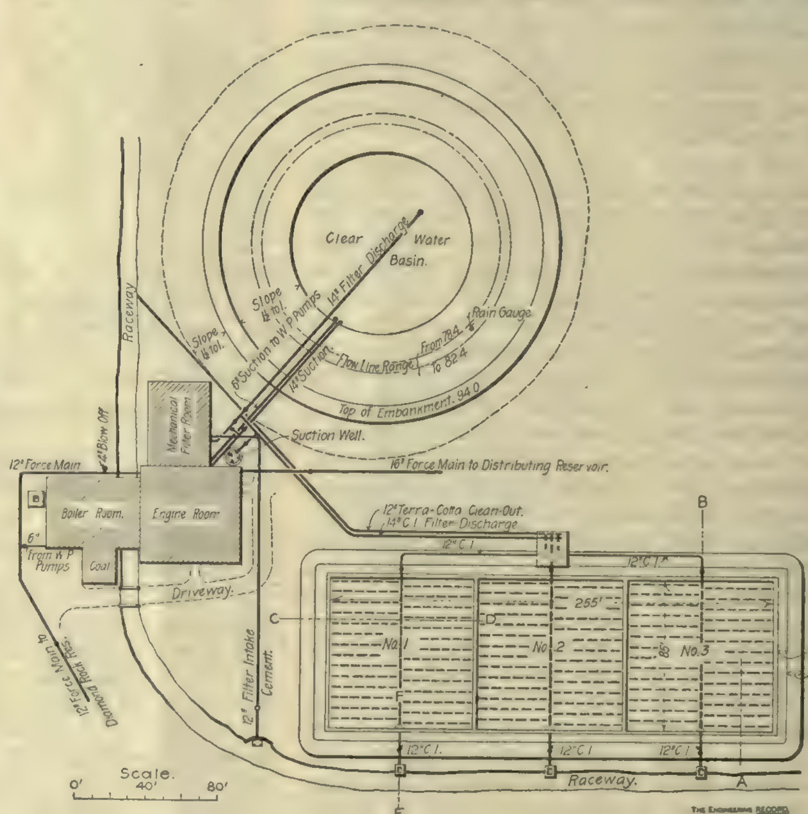
THE BERWYN SAND FILTER.

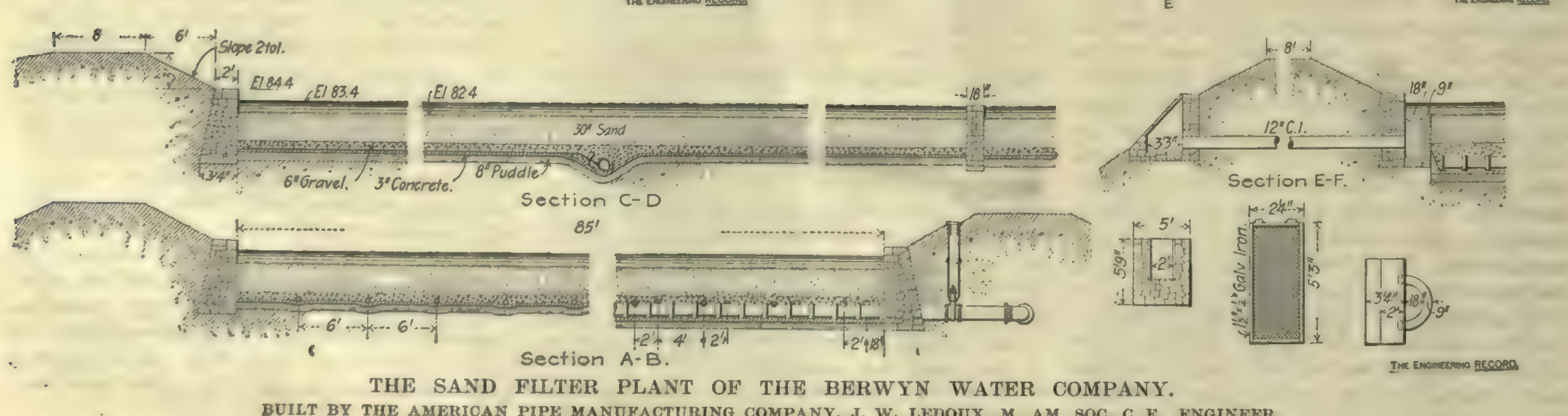
The water supplied for several years by the Berwyn Water Company to its consumers along the main line of the Pennsylvania Railroad, from Glen Loch to Bryn Mawr, has been filtered by a Warren mechanical plant having a nominal capacity of 750,000 gallons a day. It was located at the company's Pickering Creek pumping station, and gave satisfaction. It was decided, however, that the future demands upon the works would probably require greater purifying facilities, and it was accordingly determined to install a slow sand filter plant of a nominal daily capacity of 1,500,000 gallons, and give it a thorough comparative trial in connection with the older system. These sand filters were constructed by the American Pipe Manufacturing Company, of Philadelphia, and put in operation at the beginning of the current year. They were designed by Mr. J. W. Ledoux, M. Am. Soc. C. E., the company's chief engineer, who read an interesting description of them before a recent meeting of the Engineer's Club, of Philadelphia; through the courtesy of the club, the following abstract of the paper is printed before its appearance in full, with discussion, in the society's "Journal."

The sand filters are built in three compartments, each containing 7,500 square feet of effective filtering area, and arranged so that any one can be cut out or operated wasting the water without interfering with the others. Opposite the center of each filter compartment is located the screen chamber, influent pipe and chamber. The top of the influent chamber is on a level with the top of the sand. A vertical section through filter beds shows 30 inches of sand, 6 inches of gravel, 3 inches of concrete and 8 inches of puddle. The main drains are vitrified bell sewer pipes 12 inches in diameter, and laid with water-tight cement joints. The laterals are ordinary terra-cotta 4-inch tile drains without bells made in 12-inch lengths and simply butted together. They are spaced 6 feet apart, and kept from moving out of place laterally by means of a handful of cement mortar placed under each side of every length.

The laterals are placed in depressions in the concrete so that there is over each about 4 inches of gravel. The gravel was screened and washed, and graded from pea-size to 1½ inches, the smallest sizes, of course, being placed on top. Just inside the masonry walls the main drains terminate in cast-iron pipe of the same diameters. The side walls and division walls are composed of rubble masonry, consisting of stone from a nearby quarry, and hydraulic cement mortar one to two. Outside of the masonry retaining walls is the earth embankment, composed of material excavated from the enclosure, which also contained suitable material for puddle. The sand was frequently tested, and proved very uniform in quality. One test was to determine the quantity of filtered water per acre that would pass through 1 foot of the sand, under an effective head of 12







THE SAND FILTER PLANT OF THE BERWYN WATER COMPANY.

BUILT BY THE AMERICAN PIPE MANUFACTURING COMPANY, J. W. LEDOUX, M. AM. SOC. C. E., ENGINEER.

inches of water. The average showed about 60,000,000 gallons per acre per day. The effective size was 0.25 millimeter, and the uniformity coefficient 1.82. Many samples of different qualities of bar sand and Jersey sand were examined before deciding on Gloucester white sand. An apparatus for testing the rate of percolation is made by placing in a cylindrical tin tube, 3 inches or more in diameter and 2 feet long, two bottoms about an inch apart. The upper bottom is a brass cloth sieve, of No. 40 mesh, soldered in place. Between the two bottoms a ½-inch nipple, to which is attached a piece of rubber hose, is placed. In this tube is placed the required sand to a depth of 1 foot. The cylinder is then set under a spigot and the open end of the hose raised until the difference in level between top of cylinder and of hose is 1 foot. The spigot is then opened, the water falling on a lip at the top of the cylinder so as not to disturb or agitate the surface of sand, and the rate of percolation may be measured by means of a gallon measure held under end of tube, always being careful that spigot is opened wide enough so that a small amount of water constantly runs over the top of cylinder.

The effective size of the sand grains is determined as follows: A series of, say, eight screens is provided, numbering from 30 to 100 meshes per lineal inch; each is tested with standard silicious sand, by sifting a handful thoroughly until apparently no more will pass through. By shaking vigorously for a time a sufficient number of grains will pass through (say, a thousand). Weigh these carefully and then count them. The weight divided by the number will give the weight of each grain. Now, by assuming each grain to be a sphere, and the specific gravity to be 2.6, the diameter can be determined in millimeters. The sieve is then stamped with the number, and all the other sieves tested in the same way. Now weigh out, say, ten grams of the sand to be tested and try it on each sieve until one is found that will pass only 10 per cent., or one gram. The number on that sieve is the effective size, providing the assumption of the specific gravity is correct, which it should if the sand is of proper quality. The uniformity coefficient is the ratio of the size of the sieve that will pass through 60 per cent. to the size that will pass through 10 per cent. No dependence whatever can be placed on the trade number of the sieves.

Provision is made to secure a uniform rate of percolation through the filter beds. The regulating apparatus consists of a brass tube open at both ends and hanging to a float which rises and falls with the water level in the effluent chamber. The top of the tube may be considered a submerged circular orifice or weir, whose distance from the float is constant, but adjustable. The float and sliding tube are counterweighted. As the sand bed becomes clogged by sediment, the water level in effluent chamber will sink and thus increase the effective head, or difference in level between the water on filters and in effluent chamber. When this difference becomes 4 feet, the surface of the sand bed must be scraped. Ordinarily, this period, at normal rate, will be 20 or more days, which is the length of time between scrapings. In the gate house an indicator board is provided having seven indicators, one for each filter bed, one for each effluent chamber, and one for the clear water basin. The difference in level between the water on filter bed and that in the corresponding effluent chamber, which also indicates the loss of head, is shown at a glance. The board is graduated in feet and inches from ocean tide as a datum. The indicators slide in vertical grooves and are attached to No. 26 copper wires, which run over brass pulleys. Attached to the other end of the wires are floats composed of 3-inch nipples capped at both ends. These work in float pipes having ½-inch pipe connections with the water on filter beds, in effluent chambers, and in clear water basin.

The cost of the whole work was $18,536; the most expensive single item was $4,420 for 2,697 tons of sand, and the next was $2,927 for 528 yards of stone masonry in the filter basin.

A HOSPITAL SEWAGE DISPOSAL SYSTEM.

A system of sewage disposal has recently been installed at the Southern Indiana Hospital for the Insane at Evansville, Ind. This is one of four hospitals, which care for the insane of the State, and has accommodations for 650 patients. Formerly the sewage had been allowed to run away through an open ditch, but this became a nuisance to the farmers, whose land it crossed. As no outlet for a sewer through Evansville or to any adjacent stream could be obtained, a plan of precipitation and filtration was adopted.

About 600 feet west of the hospital are the outlets of two sewers, one from the hospital building and the other from the laundry, discharging into an open trench in a frame building. The building also contains a filter press with 33 discs, a sludge pump, a water pump, two mixers of 300 gallons capacity each, and an electric motor for power. One of the mixers is used for lime and the other for alum. In the summer 30 grains of lime and 15 grains of alum are added to each gallon of sewage, while in winter one-half of these quantities is used. The solutions of lime and alum are kept constantly agitated by revolving paddles, and run in continuous streams to the sewage and become thoroughly mixed with it. After this mixing the sewage passes through a screen to the settling basins, six in number, each 16 x 14 feet and 7 feet deep. By means of gateways the sewage passes diagonally through all of these basins, allowing ample time for precipitation and sedimentation, and then runs to the filter beds of which there are four. Three of these beds are each 40 x 80 feet, and the fourth is 27 x 80 with a depth of 6 feet. The walls are 12 inches thick, of brick, and the bottom is paved with brick. Both the bottom and sides are plastered with cement. The filter proper consists of an 8-inch layer of coarse river sand on a layer of gravel 3 1/3 feet thick. The sewage is spread over a bed by means of a main distributer with six branches on each side. The sewage enters the upper end of the main through a box in which there are two water-brakes, passing over one and beneath the other. At the upper end of the box are openings into two of the branches. At the lower end the sewage passes through 2½-inch openings into five gutters each 2⅝ inches wide and 3 inches deep. The lower end of each gutter is divided by a zinc partition, causing the sewage to flow to two openings, through which it drops to a pair of side distributers. Each of these has a box at the upper end and then divides into gutters 1¾ inches wide and 2 inches deep, which drop the sewage on to the bed through ½-inch openings spaced about 2 inches apart, and so arranged that each gutter supplies one-fourth of the width between the main distributer and the side of the bed. The main distributer is 72 feet and the branches are 16 feet long, and all are made of ⅞-inch white pine. The main is supported by nine brick pillars, and the branches rest upon bricks placed upon the surface of the bed. Beneath each bed are rows of 4-inch tiling placed 4 feet apart and converging to a semicircular basin at one end, from which the effluent flows to a ditch containing limestone rock. After a filter has been in use for six days, the film on top is taken off, the sand is spaded and stirred thoroughly and more is added. The filter is then given two or three weeks' rest, after which it is put in use again. The sludge from

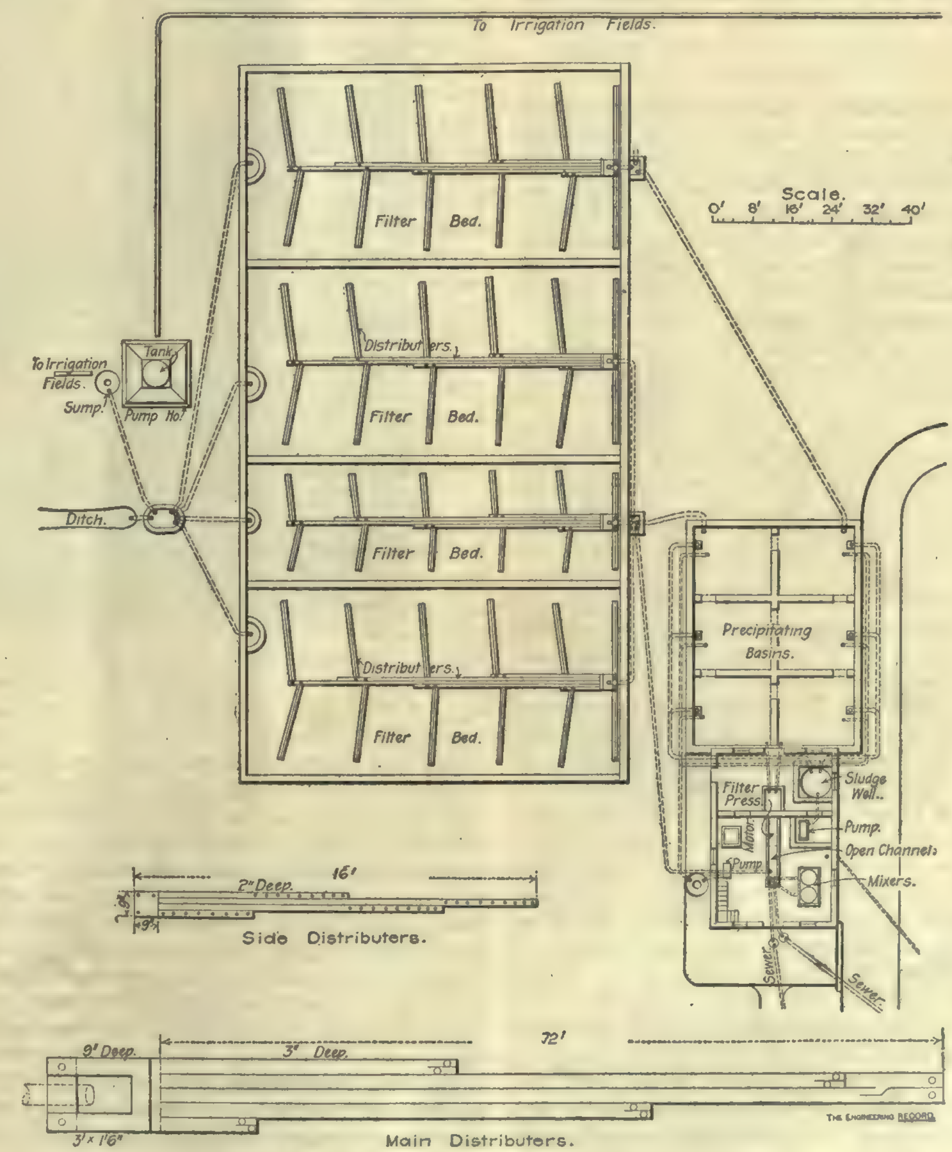


FIGURE 1.—ARRANGEMENT OF SEWAGE DISPOSAL SYSTEM.

the settling basins is thrown into a well, from which it is pumped to the filter press, where it is made into cakes weighing about 30 pounds each. These cakes are used as a fertilizer on the farm and garden.

After the effluent has run from the filter beds it is used to irrigate a part of the farm. At one side of the beds a building 14 x 14 feet was erected, in which there is a circular tank 6 feet in diameter and 4 feet deep. This tank is 18 feet above the ground and is connected to a sump-well near the building. The effluent from the beds may be turned into this well and then pumped to the tank from which it flows into flumes and troughs, which distribute it over 50 acres of the farm. Figure 1 shows the arrangement of basins, beds, pipes and pumps, and a detail of the distributers. Figure 2 shows a view of the building containing the pumps, etc., the precipitation basins in front and a corner of one of the filter beds. Dr. G. C. Mason is superintendent of the hospital, and "The Engineering Record" is indebted to him for this information.

FIGURE 2.—CHEMICAL TREATMENT HOUSE AND BASINS.

Marcellus shale, a quartzose sandstone found near Port Jervis, is referred to in the report for 1898 of Mr. Henry I. Budd, commissioner of public roads of New Jersey, and as shales are not usually regarded with favor by road builders, the following extract from his statements is of interest: "The shale, when thrown on the surface of the roadbed, seems to form a firm, compact bed, resisting wear almost like trap, forming as compact a body as the best of gravel, and has every indication of making an excellent binder for trap rock, making a finer surface for the harder rocks. Quite a large quantity of it has been spread on a driveway in Central Park, and from present appearances, it makes a road very much resembling an asphalt pavement."

PAVEMENTS IN VANCOUVER, B. C.

Although only 12 years old, Vancouver has nearly all of its central business streets paved with either bituminous rock or wood blocks, the first of which were laid in 1893. The climate of the city is unusually humid, and it is therefore interesting to learn from a paper presented to the Canadian Society of Civil Engineers by Mr. A. K. Stuart, how these materials have been wearing under the peculiar conditions.

The work under the first contract was a bituminous rock pavement begun in May, 1893, and completed in October of that year, the total length of streets paved being 1.18 miles. All the work in connection with the laying of the double track was done under a separate contract between the contractor and the street railway company, under the direction of the city engineer. The old planking having been removed, the street was first graded to the required contour. All roots, rotten wood, vegetable mold or soft soil was removed, and replaced by good dry sand and gravel or broken rock. The surface of the ground having been brought to the proper level, it was well wetted and rolled, and, where directed, well rammed until brought to an even and smooth surface, the contractor being required to take proper care of all gas, water and other pipes, and also all poles.

The concrete for the base was composed of four parts of broken stone, two of clean gravel and three of clean coarse sand to one of English Portland cement, the quality and brand being approved by the city engineer. From careful experiments this proportion was found to be exceptionally good. The depth of the concrete was 6 inches. All materials were required to be thoroughly dry, and then wetted sufficiently and rammed in place to the proper shape, where it was protected until properly set, and kept clean until the bituminous rock covering was placed on it. In places where it was found necessary or expedient to have the concrete a little deeper than 6 inches, the extra quantity was figured and allowed the contractor. The broken stone used was of such sizes as would pass through a 2-inch ring, and was supplied by the city. The work of grading, concreting and setting the curbstones was kept sufficiently in advance of the covering to allow the concrete to set properly.

The curbing used was of granite, and was 6 inches thick, 20 inches deep, and in lengths not less than 3 feet. The top surface was dressed evenly with a slight round on the outer edge, the joints throughout being kept as square and true as possible so as to make a close fit in order that they might be pointed and made water tight. The curbing at the street intersections was rounded to a 2-foot radius.

The stones for gutters were of granite, 8-inch courses, 8 inches deep and averaging 12 inches in length, the top surface being cut true to a reasonably smooth face, and the sides and ends, so that when laid there were not spaces of more than ½ inch between any two courses. The spaces afterwards were floated with pure cement. It may be stated, however, that these stone gutters were only put in where the fall was slight.

The best quality of bituminous rock covering obtainable from San Luis Obispo, California, was used, containing not less than 15 per cent. of bitumen. This was broken up and then disintegrated by steaming in a tight kettle under a pressure of not less than 60 pounds, and after being taken out of the kettle was dried in a pan heated by steam and placed while hot on the road, then raked to an even surface and rolled with a heavy hot roller until thoroughly compacted. The rolling had to be done to the satisfaction of the city engineer, and, when completed, the surface was required to be smooth and even, and the bituminous rock not less than 2 inches in thickness or weigh less than 20 pounds per square foot. The work was required to be carefully and neatly finished around the gutters, and where not accessible to the roller was rammed with a hot iron. The whole work had to be guaranteed and kept in repair by the contractor for one year, the contractor furnishing a suitable bond to that effect.

The bituminous rock pavement commenced in 1894, and finished in 1895, was 0.61 mile long, the work being carried out under a new contract, but by the same contractor, the main difference being in connection with the heavy girder rail laid. In this contract the contractor was required to give a two years' guarantee instead of only one, as in the preceding contract.

The wood block paving laid in 1894 was only a short piece, 0.05 mile long, put down as an experiment in order to compare a sample shipment of Australian mahogany, black butt and spotted gum with the local fir and cedar. This was laid in the following order, on a street measuring 57 feet 7 inches between curbs. A strip, 3 feet 7 inches long, of British Columbian cedar not creosoted; a strip, 65 feet long, of creosoted British Columbian cedar; a strip, 70 feet long, of creosoted British Columbian douglas fir; a strip, 43 feet 4 inches long, of Australian spotted gum; a strip 43 feet long, of Australian black butt; and a strip, 38 feet 10 inches long, of Australian mahogany. The conditions as to grading, concreting and granite curb were the same as in the former pavement. Between the concrete and the blocks was a ½-inch cushion of sand. The work was commenced in November, 1894, and finished at the end of December, taking about a month to complete, the work being carried out under trying atmospheric conditions. The contractors were called upon to furnish good sound fir and cedar free from defects of any kind. The blocks were sawn 9 inches long, 3 inches wide, 5 inches deep, squarely and perfectly uniform in size and surfaced. The fir and cedar were well creosoted under pressure before being laid. The Australian woods were hauled and sawn by the contractor, and all the different kinds of wood were kept separate on the street. The blocks were laid with ¼-inch space between each row, the gradient of the street being over 5 per cent. They were laid in rows running across the street, the contractor doing all the cutting and trimming necessary to break joints. After the blocks had been laid sufficiently ahead, a mixture of coal tar pitch and asphalt was poured into the joints. The joints were then filled with fine gravel well pounded in with a special tool and saturated with the asphalt mixture until filled compactly to the top of the blocks, which then received a coating of liquid asphalt and tar put on hot, the whole being covered with finely broken granite, which was supplied by the city. An expansion joint of well-tempered clay was put in next each curb to allow for the expansion of the blocks. The contractor was required to give a written guarantee for one year, and to make all necessary repairs during that period. As a matter of fact, no repairs to speak of have been necessary, and the city engineer was so pleased with the results achieved from this pavement, especially the local fir and cedar, and more particularly the latter, both creosoted and uncreosoted, that, when the matter came up early in 1898 of the desirability of further extending the system of paved streets, he recommended the use of local cedar blocks as a test on a larger scale.

The chief points of difference between the wood block pavement, commenced in July, 1898, and completed at the close of the year, and the wood pavement of 1894, may be said to be that a good deal of the work entailed the fitting in of the blocks along the heavy 70-pound T rail, and also that in this contract the specifications required the wood blocks to be laid with close joints instead of the ¼-inch space as before, ex-

cept where the gradient was sufficient to require ¼-inch space being left. In this contract the contractors were required to give a two years' guarantee to keep the pavement in proper repair.

In comparing the pavements, the paper states that the repairs to the bituminous rock pavement, especially that of 1893, have been very extensive, more so than was anticipated at the time it was put down. The greatest trouble has been along the 40-pound T rail. There can be no question that the humidity of the Vancouver climate, especially at certain seasons of the year, when there is a great deal of moisture and very little sun, is very detrimental to the wearing qualities of the bituminous rock pavement. The bituminous rock close to the light T rail has suffered very much from the vibration of the rail. On one street, however, where a 70-pound girder rail was used and the bituminous rock and concrete built up clean to the rail, no trouble of this kind has been experienced, and neither the pavement nor the portion alongside the girder rail have required any very material repairs. In frosty weather this pavement has proved very slippery for horses, but it has been found that a little sand sprinkled over it has remedied this defect, especially salt water sand, of which any quantity can be obtained here, the salt in the sand appearing almost immediately to thaw out the frost from the surface.

The wood block paving put down at the close of 1894 as an experiment has stood the traffic very well. This piece, however, has not been exposed to the very heavy traffic, and in frosty weather it has proved slippery, but a little sifted sand has been found very effectual in remedying this defect. The local fir and cedar has proved just as satisfactory as the Australian woods so far. It may be remarked, as to all these pavements, that, whenever it has been found necessary at any time to remove the covering for the purposes of repairs, the concrete exposed in each case has been found to be in a first-class condition, and to have set exceedingly hard and solid.

As to the form of rail, so far as traffic is concerned, the experience at Vancouver is that a heavy grooved girder rail is the best. So far as the street railway company is concerned, a T rail is best for their purposes. It would appear, in order to make the best and most lasting job, that the rails should be set in concrete with iron cross-ties to hold them in place, avoiding the use of wood altogether. Judging by experience, it would appear that, where a proper rigid track is put down, it is best to lay the bituminous rock or asphalt close up to the rail.

As to the wood block paving, there may be objections to it on sanitary grounds, but, owing very largely to the great clamor here for the use of local materials, it was determined early in 1898, when extensions to the paved streets were contemplated, to give it a test on a somewhat considerable scale. The object of dipping the blocks in the mixture of coal tar and asphaltum was not so much with a view to preserving the wood as to prevent absorption and to make the pavement as far as possible impervious to moisture, it not being intended that the surface water should penetrate it. With this end in view, the blocks were laid close where the gradient would admit of it. These pavements were all laid under the direction of Colonel Thomas H. Tracy, city engineer.

THE MUSCATINE BRIDGE ACCIDENT.

The accompanying illustration, engraved from a photograph furnished by Hon. George T. Baker, mayor of Davenport, Ia., shows an unusual accident which recently occurred at the bridge across the Mississippi River at Muscatine, Ia. This structure consists of the following spans, beginning at the Illinois shore: 260 feet of wood trestle, four spans of 160 feet each, of which two rest on cylinder piers, one span of 240 feet, one of 360 feet, one of 442 feet, one of 360 feet, two of 160 feet, three steel girders of 45, 58 and 55 feet respectively, and 120 feet of iron trestle. The bridge carries an 18-foot roadway with 5-foot sidewalks on each side. The original plan called for stone piers throughout, but the last three on the Illinois side were made of iron shells with concrete and pile filling in order to save expense. The span shown in the illustration is the second 160-foot span from the Illinois side. The cylinders at the right are 5½ feet in diameter, and those at the left are 6 feet. The end of the span which fell rested on rollers while the other was fixed.

Both the low stone pier carrying the rocker bent and the 6-foot cylinder piers show a movement towards the left, or the channel of the river. The cylinder piers lean some 18 to 24 inches, and are now being replaced by a stone pier. Mayor Baker writes that at the time of the accident the river was covered with ice 1½ to 2 feet thick, and the thermometer had been ranging from 0 to — 24 degrees. The river had fallen from 2 to 3 feet and the ice field, falling in consequence, separated near the line of the 5½-foot piers at the right of the illustration. It is believed that the ice caused a sufficient movement of the pier under the free end to let it fall as shown.

THE BRIDGE ACCIDENT AT MUSCATINE, IOWA.

THE FLOATING BRIDGE AT LYNN.

One of the interesting features of the history of bridge building in the United States is that its stone age begins at a late period. In Mexico there are some interesting arch viaducts dating back to the early days of the Spanish rule, but farther north the early bridge builder had only wood for a material. But while we have no old masonry arches like those of Spanish America and Europe to gratify the eye, nevertheless some of the early work in wood was of an interesting nature, and engineers of an historical turn of mind are indebted to Mr. C. J. H. Woodbury, M. Am. Soc. C. E., for the following account of a unique floating bridge at Lynn, which is taken from a paper he wrote for the Essex Institute:

In the latter part of the last century there was a demand for a better highway from Salem to Boston, and the subject received public attention, which resulted in a petition for a charter by Dr. Edward Augustus Holyoke, *magnum atque venerabile nomen*, and fifty-two others, which was granted to the "Salem Turnpike and Chelsea Bridge Corporation," March 6, 1802, and this instrument was amended by subsequent acts, February 26, 1803, increasing its right to hold real estate from $12,000 to $30,000, and also to charge additional tolls for heavy vehicles with narrow tires, and the second amendment, June 18, 1803, transferred the authority to authorize erection of turnpike gates from the judges of the Supreme Court to three Commissioners to be appointed by the Governor.

Although nearly a century before the Highway Commission, the Commonwealth found a means for the exercise of a supervision over the work by inserting in the charter a clause to the effect that tolls should not be taken until the turnpike was accepted by the judges of the Supreme Court. There was great opposition to this charter according to local interests, although there was a general desire that the road should be built; and those interested in the Turnpike Corporation later opposed the incorporation of the Eastern Railroad Company. Work was begun at Salem near Pickering's Pen, June 7, 1802, and the road was opened to Lynn one year later, on July 7, 1803, and through its whole length of twelve and three-fourths miles, September 22, 1803, at a cost of $182,063.

The directors are reported to have personally explored the available routes, and finally elected Captain Moses Brown, of Beverly, one of their number, as their agent, and he was authorized to stake out the road, purchase land, contract for building the road and do other things needful to further the project. This selection was a most fortunate one for the execution of the new enterprise, for he brought to the service of the company a mind of varied resources, which had been trained and developed by wide experience in mercantile affairs and a military career. He took leading parts in the establishment of the Beverly Cotton Factory and Essex Bridge and Salem Turnpike, being one of the incorporators in each, and was actively engaged in their construction. He was a presidential elector in 1808, and died June 16, 1820.

In the northeasterly part of Lynn, about 2,300 feet from the Salem boundary, there was an obstruction in the shape of Collins' Pond, a sheet of water 17 acres in area. This pond is of great depth, and has a soft, peaty bottom, which did not permit the use of any feasible means of constructing bridge piers. The Board of Direc-

tors authorized Captain Moses Brown to bridge the pond in the best way possible.

This bridge, as built by him, is 511 feet in length and 28 feet wide, and is virtually a raft moored at the ends, which are embedded in trenches dug in the shores of the pond at each of the approaches. It has been examined by a diver, who reported that the original structure consisted of five layers of pine timber, each at right angles to the ones next to it, the lower course being of logs hewn on one side and the upper three courses being about 1 foot square, and the whole mass secured together by 3-inch dowels, and with the top planking about 5½ feet thick.

The logs were largely cut from trees felled in Salem great pastures, and the remainder were obtained in Salem, all of them being dragged over the turnpike to the southeasterly shore of the pond, where the bridge was made in three sections, and these were separately floated to the site of the bridge and assembled together. The bridge was built at a cost of $55,469 in 1804, or a year after the turnpike was opened to Lynn, and until its completion a detour was made around the southeasterly side of the pond.

The present travel is in small proportion to that of years ago, but it now requires a new layer of 3-inch plank every third year, the actual wear of the roadway being about three-quarters of an inch a year. There has been a difference in the practice of removing the old plank before renewal, but the thickness has been greatly increased by leaving some of the old, worn plank, until it is now about 15 feet thick. The heavy timber forming the under portion has always been submerged, and is yet sound, as wood will last almost indefinitely if always wet or always dry, as is shown by the piles under Swiss prehistoric lake dwellers' houses, and by the wood from Egyptian tombs.

About thirty years ago James U. Hunt, of Lynn, with the help of others, extracted a pine log about 2 feet in diameter from the bridge, and it was floated to the land of Mr. Waitt, where it lay for a number of years. It was sound, and showed the method of half splicing the ends, and also the dowels used for connecting the logs together.

The worn remnants of the various courses of top planking, which became decayed from its alternations of wet and dry conditions, are not entirely sound. The method of joining the timber together by dowels was undoubtedly adopted to render the bridge flexible to conform to the varying heights of the water, without any injury to the structure at the approaches, and in this manner the bridge bends about 4 feet during the extreme conditions of water level of the pond. This flexibility of the structure, which is essential for its safety, also causes an appearance of insecurity, for as a vehicle is driven over the bridge the structure yields and the water flows over the sides, but does not cover the roadway in the middle, which is somewhat higher, unless the load should be a very heavy one. Once when a large drove of cattle was crossing the bridge, some of them naturally placed their heads under the railing and began drinking, but as they assembled at one side of the bridge other cattle gathered at the same side, and the bridge sank until the rail reached the water level, and several of the cattle who were the first comers were caught by the horns and their heads held under the water until they were drowned. In the commotion made by the herders to drive the cattle along the bridge to release the drowning ones, many of them swam over the rail and scattered over the country.

While one side of the bridge was depressed by the unequal load on that side, the opposite side was raised about 6 feet, and Mr. Woodbury's informant of this incident, then a boy, took a boat with some of his companions, and rowed out to examine the construction of the raised portion of the bridge. After this incident, cattle were not allowed to cross the bridge in large numbers, but droves were broken up into groups of less than a dozen.

A Salem man once moved a dwelling over the bridge, using four yoke of oxen, and when midway across the bridge submerged; but, as the oxen pulled the house along, the bridge rose again. This house is now in use on the turnpike in Lynn, near to the bridge.

The proverbial sagacity of the elephant is often cited as a true test of a bridge, but the great caution of these intelligent animals, who seem to realize their whole weight, prevented tnem from crossing this bridge. The turnpike was on the regular route in the days when menageries traveled over the highways, and the elephants would not cross the bridge, but would break into the woods and swim across the pond; but as an exception to prove the rule, it is said that one elephant was induced to cross the bridge.

This bridge may have been evolved from the floating lumber docks on the Maine waters which are divided by booms of squared timbers, which serve as boundaries and walks, and are to a certain extent floating bridges. A bridge of this kind was once built across Dexter Pond in Maine, but it has been replaced by a bridge on piers suitable for ordinary highway travel.

A comparable structure was built on the line of the Worcester Turnpike Corporation, which was chartered June 11, 1808. The road crossed the upper portion of Lake Quinsigamond by a floating bridge built of two tiers of logs covered with plank, which proved to be weak and unsafe. It was succeeded by another built on piers 30 feet apart, which was not a floating bridge, although the name of the first structure was still retained. The second bridge was broken by the sinking of some of the piers, and parted in the middle September 19, 1817. During the last part of the year another bridge of timber was built on the ice, and in the spring swung around to its place. This bridge was 525 feet long and 30 feet wide, and lasted till 1861, when the bridge was converted into a causeway by filling with gravel.

While this floating bridge at Lynn is believed to be an original design and a unique structure, yet the earliest bridges, beyond a single span of a fallen tree, were probably floating bridges of the pontoon type, in which moored boats were used for piers. In fact many of the great bridges were supported on boats. Darius built pontoon bridges across the Bosphorus and the Danube. Xerxes built two bridges across the Dardanelles, one on 360 and the other on 314 vessels. The Romans used pontoons made of wicker work, covered with skin, and the United States Army was supplied with large rubber bags for pontoons during the Mexican War. The Germans had pontoon bridges during the Thirty Years' War. Napoleon used copper pontoons of a type which were first made by the French in 1672. Wellington used tinned iron cylinders for pontoons, and Marlborough, as have others, before and since, wood boats. At Ehrenbreitstein the Rhine is crossed by a pontoon bridge 1,200 feet long, and a section is released and floats down the current to serve as a draw to let the steamer pass. There is a pontoon bridge of about the same length at Rouen, France. At Calcutta, the Hoogly is crossed by a pontoon bridge 1,530 feet long, supported by 14 pairs of iron boats, each 160 feet long and 10 feet beam, and divided into compartments. One of the most spectacular of pontoon bridges was that built by the Emperor Caligula in the year 39. This bridge was three miles in length and in the form of a crescent, sustained upon boats anchored in the bays of the Puteoli and Baiæ. Gravel was laid upon the plank, houses built and every means taken to simulate the appearance of a highway upon land. The emperor conducted the most elaborate festivities for several days, which he terminated by ordering a large number of the spectators thrown into the sea.

At Hertford, in eastern North Carolina, there is a bridge supported on empty whisky barrels, which has been used for fifty years.

THE ERECTION OF THE ALEXANDER III. BRIDGE, PARIS.

The Alexander III. bridge, at Paris, carries an important city thoroughfare across the Seine, and is being built in connection with the other permanent structures which will be prominent features of the Exposition of 1900. It is notable for the remarkable type of superstructure adopted, for its unusual proportions, for the magnitude of its substructure, and for the unusual method of erection. The bridge consists of a single-span deck structure, with short approaches, the whole provided with ornate metal embellishments, conspicuous portals, towers, approach masonry and statuary. The main span, 131.2 feet wide, consists of fifteen arch ribs of 352.7 feet span, center to center of skew backs, with vertical spandrel posts supporting the floor platform. The arch is segmental, with a rise of only 20.6 feet, and the ribs are cast-steel plate girders, made in sections connected by radial end flanges, and having pin bearings at the skewbacks and crown. There is no lateral or sway bracing between the ribs and no longitudinal bracing between the spandrel posts, which are made of riveted steel and have transverse vertical X-bracing. A general description and illustration of the superstructure was published in "The Engineering Record" of September 4, 1897.

The concrete abutments are very massive, to resist the great thrust of the flat arch. The steel caissons for their foundations have the

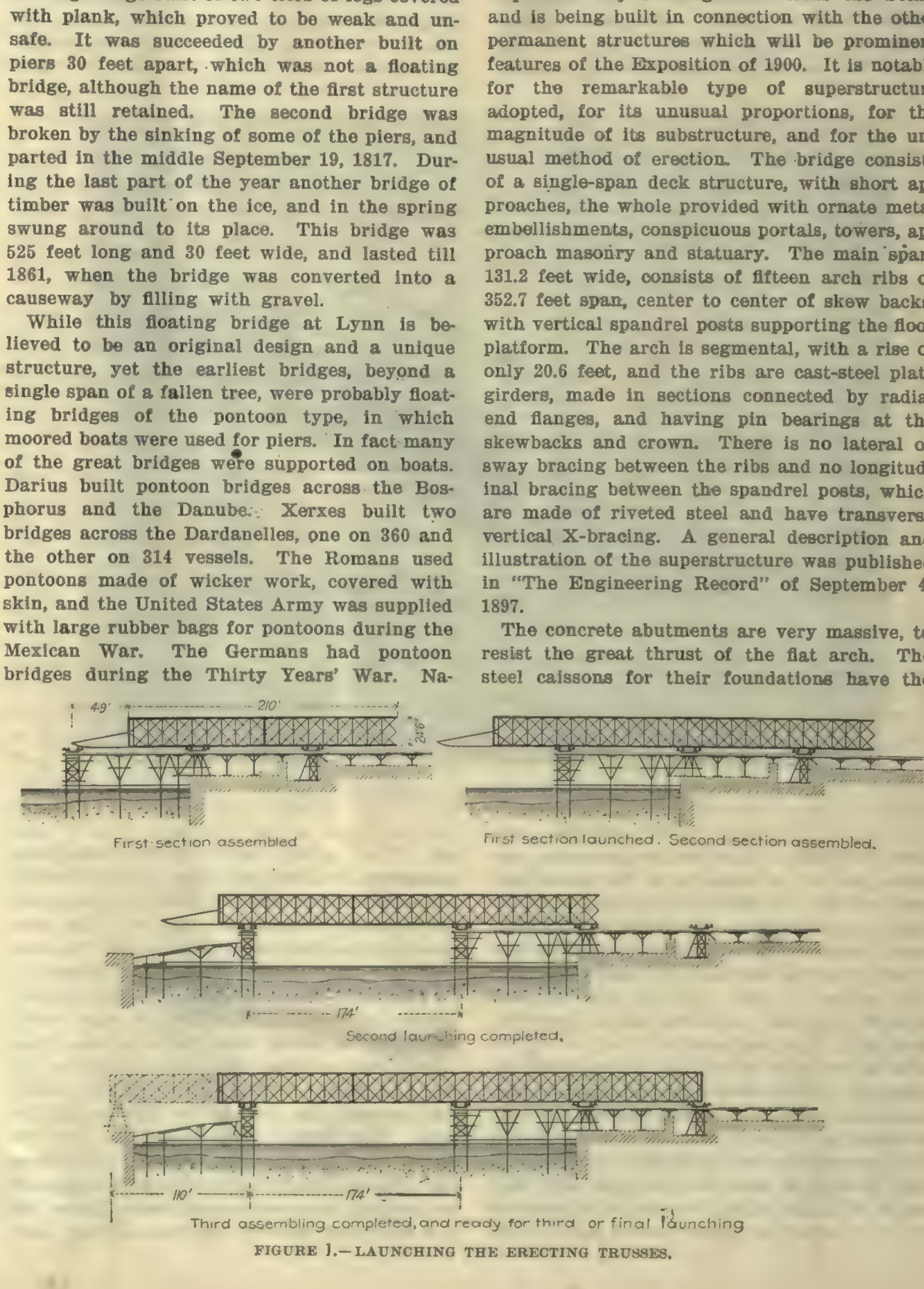


FIGURE 1.—LAUNCHING THE ERECTING TRUSSES.

largest area of all yet built, and were illustrated in "The Engineering Record" of February 26, 1898. The contract was awarded February 25, 1897, and the caisson work for the second abutment was completed March 26, 1898.

In order to prevent interference with navigation it was required to preserve an unobstructed center channel of 164 feet in width, and it was determined to erect the entire arch by suspension from an overhead falsework span. This span had an extreme length of 394 feet of continuous truss extending beyond the skewbacks of the arches, but during the actual erection and assembling of the arch segments it was supported on two side piers or temporary pile towers 164 feet apart, center to center. Pile falsework was built between these piers and the abutments, and a platform on top of it was extended on one shore to receive the falsework span which was built there in sections on the axis of the bridge and launched into position in three operations, as indicated in Fig. 1. This shows how the successive sections of the truss were built upon a platform too short to accommodate the full length at once. A pilot truss was added in front, and the span was launched by hand at the rate of about 33 feet an hour by workmen inside of it operating tackles fixed to the abutments.

The falsework trusses are lattice girders 24.6 feet deep and 18.7 feet apart, built of plates and angles and bearing two systems of horizontal lateral X-bracing, one in the plane of the top chords and one in the plane of a horizontal strut which runs from end to end of each truss midway between its chords. The vertical posts of the trusses are made very wide in the transverse plane and have there diagonal sway bracing between the upper and lower lateral systems. Below the lower lateral system each pair of posts is connected by a transverse trussed beam, from the under side of which are suspended two trolley tracks 9.4 feet apart, exactly corresponding to the spacing of the permanent arch ribs. At each abutment one end of the falsework span is supported on a traveling tower which rolls on the masonry transversely to the bridge axis. On the pile pier at each side of the open channel the falsework span is supported during erection on a pair of cast pedestals on top of short riveted towers, which are movable on a transverse distributing plate girder carried by seven bents of piles. The total weight of the falsework span is 238½ tons, and the towers, derricks, etc., weigh enough more to give a total of 383 tons for the steel work of the erection plant. The trusses were designed to have a maximum stress of 23,500 pounds per square inch, due to strains in launching.

One end of the falsework span and its rolling tower is shown in Fig. 2. An adjacent transverse section through the timber falsework between the abutment and the pile pier is shown in Fig. 3, where a pair of arch rib sections are seen suspended from the trolley tracks ready to be assembled on the platform below. A transverse section and elevation at a pile pier (Fig. 4) shows the special vertical posts of the trusses at that point which are made with solid webs. They receive the shear from the reactions of the intermediate supporting towers, which set between the arch ribs, and are movable on the cross girder. A cross-section through the center of the span is shown in Fig. 5, where a working and assembling platform is suspended below the trusses. A general side elevation of the whole erection installation is shown in Fig. 6. Materal is delivered at each end of the bridge to a locomotive derrick, which loads it on a car running on a transverse track on the edge of the abutment. These cars transfer it to points below the successive positions of the falsework span, where it is lifted by a hoist on the trolley track above and carried to the required position.

In order to provide against any possible accident from defective material or unexpected irregularity during the short periods of excessive strains developed while the span was being launched, an emergency floating pier was temporarily set near the center of the channel opening during the second period of launching. This pier consisted simply of a timber tower, wth a very large batter, which was built on a pontoon and towed into position across the axis of the span, and just clearing its lower side. The pontoon was kept in position by four guide piles, the whole arranged as shown in Fig. 7.

The assembling of the falsework span was commenced July 22, 1898, the first third of it was launched August 20, the second third September 8, and the last September 30. Each launching was accomplished in half a day and only two hours' interruption to navigation was caused. The maximum settlement of the pile piers was

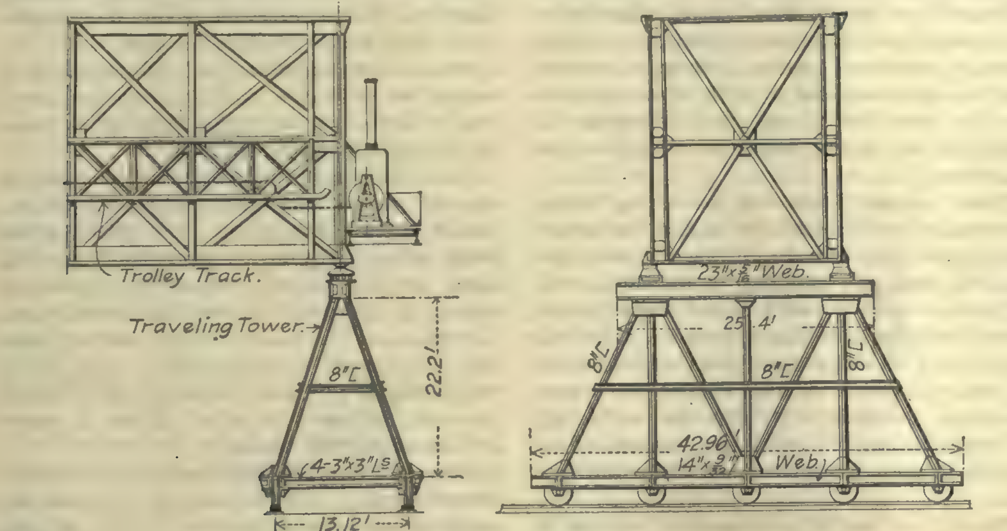


FIGURE 2.—MOVABLE PIERS SUPPORTING ERECTING TRUSSES.

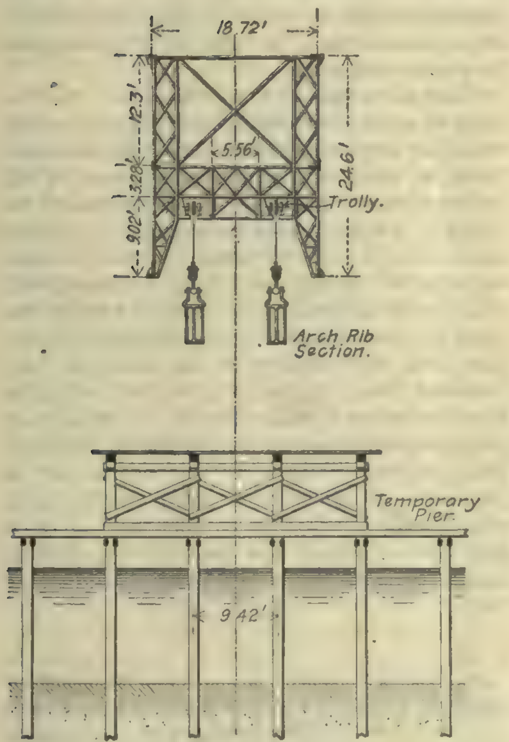


FIGURE 3. SECTION THROUGH FALSEWORK.

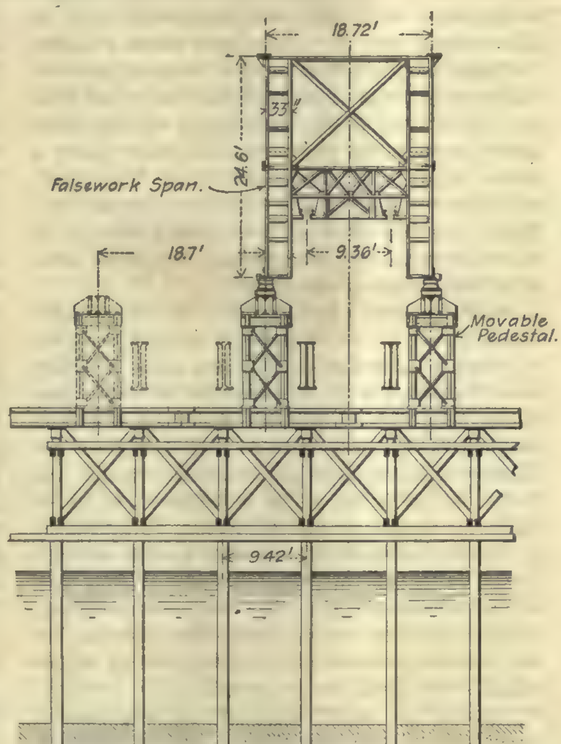


FIGURE 4.—SECTION AT SPECIAL POSTS.

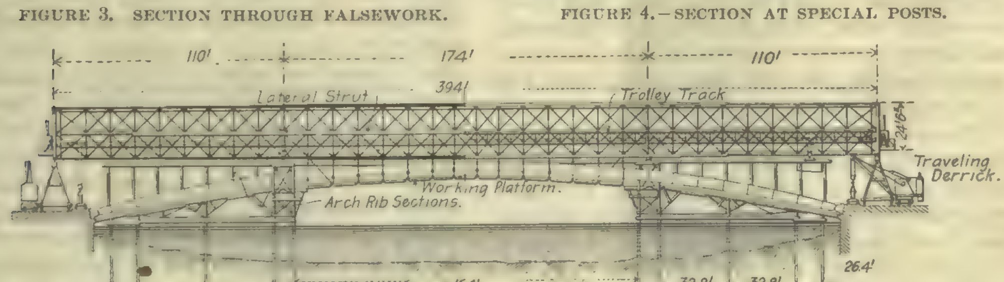


FIGURE 6.—THE GENERAL PLAN OF ERECTION.

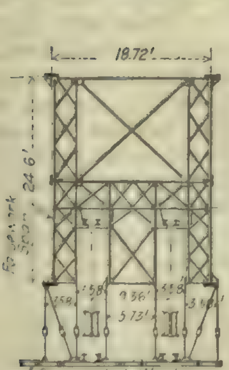


FIGURE 5.

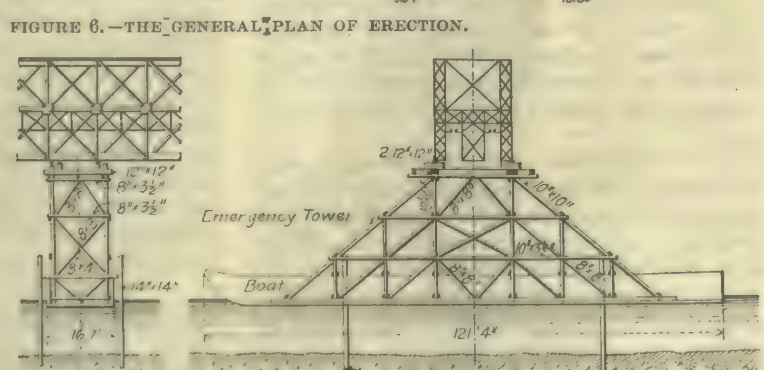


FIGURE 7.—DETAILS OF THE PONTOON SUPPORT.

0.63 inch, and the maximum depression of the pilot was 5.3 inches. In assembling the arch rib sections, they are to be fitted together accurately, and final adjustments of length are to be made by the insertion of steel packing plates in one of the last joints. The flange connections are to be made with steel rivets.

The details of the design and erection have been published in several French journals, and from the different accounts this description has been compiled, with illustrations prepared from those in the "Annales des Ponts et Chaussées."

SPECIFICATIONS FOR PORTLAND CEMENT.

A short time ago a set of specifications for both slow and quick setting Portland cement was prepared by Mr. H. Von Schon, chief engineer of the Michigan Lake Superior Power Company, of Sault Ste. Marie, Mich., which has attracted considerable attention. Bids were asked for about 20,000 barrels of quick-setting cement and 48,000 barrels of slow-setting, all to be made without using furnace slag, gray limestone, clay slate, hydraulic lime or trass. The leading articles of the specifications were as follows:

Mill Inspection.—The engineer is to be given by the contractor all facilities required by him to inspect the mill where the cement to be furnished under this contract is being manufactured; or to examine at all times the plant or any part thereof, or any material used in the manufacturing process, or the methods employed in the production and handling of the cements, and the contractor is to furnish to the engineer the use of such instruments, tools and implements, and materials and labor required in the opinion of the engineer to satisfactorily carry on such inspection; and the contractor is not to claim any extra compensation for any services thus rendered for the purpose of mill inspection, but it is understood and agreed that the price of his proposal covers all such services and cost of material and labor.

Mill Tests.—The contractor is to test the cement to be furnished under this contract, at the place where the same is being manufactured or stored, and before it is shipped for delivery, in the presence of and under the direction of the engineer and in accordance with these specifications as interpreted by the engineer; and the contractor is to furnish the use of all instruments, tools and implements, and all materials and labor required in the opinion of the engineer to satisfactorily carry on such tests, and the contractor is to claim no compensation for this testing and all that may be required in connection with it, but it is understood and agreed that the price of his proposal covers all such testing, which is required to be done at the place of manufacturing or storing before shipment for delivery in accordance with the direction of the engineer.

Scope of Mill Inspection and Tests.—Inspection may be required at the discretion of the engineer of the quantities of the raw material used in the mixture, the preparation of raw material for calcining, the calcining, the selection of clinkers for grinding, the grinding, the storing, the barrels before packing, the barrelling, the marking of the barrels, the weight of the barrels ready for shipment, and the loading and shipping.

Tests may be required to be made to establish the identity and chemical characteristics of the raw materials used, of the degree of heat reached in calcining, of the chemical characteristics of the finished cement, of the fineness of the cement, the time of setting, its volume constancy, and of its tensile strength.

Character of the Inspection and Tests.—Inspection may be personal or of records, or both, and whenever required to do so the contractor must furnish inspectors who are acceptable to the engineer for any of the subjects detailed [under Scope of Mill Inspection and Tests], and all records kept by the contractor and which relate to the matters subject to inspection must at all times be at the disposal, both for reference or copy, of the engineer.

The complete set of cement tests shall consist of:

First: A chemical analysis of the cement which accounts for at least 99 per cent. of its component parts and gives the specific gravity.

Second: A test to ascertain the fineness of the cement is to be made by thoroughly sifting about 2 pounds of cement through a covered nest of sieves composed of a No. 50 on top and a No. 100 sieve below, and then weighing the quantities of cement retained on each of the two sieves.

Third: A test to establish the setting time of the cement is to be made by mixing the cement with 20 per cent. of water, filling the same in a suitable mold and applying to its surface under a presure of ¼ and 1 pound respectively a Vicat needle of 1/12 inch diameter. When the needle fails to break the mortar surface under the pressure of the smaller weight, the cement has taken the initial set; when the needle fails to break the surface under the pressure of the greater weight, the cement has taken the final set.

Fourth: A test of constancy of volume of the cement is to be made by mixing neat cement with water to a stiff paste and forming it on glass plates into two cakes each about 3 inches in diameter, ½ inch thick and thinned down on edges to ⅛ inch. After having taken the final set one of the cakes, remaining on the glass plate, is placed in water and the other under a damp cloth, both being protected from draft and direct sun rays and thus kept for 28 days. Daily examinations of both cakes are to be made for cracking, checking, warping or spotting and changing of color.

Fifth: A test to ascertain the tensile strength of the cement is to be made by mixing one part of cement by weight and three parts of Point aux Pins sand with 20 per cent. of water, and filling this mortar into five standard briquette molds under a dead pressure of 20 pounds per square inch applied mechanically until the initial set is taken. The briquettes are to remain in the molds for 24 hours, and then to be placed in water where they are to be kept for 27 days, and then removed and at once tested for tensile strength by a machine acceptable to the engineer. Only briquettes breaking in the smallest transverse sections are to be accepted as satisfactorily tested.

Sand.—The sand required for the cement tests is to be that specified in the construction in which the cement is to be used, and which is obtained from Point aux Pins, near Sault Ste. Marie, Mich. For tests to be made at other points than the place of delivery, the sand will be furnished free to the contractor.

Water.—All water used in connection with the cement tests shall be of a temperature between 50 and 60 degrees Fahrenheit, and shall be daily renewed. The temperature in the mixing room shall be between 65 and 75 degrees Fahrenheit.

Acceptance Requirements.—The requirements to be fulfilled by the cements to be furnished under these specifications in order to be acceptable for the construction as evidenced by the results of the inspection tests before described are:

First: That the composition of the cement must be within the following limits: Carbonate of lime, from 62 to 65 per cent. Silicic acid, from 20 to 24 per cent. Clay, from 5 to 8 per cent. Iron oxide, from 2 to 4 per cent. Alkalies, to 2½ per cent. Sulphuric acid, to 2 per cent. Magnesia, not exceeding 3 per cent. Loss by calcination, carbonic acid and water, to 2½ per cent. Specific gravity, between 3.12 and 3.25.

Second: The fineness of all cements must be such that 95 per cent. by weight will pass the No. 50, and 85 per cent. by weight will pass the No. 100 sieve.

Third: The setting time of the quick setting cement must be as follows: Initial set in 30 minutes; final set in one hour. For slow-setting cement, the initial set must occur in not less than one hour.

Fourth: The constancy of volume of all cement must be perfect; that is, no cracking, checking, warping or spotting, and no change of color must appear during the test.

Fifth: The maximum tensile strength of all cement as developed in 28 days by mixture of one part of cement to three parts of sand must be 240 pounds per square inch.

Test Samples.—The cement to be tested at the mill may be taken from the bins before barreling or from the cement after barreling, this being left entirely to the discretion of the engineer, but the lot from which the cement for testing is taken will be accepted or rejected in accordance as the results of the tests may show that the cement complies with or fails in the requirements of these specifications, provided, however, that each lot of 100 barrels of cement will be separately tested.

Final Tests.—The Michigan Lake Superior Power Company reserves the right to make final tests of the same character and in the same manner as those described for mill tests of all cements delivered to it at Sault Ste. Marie, Mich., extending to the contractor all facilities to witness the same.

Final Acceptance.—If the results of the final tests show that the cements delivered comply with the requirements of these specifications, then the same will be finally accepted by the Michigan Lake Superior Power Company, but if any of it fails in such requirements, or any of them, then the lot of cement which is found wanting will be rejected and the contractor will be required to move such rejected lot within five days of being notified by the engineer in writing, from the property of the Michigan Lake Superior Power Company; provided, that all cement delivered at Sault Ste. Marie, Mich., shall be passed upon all its requirements in accordance with the results of the tests within 60 days after it has been delivered to the Michigan Lake Superior Power Company at Sault Ste. Marie, Mich., and provided it shall be passed upon in lots of not more than 100 barrels.

A Geodetic Observatory has recently been built on a hill in Middlesex Fells near Boston by the Massachusetts Institute of Technology. It is intended for instruction in refined methods of determining latitude and longitude, and for magnetic and gravity observations. The site offers a firm foundation for delicate instruments, freedom from vibration and magnetic disturbances, and an unobstructed view of the heavens and the horizon. The apparatus includes a transit instrument of 2½ inches aperture and 27 inches focus, a siderial chronometer, a chronograph, a magnetometer, a dip circle, an altazimuth instrument, and smaller pieces, while a half-second pendulum for gravity determinations will be added during the present year. Delicate work can here be accomplished, which is impossible in a city, and students of geodesy are enabled to acquire a practical as well as theoretical knowledge of the methods of making careful observations. On account of the unique location of the observatory, it is expected that the magnetic observations made there will be incorporated in the general magnetic work of the United States Government.

Gravel Roads are commended for light travel in the annual report of Mr. James H. MacDonald, commissioner of highways of Connecticut, who says: "A mistaken idea prevails to some extent that to make a perfect system

of roads throughout the State, a macadam system must be inaugurated. This is not of necessity so, as I have seen many miles of roads in different towns in the State of splendid natural gravel roads. What I mean by natural gravel roads is that the roads have been laid out through territory of gravel formation. All that was necessary in the improvement of the road was to open up the road without the addition of any other material than was found on the road itself. These roads could be made first-class roads by widening out and shaping the road and forming gutters, thus making them first-class roads with very little expense It would not only be extravagant, but very unwise to import stone where such a condition exists to make a macadam road. In other towns of the State I have found roads of good gravelly earth where a little attention in rounding up the road and forming gutters would make them suitable for the travel they would have to accommodate."

STRESSES IN STEEL FOUNDATIONS.—I.

[By Samuel B. Durand.]

In its broadest sense the field of foundation work is the most difficult of all civil engineering problems, because the forces to be resisted and the conditions to be governed are more or less obscure, and yet the rational and proper treatment of every foundation question involves the safety and economy of the whole structure. This bears with especial force upon the treatment of the foundation problems of high buildings, and particularly the high steel building, whose entire structural design requires an application of engineering principles, governed by judgment and trained by the widest experience.

Unfortunately the existing conditions in Chicago and New York, the two cities whose needs have brought the high steel office building into existence, are by far the most difficult that have yet been encountered in this country. The soil of Chicago has been described as clay, which changes from firm to very soft in small depths, and within small areas, with a crust of loam 10 to 12 feet thick, and a foundation of limestone from 40 to 80 feet below the surface, while that of New York has been described as quicksand with a bed of rock from 15 to 50 feet below the surface.

At the time the skeleton construction was being introduced, less than ten years ago, Mr. Charles Sooysmith objected to the foundation methods that were being adopted for these heavy structures, claiming that the only proper solution of the problem would be to carry masonry piers down to bed rock and not to depend upon the compressible soil for support. But this method, undoubtedly the best theoretically, has been found too expensive to be adopted for general practice. For not only is the long masonry pier itself expensive, but also its erection, which must be accomplished by the most careful methods, in order that adjacent buildings shall not be disturbed by the flow of the soil, which deep excavations in these localities are very liable to cause. Sometimes, however, it is the only method which can be used, as in the case of the Manhattan Life Insurance Building in New York, where the enormous weight of the structure could not safely be carried on the soil nor on piles within the area of the site. But the expense of the masonry substructure alone in this case was 9 per cent. of the total cost of the building on account of the necessity of sinking the piers by the pneumatic caisson process, and of shoring up and carefully watching the walls of adjacent buildings to prevent displacements.

There are some cases, however, where foundations have been carried to bed rock by excavating inside of sheet-piling and filling with concrete. This method was used with good results for the foundation of the Methodist Book Concern Building in New York, but on being tried for the Mills Building in the same city, when the excavations reached a certain depth, the quicksand flowed in so rapidly that the pit had to be filled with concrete, and fear was entertained for all the buildings in the vicinity.

Of the many different methods that have been used for the foundations of heavy structures on compressible soils, but two have proved to be well adapted to the exceptional conditions existing in these localities, a pile foundation, and a spread foundation where each pier is carried on a footing, isolated from those carrying the adjacent piers. It can hardly be said that a consensus of opinion exists among architects and engineers as to which of these two methods is preferable for general practice in these localities; but for the case of the steel skeleton structure, the spread foundation has met with the most general favor both in Chicago and New York, there being but one firm of architects in the former place who use piles regularly for the support of buildings of this style. This preference is largely due to the elasticity that such systems afford, especially when acting with an elastic superstructure.

Mr. Jenney, who was the originator of the skeleton type of construction, and the first to use this foundation method, says there is one redeeming feature about Chicago soil, and that is that it satisfies Prof. Tyndall's definition of a solid: "Under a given load it will compress a certain amount and stop, and compression will not be renewed without a change of condition." It has been found that the larger part of this compression takes place when the soil first receives its loading, on account of the squeezing out of the water from the soil adjacent to the surfaces of pressure. Since it is impracticable to keep the entire supporting area of a building uniformly loaded during construction, the settling of its different parts separately is always to be expected, hence the importance of using a foundation which will not be liable to injury by this unequal settlement.

A continuous foundation on such soils is liable to be broken up on this account, as was exemplified by an important public building in Chicago, which was built on a continuous platform of concrete covering the whole area of the site, for the irregular settling not only cracked the foundation itself dangerously, but also the supporting walls.

Although a steel skeleton building founded on a system of isolated spread footings possesses sufficient elasticity to allow of the first unequal settlement of its different parts, the greatest care must be exercised in figuring its foundation loads and distributing them over the soil, for otherwise an equal final settlement cannot be counted upon to relieve the great stresses that this action produces. Experience has taught that a soil load of 3,000 pounds per square foot in Chicago will cause a compression of about 2 inches, and that if this load is increased very materially a uniform settlement cannot be counted upon in the end.

It is, however, considered good practice at present to neglect the live loads in computing the clay areas, as the building does not receive them until after the greater portion of the compression of the clay has taken place. It is certainly true that by neglecting them an even final settlement cannot be depended upon, which is an objection to the practice; but it has been found in cases where they were not neglected that during the first compression the settlement proved to be dangerously unequal, because the footings in the interior of the building carry a greater percentage of live loading than those on the outside. It has been customary, however, in cases of warehouses and buildings in which heavy machinery is to be used, to make allowances for the live loadings. In the latter case the clay area is figured for double the actual weight of the machines, to allow for the tendency they have to increase the soil compression. This assumption is so unreliable that, wherever possible, the foundations of steam engines, etc., should be separated from those of the main structure. These foundations should, further, be made of elastic material, for if a jar comes on the clay, it may be transmitted through the entire building, as was proved by the excessive trembling felt in the upper stories of one of the high steel buildings in Chicago, which was situated next to the central power station of the Edison Electric Company. A description can be found in "The Engineering Record" for May 6, 1893, of the foundation method used for the engines in the Hotel Waldorf in New York. In designing a foundation system of this nature, where the live loadings are to be neglected, the lengths of the perimeters of the footings should be taken into consideration, but at present little or no attention is paid to it.

The Home Insurance Building in Chicago, besides being the pioneer skeleton structure, was the first to test the isolated foundation system, and experiments show that its maximum settlement four years after completion was 2¼ inches, while the greatest variation was but 11/16 inch. The footings used were constructed of masonry calculated by the ordinary method of offsets, and whenever two touched each other, their actions were kept distinct by means of sheet-piling driven on their line of junction. This footing design required such immense piles of stonework to spread the column or pier load over the necessary ground area, that it either rendered the basement of the building useless or else required the upper stratum of clay to be cut, which, on a soil like that of Chicago, is a very undesirable thing to do; so the drift of practice has been toward making foundations thinner by the use of steel covered with concrete.

When this method was first used in practice old rails were used on account of their cheapness, and but little attention was paid to their design. Now, however, the old rails have given place to new ones, and to heavy beams, but the importance of using a method of calculation for their design which can be proved to be theoretically correct has not as yet been felt. An explanation of the method in present use can be found in Chapter xxviii. of "The Theory and Practice of Modern Framed Structures," edited by Mr. J. B. Johnson. This theory is based on the assumptions that each course of the footing distributes its load evenly over its supporting course, and that the clay reactions are distributed over the entire base of the footing. The method employed in the calculations is either to determine the size and number of beams required for a given width of offset, or with the number and size of beams given to determine the allowable width of offset. In either case the design is made to depend upon the bending moments around the inner end of the offsets, although this is not the point of maximum bending, supposing the assumptions upon which the theory is based to be true. To show this let Figure 1 represent any beam loaded according to the assumptions of the theory.

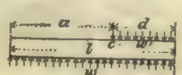


FIG. 1

Since in general footings are symmetrically loaded and designed, but one end of the structure need be considered. Let l = half the length of the course, d = half the width of the next course above, a = width of offset, which is a constant for any special case, w = the load that this course distributes per unit of length, w^1 = the load that the course above distributes per unit of width, M = bending moment at any point $x + a$ from the end of the course.

(1) $l = a + d$

(2) $M = \frac{1}{2} w (x + a)^2 - \frac{1}{2} w^1 x^2 = \frac{1}{2} wx^2 + wax - \frac{1}{2} w^1 x^2$

(3) $dM \div dx = wx + wa - w^1 x$

From calculus, $dM \div dx = o$ is the condition for finding the value of x, that will make M a maximum.

(4) $(x \div d)$ $(l - d) = a$, since $wl = w^1d = \frac{1}{2}W$. Substituting from equation (1) and solving, we get $x = d$. Therefore the point of maximum bending for a beam acting under this condition of loading is at its center; but were w^1d (say $= P$) concentrated at any point c, then the maximum bending would be at that point. Suppose a is the distance from the free end of the beam to that point, and that x is measured from c as zero. Since $P = w\ (a + d)$.

(5) $M = \frac{1}{2}\ w\ (a + x)^2 - w\ (a + d)\ x = \frac{1}{2}\ wa^2 + \frac{1}{2}\ wx^2 - wdx$.

If $x = bd$, $M = \frac{1}{2}\ wa^2 + \frac{1}{2}\ wb^2d^2 - wbd^2$. Since equation (5) holds good for points between the center of the beam and c only, the greatest value that b can have is one. Therefore the maximum value of M will be when b, and hence x, equals zero. That is to say, that the point of maximum bending is at the point of application of the concentrated load.

The following is the general theory of flexure for beams loaded as this method assumes those in the footing to be. Referring again to Figure 1, let w, w^1 and l have the same meanings as given above for this figure, but let x be measured from the free end of the beam as zero, instead of from c, as above. Let $W =$ total load on either side of the beam. Since the end and central part of the beam are differently loaded the elastic curve will be composed of two parts of different radii, therefore the equation of flexure must be applied to each separately.

$$(1)\quad E\,I\,\frac{d^2y}{dx^2} = M_1 = \frac{wx^2}{2}$$

$$(1^1)\quad E\,I\,\frac{d^2y}{dx^2} = M_2 = \frac{wx^2}{2} - \frac{w^1\,(x - a)^2}{2}$$

where $M_1 =$ bending moment at any point to the left of c, and $M_2 =$ bending moment at any point to the right of c and the left of the center. Integrating with respect to x:

$$(2)\quad E\,I\,\frac{dy}{dx} = \frac{wx^3}{6} + c_1$$

$$(2^1)\quad E\,I\,\frac{dy}{dx} = \frac{wx^3}{6} - \frac{w^1x^3}{6} + \frac{w^1ax^2}{2} - \frac{w^1a^2x}{2} + c^1.$$

From symmetry, when $x = l$ in (2^1), $dy \div dx = o$. Therefore

$$C^1 = -\frac{wl^3}{6} + \frac{w^1l^3}{6} - \frac{wal^2}{2} + \frac{w^1a^2l}{2}$$

When $x = a$ in (2) and (2^1), the two curves have a common tangent, hence the left hand members of the two equations are equal, and $c_1 = -\frac{wl^3}{6} + \frac{w^1d^3}{6}$. Integrating the second time:

$$(3)\quad EIy = \frac{wx^4}{24} + C_1\,x + C_2;$$

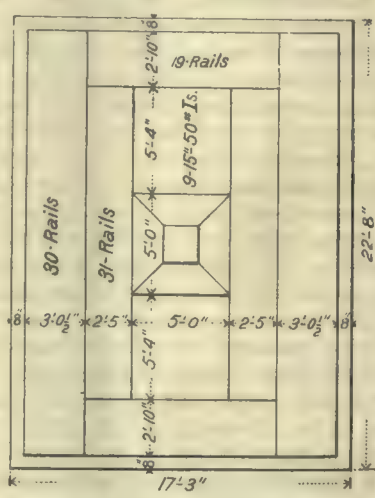
$$(3^1)\quad EIy = \frac{wx^4}{24} - \frac{w^1x^4}{24} + \frac{w^1ax^3}{6} - \frac{w^1a^2x^2}{4} - \frac{wl^2x}{6} + \frac{w^1l^3x}{6} - \frac{w^1al^2x}{2} - \frac{w^1a^2lx}{2} + C''$$

The value of C'' can be determined by the condition, that $y = o$ when $x = l$ in (3^1). When $x = a$, the y of (3) = the y of (3^1), as they are the deflections of a common point, which gives a condition for determining the value of C_2. The maximum value of y is at the free end of the beam, or where $x = o$ in (3), therefore the maximum value of

$$EIy = \frac{wl^4}{8} + \frac{w^1a^4}{24} - \frac{w^1l^2}{24}\,(3l^2 - 8al + 6a^2)$$

$$= \frac{wl^4}{8} + \frac{w^1d^3}{24}\,(d - 4l).$$

Applying this formula to the accompanying plan of the old style of footing, the deflections will be found which would exist if the assumed conditions of the method accounted for all the forces acting. The question will naturally arise here, can the above formula be applied to this case? It certainly cannot, if true results are expected; but logically it can be, for the method by which it was designed regards each course as acting independently of all other parts of the structure. First considering the upper or first course alone, which is composed of nine 15-inch 50-pound I-beams, 15 feet 8 inches long, the deflection will be 0.28 inch, supposing that the cast-iron stool uniformly distributes the column load of 1,166,000 pounds over its base, which is 5 feet square. In the second course this formula can be used, since the footing is symmetrical both in design and loading. This gives a deflection of 0.47 inch for this course alone, of 4.29 inches for the third course alone, and of 1.64 inches for the bottom course. This shows that the assumed conditions of loading cannot be correct, because the curves of flexure of courses with parallel beams are not similar, for if the concrete does not crack, all points in the same vertical line must have the same deflections. Hence the stiff I-beams of the upper course of this footing, for instance, must strengthen the more elastic rails of the third course, and thus decrease the deflection of the footing as a whole in this direction. There can be little possibility, however, of this resulting in an action similar to a rigid girder. The concrete, too, besides acting as a simple beam, must in a similar manner to the above form a combined action with the steel, and it therefore plays too important a part to have its action omitted in the calculations.



Plan of Old Style of Footing.

Notwithstanding these combined actions, appreciable deflections must exist in the footing, as a whole, therefore bending must also play too important a part in the structure to be omitted. For example, consider the effect of bending upon the distribution of loading in the second course of the above example. When bending occurs the tendency will be to concentrate its upward reaction on the edge of the first course, while concentrating its downward reaction on the center of the third course. This has the effect of overloading the outside beams of the first layer with a corresponding decrease of stress on its inside beams, and the second result has the final effect of concentrating the larger part of the column load near the center of the concrete base. This certainly suggests the possibility of the two assumptions being independent conditions, and of the method producing a design in which neither will be satisfied.

For this reason the tendency has been in recent practice to restrict the application of this method to the design of footings composed of but two courses of steel. A structure thus designed is far from being unsafe, as the results of the bending calculations prove in the following example, taken from Professor Johnson's book, but the omissions in the method, besides producing a design which is very unsatisfactory from a theoretical standpoint, must prevent the greatest possible economy being attained on the practical side. The conditions specified for the design of this problem are as follows: A column load of 1,233,300 pounds is required to be distributed over a soil which will safely carry a load of 4,000 pounds per square foot. As designed, the upper course of beams is composed of six 20-inch 80-pound I-beams, 15 feet 7 inches long, carrying a cast-iron stool 4 feet 6 inches square, and resting on a layer of thirteen 15-inch 50-pound I-beams 15 feet 5 inches long. Upon recalculating the design by using the bending moments at the center, the fiber stresses are found to increase from 16,000 pounds per square inch to 22,000 pounds in the lower beams, and to 23,600 pounds in the upper. The deflections are found to be but 1/5 inch in both cases by using the same formula as in the other example.

Therefore, from a theoretical standpoint, the structural design of a footing must primarily be based upon the conditions governing the actions of the external forces, and secondly, upon the distribution of internal loadings, which they produce, when the combined actions of the individual parts are considered. It is plain from the conclusion previously drawn from the results of investigating the deflections of footings designed by the present methods, that a solution which will fulfill these conditions must be based upon the theory of flexure of beams.

Complex as these conditions are, by confining them to the design of a footing composed of but two layers of beams and by introducing the further condition, that the beams in the lower layer must be so designed that no appreciable bending will occur in them, the calculations prove to be of sufficient simplicity to be of practical use, while producing a design far more economical than that resulting from the method of calculation in present use for the same requirements. The bending restriction for the lower layer simplifies the problem by preventing complex warping occurring in the horizontal planes.

Warping will not change the assumed condition of clay loading, however, for it has been proved in several ways, that the soils of both Chicago and New York will flow when unequally loaded. For instance, it has been found in Chicago that unless the walls of the ejector-pits under heavy buildings are anchored down, that during the clay's compression they will be forced up a greater amount than the building settles; and an instance which proves this for New York soil has already been mentioned in connection with the discussion of carrying foundations to bed rock.

(To be Continued.)

FIREPROOF STABLE CONSTRUCTION.

The stables of the Gottfried Brewing Company in Alexander Street, Chicago, are 100 x 175 feet in plan, three stories in height, and of fireproof construction with solid concrete floors. The exterior brick walls have a uniform thickness of 13 inches, except where pilasters or buttresses 4 to 8 inches thick are provided to act as piers for the ends of the floor beams. The first tier of floor beams is carried by 49 riveted steel interior columns set on concrete piers 8 feet square on the bottom, 4 feet square on top, and averaging about 6 feet high. The upper floors are carried by 80 cast-iron columns in each story. Some of these columns rest on the tops of the first floor columns and some of them are intermediately spaced and supported on longitudinal and transverse plate girders carried by the first tier of columns. There is a row of longitudinal columns parallel to each side wall of the building. One row is about 4 feet from one wall, and the second row is 2 feet from the other wall. The transverse floor beams of each story overhang these columns and reach to the walls, but are clear of them, thus carrying the whole of the floor load independently of the brickwork in all but the end panels. In the end panels the longitudinal floor beams, about 25 feet long, have their outer ends carried by the wall buttresses.

The two upper floors are each formed of concrete arches of 6 to 10 feet span, sprung between steel I-beam joists parallel to the transverse floor beams. Each end wall of the building therefore carries only one-half of the adjacent floor panel—equivalent to a floor surface of about 13 feet wide. The metal framework

and the foundations are proportioned to carry an additional story if, at some future time, it is decided to add to the present structure. The general design and leading dimensions of the building are shown in Figures 1 and 2, which are respectively longitudinal and transverse sectional elevations. The continuous footing course and the foundation piers here shown are composed of concrete made of one part AA, Chicago Portland cement, six parts sand and four parts stone. The first floor has a cement pavement 8 inches thick. The second and third floors are of concrete made one part AA. Portland cement to eight parts aggregate. The arches have a minimum thickness of about 5 inches at the crown, and are made about 3 feet deep at the skew backs so as to enclose solidly all of the floor beams except the lower flange surface. Eighteen hundred barrels of cement were used in these two floors. The gutters were formed when the floors were made, and were lined with sheet lead. The floor surface is covered with asphalt 1½ inches thick.

The dimensions and arrangement of columns, beams, girders and joists are shown in Figures 3 and 4, which are respectively longitudinal and transverse sections of the framework. A detail of one of the longitudinal plate girders showing its connections to the tops of the first story columns is given in Figure 7, which is an enlargement of part of one of the middle pannels of Figure 3. The stalls on the second floor are reached by an inclined plane shown by dotted lines in Figure 2. The details of stall framing and fitting are shown in Figure 5. The ground arrangement of the stable is shown in Figure 6.

The stalls are arranged in sixteen groups, all of which have eight stalls each, except some

FIGURE 1.—LONGITUDINAL SECTION OF STABLES.

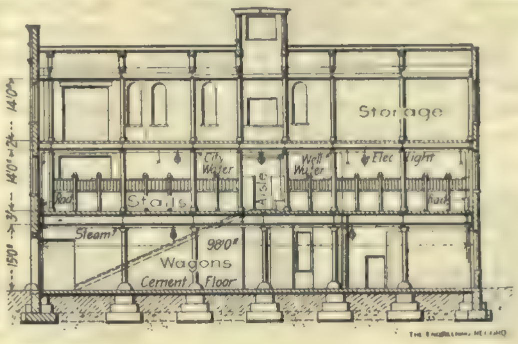


FIGURE 2.—CROSS SECTION.

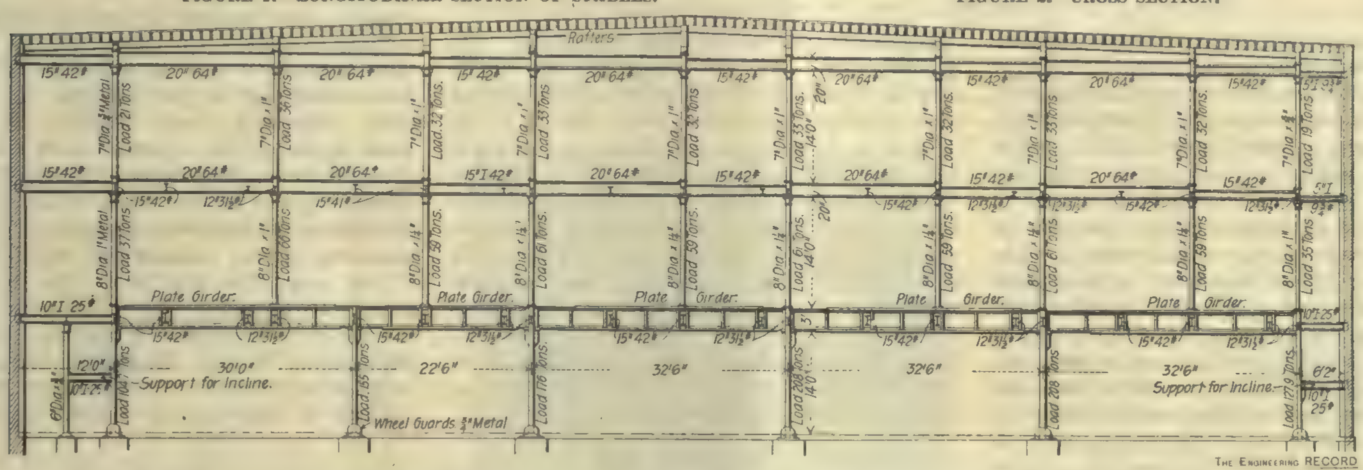


FIGURE 3.—THE LONGITUDINAL ARRANGEMENT OF COLUMNS AND GIRDERS.

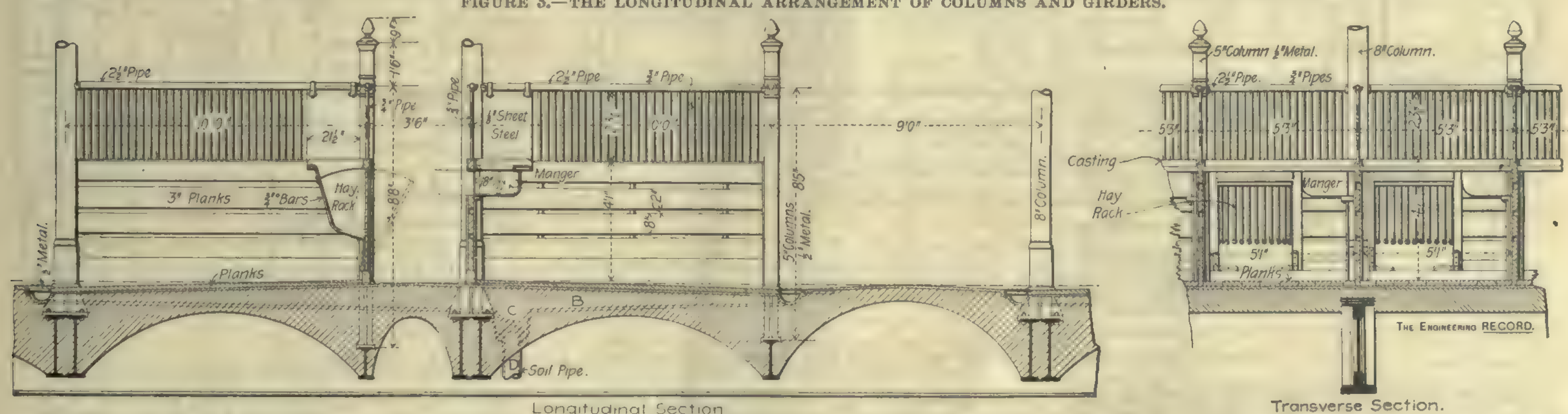


FIGURE 5.—DETAILS OF STALL FRAMING AND FITTING.

FIGURE 4.—TRANSVERSE ARRANGEMENT OF COLUMNS AND GIRDERS.

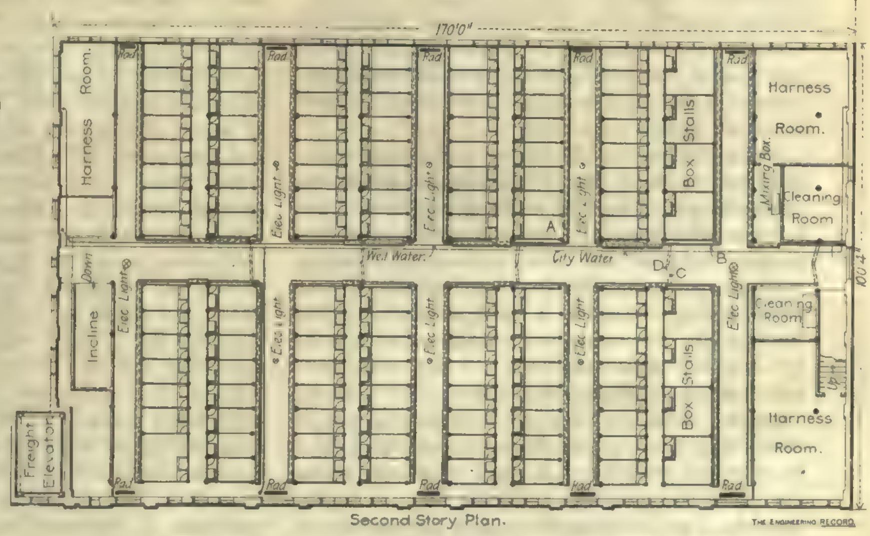


FIGURE 6.—ARRANGEMENT OF THE STALLS AND HARNESS ROOMS.

STABLES OF THE GOTTFRIED BREWING COMPANY, CHICAGO.

THE WILLIAM GRIESSER ENGINEERING COMPANY, ARCHITECTS.

that are divided to give nine box stalls 10 feet square. Two groups of stalls make a block 26 x 42 feet, with a gangway and entrance 8 feet wide on each side, and a feeding passageway 3½ feet wide extending from one gangway to another between the heads of the stalls. A 10-foot aisle extending longitudinally through the center of the building serves as a general passageway and means of entrance and exit for feed trucks. Each stall is 10 feet by 5 feet 3 inches center dimensions. The floor is made tight of 2¾-inch plank, removable in halves, and is pitched 1 in 40 to a grated gutter across the rear or open end. The partitions between the stalls are 4 feet high, made of 3-inch oak plank with three longitudinal spaces 2 inches wide between them, as shown in Figure 5. Above the plank the partition is extended to a total height of 6 feet 7 inches by a railing of ¾-inch vertical gas pipe 3 inches apart, which continues across the front of the stall.

The galvanized cast-iron mangers are pivoted on vertical pins so as to swing outside the stall into the passage to the position indicated by the dotted lines, when they are filled. The galvanized iron hay racks are similarly pivoted to swing out and be filled, but are mounted on horizontal pivots, as shown in Figure 5. The partitions are framed to 5-inch cast-iron posts and all iron work about the stalls is galvanized.

A 7-inch gutter 4 inches deep, A Figures 5 and 6, was formed in the concrete across each open end of the stalls, i. e., one gutter each side of the gangway between the blocks of stalls, or 17 gutters in all, each about 40 feet long and transverse to the axis of the building. These gutters are connected together in pans by longitudinal cross gutters, B, 24 feet long, along the edges of the main aisle. These gutters pitch to a central point, and discharge thence through covered channels C to trapped soil pipes D, each of which drains 32 stalls.

Besides stalls for 125 horses, the second story contains rooms for storing and cleaning harness and saddlery. The first story is principally devoted to wagon storage, but has several separate rooms provided for wagon washing, buggy washing and blanket drying, besides a tool room, water closet and a room with foot baths for horses. The upper story is intended wholly for hay and grain storage. At one end there are grain bins with a capacity of 5,400 bushels. They are built with hopper bottoms and chutes delivering to the stable floor, and are filled by a mechanical conveyor. A large platform elevator takes the wagons to the top floor to be unloaded. The building is lighted by electricity, heated by steam radiators, and piped with hot and cold water. The William Griesser Engineering Company was the architect of the building, Mr. Carl Binder and Messrs. Stormsen & Blome were respectively contractors for iron work and for concrete and asphalt. All are Chicago firms.

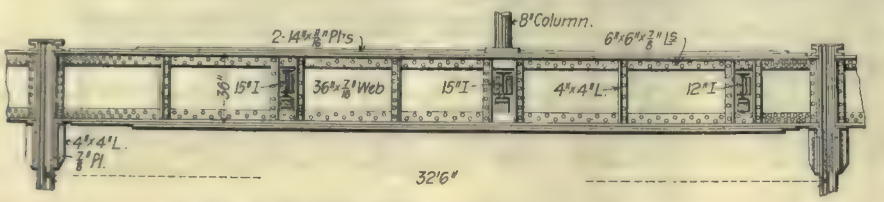


FIGURE 7.—CONNECTION OF GIRDERS AND COLUMNS.

VENTILATION AND HEATING OF POST-OFFICE, AMSTERDAM, HOLLAND.

A new post-office building has recently been completed in Amsterdam, Holland, presenting in its heating and ventilating plant some interesting points of foreign design and construction. An indirect hot-blast apparatus in the basement of the building delivers to certain of the rooms a heated supply of fresh air. The remaining rooms of the building are for the greater part given up to purposes of storage or such uses as do not require special provision for fresh air, and the building is equipped throughout with direct steam radiators. The quantity of hot air supplied the building is intended to be sufficient to change the volume twice every hour, and it is delivered at a temperature calculated to maintain an internal temperature of 20 degrees centigrade (68 degrees Fahrenheit) when the temperature outside the building is 5 degrees centigrade below zero (23 degrees Fahrenheit above zero). The minimum external temperature in Amsterdam, however, is 15 degrees centigrade below zero (5 degrees Fahrenheit above zero), so that the direct radiation is depended upon to supplement the hot-blast apparatus during the coldest days.

The post-office is a three-story and basement building, somewhat trapezoidal in plan, and measuring about 250 feet in extreme length and 110 feet in width. The general outline of the building may be seen in the accompanying figures, which show the various rooms in basement and ground floor. The main entrance is in about the center of the longer dimension and opens into a vestibule with a stairway on either side. The vestibule runs to a large central space, as shown on the ground-floor plan, extending through the building to the roof, where it is lighted by a glass skylight, supported on its four sides by two arcades, one above the other on the first and second floors respectively. The rooms surrounding this space on the two floors mentioned are thus lighted from the inside, as well as from without, in the manner which is often to be seen in such buildings in this country. In addition to this large enclosure, the rooms themselves may be said to be quite lofty, the inside height for the ground, first and top floors being respectively about 21 feet, 17 feet 8 inches and 16 feet 8 inches. The large sizes of the rooms, according to the designers, made it unnecessary to change the air within the rooms more than twice an hour.

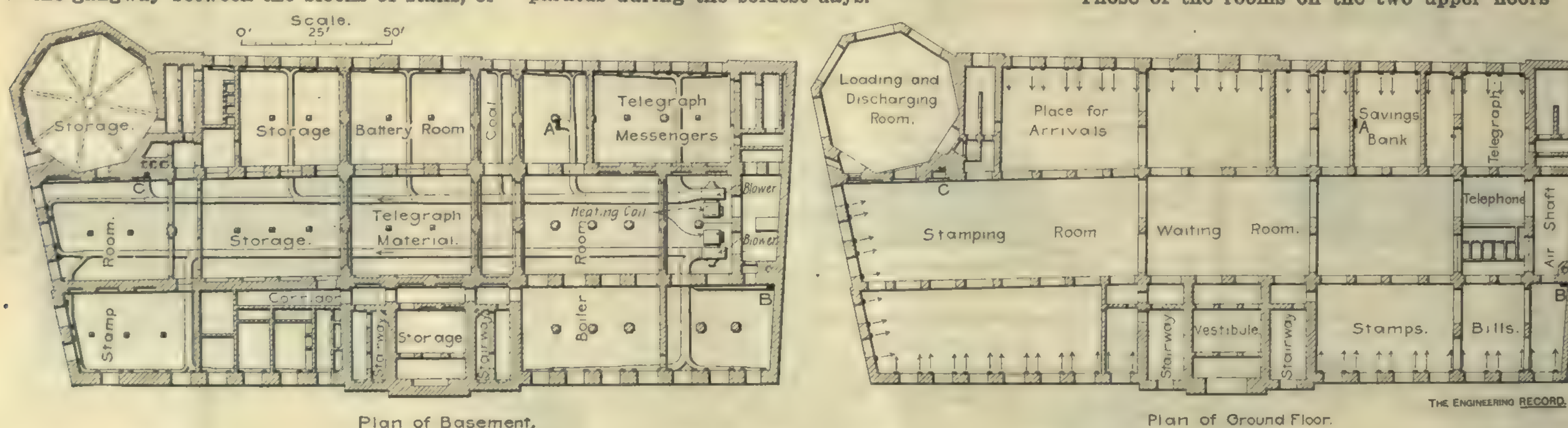
The rooms surrounding the central space on the ground floor are devoted to the departments usually to be seen in the modern large post-office, including at one end booths for telephone and telegraph service. The rooms on the two floors above are in general smaller than the ground-floor apartments, but a few large rooms are set apart for the telegraph and signal service, and for the use of letter carriers. The basement is divided up as shown in the figure, and includes besides a boiler plant, machine room and air chamber with hot-blast apparatus, several storage rooms for telegraph apparatus and materials, and for postage stamps and mail.

Air enters the building at one end, descending directly to the basement in a shaft which indents one end of the structure, and which measures about 12.5 feet by 29 feet in cross section. Near the base of the shaft, there are two sets of indirect apparatus, as shown in the basement plan, each heating the air for a separate blower. The two blowers are mounted on separate shafts lying in the same line, and are each driven by a direct connected vertical steam engine. Two systems of ducts at the basement ceiling, extending the length of the building with branches at various points to the outside walls, carry all the air heated by the indirect coils. The ends of the branches, as will be seen, divide at the exterior walls, running a short distance along them in either direction. From the top of the ducts, short flues rise directly to the rooms on the ground floor, and discharge the air through side registers, about 10 feet above the floor level. The flues being located at the outside walls discharge towards the center of the building, and the velocity of the air flow through the register faces is said to range between 500 and 600 feet per minute.

Those of the rooms on the two upper floors that also receive fresh air are supplied in a similar manner. At the points marked A, B, and C on the two drawings, flues rise from the top of the basement ducts, passing through the ground story to the ceiling of the first story, where each connects with a lateral ceiling duct. Short vertical flues drop from the under side of this for the supply of the first story rooms, and others pass from the top into the rooms of the second story. The ends of the flues are closed, and are of such a length as to deliver air through side registers about 10 feet above the floor in both stories.

Most of the air in its passage out of the building diffuses into the central court already described, and rises to the skylight roof, where vents are provided.

The building was erected from the plans of Mr. C. M. Peters, architect, of Amsterdam. The hot-blast heating and ventilating system was designed and the apparatus furnished by the Sturtevant Engineering Company, of London, England, the European representatives of the B. F. Sturtevant Company, of Boston, Mass.

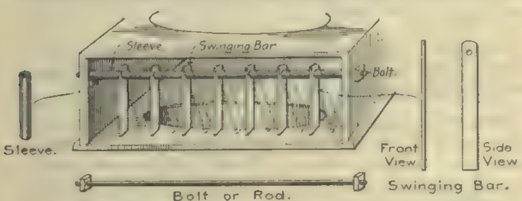


FLOOR PLANS SHOWING HEATING DETAILS OF THE POST OFFICE BUILDING AT AMSTERDAM, HOLLAND.

NOTES.

An Important Contract for which bids are now being received by Major J. H. Willard, Corps of Engineers, U. S. A., who is in charge of the U. S. Engineer Office at Vicksburg, Miss., has for its object the construction of a new outlet into the Mississippi of the various streams forming the Yazoo system, and the restoration of the Vicksburg harbor. The work contemplates about 7,500,000 yards of earth excavation from a point about 9.8 miles above the present entrance of the Yazoo into the Mississippi to deep water in the latter river at Kleinston Landing. The route is about 9.31 miles long, and the channel is to have a bottom width of 98 feet with slopes of about one on five.

A New Sewer Inlet, shown in the accompanying cut, consists of a horizontal rod of iron fastened into the side of the inlet 3 or 4 inches from the mouth, where the opening is larger than at the curb line. Hung from the rod are



a number of flat bars separated by sleeves made of gas pipe. The bars are usually made of 1¼ x ¼-inch iron or steel and swing freely, so as to offer but little obstruction to the flow of water while preventing rubbish from entering the catch basins. These inlets are made by Mr. Ewald Over, of Indianapolis, who has applied for a patent for the device.

A Hoisting Engine for the use of erectors has recently been placed on the market by Thomas Carlin's Sons, Allegheny, Pa., which contains a number of modifications of previous patterns. It is a four-spool, light, compact engine arranged with protected driving gear in the middle of the two main shafts, each of which ends in a spool specially designed to reduce to a minimum the wear of the rope and keep it from climbing or binding. Each spool is thrown in or out of gear independently. Special provision is made for oiling the spools and bearings of the shafts, and the latter have their caps set at an angle so that the center of the solid bearings is in the line of greatest pressure. The connecting rods have solid forged steel wrist-pin bearings with screw and wedge adjustments. The engine has two 8 x 10-inch cylinders, is mounted on a deep and narrow bedplate, and weighs only 6,800 pounds complete.

Anemometer Calibration and the great care with which Pitot tubes must be used were briefly discussed by Prof. R. C. Carpenter, of Cornell University, at the recent meeting of the American Society of Heating and Ventilating Engineers. He said the Pitot tube was often unreliable, citing an instance where a slight change in the nozzle caused a change of 20 per cent. in the coefficient of the tube. A method he used to calibrate anemometers was to pass air through a 2 x 2-foot box, 15 or 20 feet long, heating the air in its passage by a 2-inch steam pipe. The condensation occurring in the pipe was determined, and a measure was thus obtained of the heat supplied the air. The rise in the temperature of the air was read from two thermometers, one at each end of the box, and knowing the heat imparted to the air from the steam, sufficient data were then at hand for calculating the total quantity of air. The time of the test and the cross-section of the air flow finally enabled the velocity to be determined.

The Juniors of the American Society of Mechanical Engineers, like those of the American Society of Civil Engineers, are now receiving special attention, with a view to interesting them more closely in the work of the society. At a special meeting held March 7 a committee appointed to suggest means of bringing about this end, recommended holding special monthly meetings of Juniors during the autumn, winter and spring, at which papers would be presented and discussed. The committee suggested sending an abstract of the paper and discussion to the entire membership, and allowing any one who so desired to borrow a full draft of the paper and discussion. A recommendation was also made to carry into effect the practice of the Institution of Civil Engineers of printing in full in the "Transactions" any of the papers which were deemed of sufficient merit. This report was accepted and the committee requested to carry out its recommendations, the first meeting to be held April 4. The committee consisted of R. C. Ball, chairman; F. E. Frothingham, secretary; Percy Allen, A. L. Rice and Prof. F. R. Hutton.

The Electric Hoisting Engine shown in the accompanying cut is not a steam hoist with an electric motor attachment, but a new machine throughout. It is built for high, medium and low hoisting speeds, and is entirely self-contained, being shipped in one piece. The bearings are solid with the heavy side frames, and each has a replacable phosphor-bronze bushing. The side frames are faced and bored for the bearings and distance bars at one setting in order to insure true alignment. The machine is

built to gigs and templates throughout, and the work is in no way dependent on the mechanics' measurements. In assembling the parts the armature is located by its shaft in the bearings, and the fields are afterward adjusted accurately to the armature and fastened rigidly to the distance bars. For this reason the machine is ready for use when received. It is operated by a friction clutch so constructed as to cause no strains tending to spread the frames. A differential brake requiring little force to be exerted in holding and lowering the load has been provided to assist the engineer. Each bearing has its own oil reservoir, and these devices have received careful attention. The hoist is made by the C. W. Hunt Company, West New Brighton, N. Y.

PERSONAL AND OBITUARY NOTES.

Mr. W. S. Pugh has been elected borough engineer of Pottsville, Pa.

Mr. R. E. Neumeyer has been re-elected borough engineer of Bethlehem, Pa.

Mr. George A. Carpenter has been re-elected city engineer of Pawtucket, R. I.

Mr. C. Cameron Corson has been chosen borough engineer of Norristown, Pa

Mr. J. B Davidson has resigned the office of city engineer of Kenosha, Wis., which he has held for several years.

Mr. John Brazier has been elected superintendent of the Alliance, Ohio, water-works, with which he has been connected for some time.

Mr. Edward B. Guthrie, M. Am. Soc. C. E., and Mr. George C. Diehl have formed a partnership and opened offices at Ellicott Square, Buffalo, N. Y.

Mr. H. S. Williams has been elected borough engineer of Phoenixville, Pa., and Mr. B. H. Willauer has been elected superintendent of water-works.

Messrs. William H. Bryan and Henry H. Humphrey, consulting mechanical and electrical engineers, St. Louis, have moved their office to more commodious quarters at 706-708 Lincoln Trust Building.

The passage of the Navy Personnel bill has promoted the following officers to the rank of rear admiral: George W. Melville, president Am. Soc. M. E.; M. T. Endicott, M. Am. Soc. C. E., and Philip Hichborn.

Mr. Ross Morgan, who was until lately engaged on the construction of the Blue Lakes Water Company's famous power plant, has opened an office as hydraulic and mining engineer at Sutter Creek, Cal.

Messrs. Gardner C. Sims and W. S. Aldrich, respectively chief engineer and passed assistant engineer in the navy during the war with Spain, gave an interesting account of their experience on board the repair ship Vulcan, at a special meeting of the American Society of Mechanical Engineers on March 7.

Mr. Herbert Steward, Assoc. Am. Soc. C. E., one of the leading New York contractors, died in that city on March 5. He was engaged on the construction of many notable works, including the Sixth Avenue elevated line in New York, the Washington arch bridge over the Harlem River, and the 155th Street viaduct.

Major T. W. Symons, M. Am. Soc. C. E., Corps of Engineers, U. S. A.; Gen. Francis V. Greene, M. Am. Soc. C. E., president of the Barber Asphalt Paving Company; John T. Scatcherd, of Buffalo; G. E. Green, of Binghamton, and Frank S. Witherbee, of New York, have been appointed by Governor Roosevelt of New York an advisory board to the State Engineer and the Superintendent of Public Works, to investigate the advisability of completing the improvements of the State canals and of turning them over to the national government, and also to ascertain the extent to which railways have taken the place of canals.

Mr. William Ledyard Cathcart has been appointed adjunct professor of mechanical engineering at Columbia University, and will begin his duties in this office in October. He was graduated from the Naval Academy in 1875, and served on sea and shore duty until January, 1891, at which time he had held the rank of past assistant engineer for a number of years. After becoming interested in a particular line of manufacture, he resigned from the navy to pursue the work of his choice. He received an appointment in 1897 from Mr. William H. Webb, founder of Webb's Academy, as instructor in marine engineering, but on the breaking out of the war he volunteered, and was appointed chief engineer on duty at the Bureau of Steam Engineering at Washington. He was honorably discharged in October, 1898.

Dr. J. L. Bloomen, who takes the place of Mr. David L. Wildrick as chemist and superintendent of the Nitro Powder Company of Kingston, N. Y., is a graduate of the Stockholm Atheneum and the Military Academy of Carlberg. He came to this country after serving for a time in the Swedish army, and from 1889 to 1894 was with the American Forcite Powder Company as chief chemist or superintendent. He left the company to occupy the chair of physics at Columbia University, Washington, and about the same time was retained as chemist by several gas companies, and was also engaged in making cream of tartar and organic acids. While at the university he invented Jovite powder and built the works for making it which are now owned by the United States. After leaving the university he visited the Pacific Coast as an expert on explosives, and lately has been chief chemist of the Laflin & Rand Powder Company.

CONTRACTING NEWS

OF SPECIAL INTEREST TO

CONTRACTORS, BUILDERS, ENGINEERS, AND MANUFACTURERS

OF ENGINEERING AND BUILDING SUPPLIES.

For Proposals see pages xi, xii and 344.

SUNDRY CIVIL EXPENSE APPROPRIATIONS.

The following appropriations have been made for the sundry civil expenses of the U. S. Government, as published in Public Document No. 188. Such items as do not admit of the classification below will be found under their respective heads elsewhere:

Buildings, Including Lighthouses.

Altoona, Pa.—Public building, including site, $50,000.

Buffalo, N. Y.—Postoffice, $231,000.

Ellis Island, N. Y.—Four towers, main building, $50,000; main hospital, $150,000; outbuilding, $33,340; boiler house, $50,000; closed porch, $22,000; covered walks, $25,000; contingencies, etc., $390,850.

Newport News, Va.—Site and building for Custom House and Postoffice, $35,000.

Philadelphia, Pa.—Continuation of mint, $600,000.

Portland, Ore.—Custom House, $200,000.

St. Paul, Minn.—Postoffice, etc., $250,000.

San Francisco, Cal.—Postoffice, $500,000.

San Francisco, Cal.—Repair of branch mint, $45,000.

Buildings—Indianapolis, Ind., $250,000; Fitchburg, Mass., $50,000; Brunswick, Ga., $25,000; Elgin, Ill., $50,000; Kansas City, Kan., $50,000; Lawrence, Mass., $50,000; Jamestown, N. Y., $37,500; New Iberia, La., $25,000; Tampa, Fla., $50,000; Rome, N. Y., $25,000; Elmira, N. Y., $50,000; Joliet, Ill., $50,000; New Brunswick, N. J., $50,000; Eau Claire, Wis., $50,000; Elizabeth City, N. C., $25,000; Newport, Vt., $25,000; Monmouth, Ill., $23,500; Oskaloosa, Ia., $25,000; Creston, Ia., $25,000; Clinton, Ia., $50,000; Bristol, Tenn., $25,000; Streator, Ill., $25,000; Joplin, Mo., $25,000; Fergus Falls, Minn., $37,500; Aberdeen, S. D., $43,500; Abilene, Texas, $37,500; New Brighton, Pa., $37,500; Blair, Neb., $21,500; Oakland, Cal., $75,000; Beaumont, Tex., $37,500; Wilkesbarre, Pa., $50,000; Butte, Mont., $75,000; Salt Lake City, Utah, $75,000; Seattle, Wash., $75,000; Annapolis, Md., $50,000; St. Cloud, Minn., $25,000; Stockton, Cal., $40,950; Janesville, Wis., $25,000; Anniston, Ala., $25,000; Salem, Ore., $50,000; Norwich, Conn., $50,000; Winston, N. C., $25,000; Leadville, Col., $25,000; Lockport, N. Y., $25,000; Freeport, Ill., $37,500; Menominee, Mich., $25,000.

Omaha, Neb.—Court house and postoffice, $150,000.

Minneapolis, Minn.—Postoffice, $55,000.

Macon, Ga.—Postoffice, $58,000.

Hot Springs, Ark.—Postoffice, $39,000.

Dubuque, Ia.—Enlarging Custom House, $50,000.

Springfield, Mass.—Postoffice, enlarging, $20,000.

Columbus, Ga.—Postoffice, enlarging, $50,000.

Jackson, Miss.—Court house, addition, $31,000.

Cleveland, O.—Postoffice and site, $300,000.

Gulf—Quarantine station, $36,000.

Port Townsend, Wash.—Quarantine station, $26,200.

Pollock Rip Shoals, Mass.—Lighthouse, etc., $80,000.

Tompkinsville, Staten Island, N. Y.—Sea wall, etc., $25,000.

Lighthouse Board, depot for Sixth Lighthouse District, $35,000.

Buffalo, N. Y.—Enlarging lighthouse, $50,000.

Atlanta, Ga.—Penitentiary, $500,000, direction of Attorney-General.

Marion, Ind.—Various buildings at soldiers' home, $22,500.

Danville, Ind.—Four barracks, houses, chapels, other buildings, water-works, heating, sewerage, in all, $737,500.

Harbor and River Improvement.

Humboldt, Cal.—Harbor and bay, $143,115.

Savannah, Ga.—Harbor, $400,000.

Cumberland Sound, Ga., and Fla.—$400,000.

Boston, Mass.—Harbor, $163,750.

Buffalo, N. Y.—Harbor, $485,498.

Delaware Bay, Del.—Harbor of refuge, $377,000.

Winyaw Bay, S. C.—Harbor, $58,500

Sabine Pass, Texas—Harbor, $264,000.

Cleveland, O.—Harbor, $100,000.

Duluth, Minn., and Superior, Wis.—Harbor, $300,000.

Oakland, Cal.—Harbor, $133,000.

San Pedro, Cal.—Breakwater, $200,000.

Grays Harbor, Wash.—Harbor and bar entrance, $285,000.

Bayou Plaquemine, La.—Improvement, $400,000.

Ohio River.—Davis Island Dam—Dams numbered 2, 3, 4 and 5, $400,000.

Illinois and Mississippi Canal, $700,000.

Mississippi River—Improvement from Ohio River to Missouri River, $673,333.33; improvement from Missouri River to St. Paul, Minn., $826,666.67; improvement from head of the passes to Ohio River, $2,583,333.

Missouri River—Improvement from mouth to Sioux City, Ia., $200,000.

WATER.

Windsor, N. Y.—Bids are wanted March 23 for a gravity system of water-works, as advertised in "The Engineering Record."

Winnipeg, Man.—Bids are wanted April 3 for furnishing certain water-works supplies, as advertised in "The Engineering Record."

Washington, D. C.—Bids are wanted April 1 for furnishing fire hydrants, as advertised in "The Engineering Record."

Boston, Mass.—Bids are wanted March 14 for furnishing, during 1899, 1,350,000 lbs. of small iron castings. John R. Murphy, Water Commr.

Cullman, Ala.—Bids are wanted April 1 for a water-works and electric light system. W. H. Jones, City Clk.

Darlington, Okla.—See "Government Work."

Brooklyn, N. Y.—Bids are wanted March 23 for laying water-mains in several streets and avenues, and in Canarsie Road and Rockaway Parkway.

Dillon, S. C.—A. B. Jordan, writes that plans are being considered and estimates made for the establishment of a system of water-works; artesian wells to be used. Dr. J. H. David is interested.

Rome, N. Y.—Charles C. Hopkins writes that bills relating to amendments to the city charter for paving and for an increased water supply are before the State Legislature.

Carthage, N. Y.—T. J. Quinn, Supt. of Water-Works, writes that about 1,800 ft. of water main extension will be made, but estimates have not yet been prepared.

Springboro, Pa.—It has been voted to bond for a water plant. This is a correction of item under Springford, Pa., in our issue of March 4.

Ward, S. D.—It is stated that Chas. Bowick contemplates establishing an electric light and water-works plant in the spring.

Collierville, Tenn.—A bill has passed the Legislature authorizing the issue of bonds for water-works.

Wykoff, Minn.—It is stated that the question of water-works construction will be voted upon at the election to be held March 14.

Napoleon, O.—It is stated that an election has been called to vote on the issue of $15,000 water and light bonds.

Rockwell, Ia.—Press reports state that the proposition to construct water-works and an electric light plant is under consideration.

Martins Ferry, O.—See "Sewerage and Sewage Disposal."

Watsonville, Cal.—Press reports state that Engineer V. T. McCray has submitted a report to the City Trustees, in which he estimates the cost of a sewer system at $40,000, and a water system at $50,000 or $55,000.

Wadesboro, N. C.—The Council is stated to be seeking authority to issue $30,000 water and light bonds.

Sacramento, Cal.—A bill has passed the Assembly authorizing the Secretary of State to bore a well, furnish and set stand pipes, tanks, filter and lay pipes in the Capitol grounds, and appropriating $7,500 therefor.

Massena, N. Y.—The St. Lawrence Water Co. has been incorporated with a capital of $30,000. Directors: Thomas H. Gillespie, of 526 Fifth Ave., New York City, and Robert Swan, of Massena.

Seattle, Wash.—Local press reports state that new bids will probably be received about April 20 for the Cedar River Water-Works contracts.

Schenectady, N. Y.—The Legislature has passed the bill authorizing the issue of an additional $15,000 bonds for water mains.

Laporte, Ind.—Press reports state that the Council has decided to erect a pumping station on the Kankakee River, five miles from the city. The Water-Works Committee has been instructed to advertise for bids for water mains.

Ruthven, Ia.—The question of issuing water bonds is under consideration.

Whitehall, Ill.—Press reports state that the city has awarded to the Whitehall Electric Co. a contract for supplying 80,000 gallons of water a day for 10 years. Amount of contract, $28,000.

Penngrove, N. J.—The matter of constructing water-works is under consideration.

Laurel, Del.—The citizens voted on March 1 for the construction of water-works.

Appleton, Minn.—At a recent mass meeting the citizens adopted a resolution in favor of establishing a system of water-works for fire protection.

Cripple Creek, Colo.—The City Council is stated to have granted a franchise to H. R. Ingersoll, of Denver, for the construction of a new water-works system.

Tupper Lake, N. Y.—Articles of incorporation have been filed by the Tupper Lake Water Co., which proposes to supply the town of Altamont with water. Capital stock, $10,000. The directors for the first year are James L. Jacobs, P. H. McCarthy, C. L. King and others, all of Tupper Lake.

Tarboro, N. C.—Bills have been passed providing for the construction of water-works, sewers and electric lights.

Pendleton, Ind.—Articles of incorporation have been filed by the Pendleton Water and Light Co. Capital stock, $5,000. Shareholders, John H. Brown, Geo. Mayer and B. O. Mayer, all of Chicago.

Williamstown, N. J.—It is stated that the construction of water-works and electric lights is under consideration.

Lisbon, O.—The citizens propose to vote on the question of issuing $20,000 bonds to purchase a site for the water-works pumping station and improve the system.

Waterbury, Ct.—It is stated that bids are wanted March 14 for laying 1,750 ft. of 12, 16 and 20-in. water pipe; also for 3,000 ft. of 8 to 15-inch pipe sewers. R. A. Cairns, City Engr.

South Bend, Ind.—It is stated that bids are wanted March 29 for furnishing and installing an 8,000,000 gal. pump. W. H. Rosecrans, City Engr.

Danville, Ill.—See "Sundry Civil Expense Appropriations."

Humphrey, Neb.—R. P. Drake, Village Clk., writes that it was voted on Feb. 28 to issue $5,600 bonds for a water system.

Marianna, Ark.—Bids will be asked within 60 days for the construction of water-works and an electric light plant to cost $12,500 to $15,000. W. S. McClintock, Secy. Bd. of Improvements. Owen Ford, of St. Louis, Engr. in Charge.

Raleigh, N. C.—The House and Senate have passed bills appropriating $7,500 for water-works at the State University.

East Highland, Cal.—Articles of incorporation have been filed by the Cram & Van Lewen Water Co. Capital stock, $144,000. Directors: L. F. Cram, A. M. Aplin, A. F. H. Cornelius, of East Highland, and others.

Baltimore, Md.—Bids are wanted March 15 for installing the auxiliary piping, etc., complete for the Mt. Royal pumping station. William L. Kenly, Ch. Engr. Water Bd.

Mena, Ark.—A correspondent writes that bids will probably be asked in about 30 days for the construction of water-works, estimated to cost $25,000. Robertson & Smith, Engrs. in Charge.

Jackson, O.—M. D. Jones, City Clk., writes that it was voted on March 6 to ratify the water-works franchise recently granted to S. C. Boyer and James Kinney, Jr.

Seaford, Del.—At a recent election it was voted to construct water-works.

Attleboro, Mass.—The citizens are stated to have voted March 6 to issue $30,000 water supply bonds and $15,000 bonds for the purchase of a new pump.

Meadville, Pa.—The Council on March 3 decided to ask for bids for necessary water pipes and hydrants to be used on streets to be repaired.

Oconomowoc, Wis.—The Common Council has decided in favor of bonding to the amount of $42,000 for the establishment of water-works.

Durand, Mich.—A bill has passed the Senate authorizing the issue of $30,000 bonds for the purchase of water-works.

Atlanta, Ga.—An election will be held April 12 to vote on the issue of $200,000 water bonds.

Pueblo, Colo.—Bids are wanted March 20 for 1,400 ft. of 4 and 6-in. cast iron pipe, gate valves, etc. H. Work, Supt. Colorado State Insane Asylum.

Philadelphia, Pa.—Bids are wanted April 11 for 2 pumping engines for Roxborough Station; pump and valves, etc., for engines Nos. 2 and 3, at Spring Garden Station. Thomas M. Thompson, Dir. Dept. Pub. Wks.

South Bend, Ind.—Bids are wanted March 29 by the Board of Water-Works Trustees for an 8,000,000-gal. pumping engine.

Washington, D. C.—See "Government Work."

Windsor, N. Y.—The following bids for about 300 tons of pipe and 5 tons of special castings were opened Feb. 27 by the Board of Village Trustees, as advertised in "The Engineering Record." J. F. Witmer, Engr., Buffalo, N. Y.: *a*, price per ton for 8, 6 and 4-in. pipe; *b*, price per pound for special castings: Addyston Pipe & Steel Co., Cincinnati, O., 8 and 6-in. pipe, $24.90 per ton; 4-in. pipe, $26.90; *b*, 2 cts. Warren Foundry & Machine Co., 160 B'way, N. Y. City, *a*, $21; *b*, 2⅛ cts. American Pipe & Foundry Co., Chattanooga, Tenn., *a*, $22.40; *b*, 2 cts. Chas. Millar & Sons, Utica, N. Y., *a*, $19.65; *b*, 2 cts. R. D. Wood & Co., Philadelphia, Pa., *a*, $20.90; *b*, 2 cts. Fox & Engel, 253 B'way, N. Y. City, 8 and 6-in. pipe, $18.40; 4-in. pipe, $20.20; *b*, 1.97 cts. M. J. Drummond & Co., 192 B'way, N. Y. City, *a*, $19.60; *b*, 2 cts.

Amsterdam, N. Y.—S. E. Babcock, Consulting Engineer of Little Falls, N. Y., writes that the following bids were opened March 1 by the Board of Water Commissioners for the construction of an extension to the present water-works system; the prices given are for laying pipe, exclusive of cost of pipe, valves, etc., which are furnished by the city: *a*, Conduit Section No. 1 includes the laying of 3,508 ft. of 24-in. iron conduit, 228 ft. of 20, 12 and 6-in. iron pipe, 3,000 yds. of excavation, also rubble masonry, gate house, etc.; *b*, Conduit Section No. 2 includes the laying of 10,988 ft. of 36 to 18-in. iron conduit, setting valve, rock excavation, rubble masonry, etc. M. R. Grannis, Syracuse, N. Y., *a*, $8,067.58; *b*, $8,479.44. A. Costa, Orange, N. J., *a*, $9,691.54; *b*, $10,211.54. Troy Public Works Co., Utica, N. Y., *a*, $8,349.98; *b*, $10,473.94. T. Henry Dumary, Albany, N. Y., *a*, $11,344.50; *b*, $16,219.60. Geo. W. Van Vranken, Schenectady, N. Y., *a*, $11,340.45. Albert M. Banker, Gloversville, N. Y., *a*, $10,187.60; *b*, $24,548.70. Halliman Bros., Little Falls, N. Y., *a*, $8,616.70; *b*, $9,618.

SEWERAGE AND SEWAGE DISPOSAL.

Saratoga Springs, N. Y.—Prof. Olin H. Landreth, of the Engineering School of Union College, Schnectady, has been engaged to make an examination and report on the matter of sewage disposal.

Waycross, Ga.—Mayor Knight has called an election for April 1 to vote on the issue of bonds for a sewerage system.

St. Paul, Minn.—Bids are wanted March 14 for sewers in Robie and East Fourth Sts. John Copeland, Pres. Bd. Pub. Wks.

Mt. Vernon, N. Y.—Bids are wanted March 21 for 8-in. lateral pipe sewers in North Terrace Ave. and North High St., also for lateral sewers in North Seventh Ave., Howard and Locust Sts. Wm. N. Hoyt, City Clk.

Watsonville, Cal.—See "Water."

St. Paul, Minn.—Bids are wanted March 14 for furnishing vitrified pipe to be used in maintaining or repairing the sewer system during 1899. Matt. Jensen, City Clk.

Livingston, Mont.—Bids are wanted March 25 for sewers in Improvement District No. 2. A. P. Stark, City Clk.

Martins Ferry, O.—The Council is stated to have passed a resolution to build sewers, at a cost of about $50,000. The city will expend $35,000 on improvements to the water-works system during the coming summer.

Galveston, Tex.—A correspondent writes that the city has in contemplation the construction of a municipal sewerage system.

Taunton, Mass.—The Aldermen have adopted an order appropriating $50,000 for sewer extensions.

Boston, Mass.—Supt. Wells, of the Street Department, has $1,000,000 at his disposal for sewer purposes, for the current year. Of this amount, work covering about $600,000 is now under construction.

Yazoo City, Miss.—Press reports state that bonds are to be issued for a sewerage system.

Grand Rapids, Mich.—The Common Council has passed a resolution providing for the construction of a sewer system in Brainard and Benson Sts., and Dudley Place. Frank D. Warren, City Clk.

Charles City, Ia.—Press reports state that the City Council has voted to construct a sewer system.

Schenectady, N. Y.—The bill has passed the Legislature authorizing the issue of $15,000 bonds for sewer purposes.

Islip, N. Y.—The proposition to build a 2½-ft. brick sewer at a cost of $3,000 will probably be voted upon in the near future.

Tarboro, N. C.—See "Water."

Albany, N. Y.—See "Paving and Roadmaking."

Wyandotte, Mich.—The Council has under consideration the report of Engineer J. D. Cooke on the proposed sewer system. His plans provide for trunk lines through several streets and for 58,560 ft. of 8 to 24-in. crock sewer, estimated to cost about $38,000.

Kearney, N. J.—It is stated that bids are wanted March 28 for about 2 miles of pipe, storm water, sewers. Wm. S. Logan, Town Engr., Arlington, N. J.

Waterbury, Conn.—See "Water."

Bradford, Ont.—It is stated that bids are wanted March 20 for sewer pipe and cement. W. G. Elliott, Chmn. Bd. Wks.

Danville, Ill.—See "Sundry Civil Expense Appropriations."

Everett, Mass.—The Aldermen are stated to have adopted an order authorizing the City Treasurer to borrow $25,000 for sewer purposes.

Wallace, Idaho.—The City Council has decided to submit to the voters at the coming election the proposition to bond to the amount of $15,000 for the purpose of completing the sewer system.

Memphis, Tenn.—Jas. H. Elliott, Asst. Engr. in Charge of Sewers, estimates that the construction of 75 7/10 miles of sewers will be required for the unsewered districts of the old city of Memphis and for the annexed territory. Total estimated cost, $452,605.

Buffalo, N. Y.—The Board of Public Works has been directed to readvertise for constructing a 20-in. tile, 5 ft. 4 in., 4 ft. 3 in. brick sewer on Hopkins and Amber Sts., also for brick and tile sewers on Park Ave.

Folsom, Cal.—The bill appropriating $15,000 for the construction of a sewerage system at the State Prison has been signed by the Governor.

Havana, Ill.—Bids are wanted April 1 for furnishing materials and constructing 1,055 lin. ft. of 48-in., 800 lin. ft. 24x36-in., 400 lin. ft. 22x33-in. brick sewers, 420 lin. ft. 12-in. pipe sewer, man-holes, catch-basins, etc., as advertised in "The Engineering Record."

New London, Conn.—Bids are wanted April 6 for building and laying a submerged sewer; also for furnishing and laying vitrified pipe sewers, as advertised in "The Engineering Record."

St. Paul, Minn.—Local press reports state that the Board of Public Works will recommend a final order to the Council for the Hamline sewer system, which calls for the construction of about four miles of sewers. Estimated cost, $40,000.

Kearney, N. J.—Bids are wanted March 28 for lateral sewers, work to consist of 6,454 lin. ft. pipe for house connection, 12,609 lin. ft. of 10 to 30-in. pipe sewer, manholes, etc. James F. Kelly, Town Clk.

Cincinnati, O.—The following bids were opened March 3 by the Board of City Affairs for constructing a sewer and drain in Bates, Stock and Massachusetts Aves. and other streets: J. M. Peter, $82,713.62; J. W. Sullivan, $92,065.25; L. Drach, $82,972.40; McCarren & Dawson, $73,802.64; Queen City Construction Co., $83,168; A. J. Henkel & Bro., $82,063.15; David Folz Asp. Pav. Co., $92,759.04; Delaney & Broemann, $88,451.60; George Ashman, $82,736; Henry Frank, $81,999; Geo. P. Walker, $74,943.80; Van Sandt & Meeds, $77,475.08; Henry Dieckmeier, $86,718.52; Thos. J. Peter, $77,329.10; Jos. Strack, $73,756.71; J. E. Mahoney, $89,459.60; M. T. Flynn, $94,685.28; P. N. Jonte, 134 East Court St., Cincinnati, who received contract, $72,459.

Washington, D. C.—Congress has appropriated $383,000 for the extension of the general sewer system of the District of Columbia.

Boston, Mass.—It is stated that bids are wanted March 15 for sewers, castings, etc. B. W. Wells, Supt. Sts.

Boston, Mass.—Bids are wanted March 21 for continuing and completing Section 2 of the Clinton sewerage system, as advertised in "The Engineering Record."

BRIDGES.

Pittsburg, Pa.—Local press reports state that the Allegheny Valley R.R. will replace the bridge damaged by the ice at West Penn Junction by a truss bridge, to cost about $100,000.

Dubuque, Ia.—Local press reports state that the Dubuque & Wisconsin High Bridge Co. has under consideration the construction of a high bridge at Eagle Point, to cost about $110,000.

Reading, Pa.—A correspondent writes that an iron bridge is to be built this spring by the Berks County Commissioners.

Mt. Vernon, N. Y.—Local press reports state that bids will soon be asked for widening and otherwise improving Hutchinson River bridge, at East 3d St.

Richmond, Va.—Permission has been granted to the Richmond, Petersburg & Carolina R.R. Co. to construct a bridge over the James River.

Bay City, Mich.—The construction of a viaduct over the Michigan Central R.R. tracks at Washington St. is stated to be under consideration.

Athens, Ga.—Bids are wanted March 18 for a steel bridge across the Oconee River. Probable cost, $2,500. J. W. Barnett, City Engr.

Denver, Colo.—Local press reports state that the Secretary of the Board of Public Works will receive bids March 14 for constructing two abutments to the Stout St. bridge.

Otto, N. Y.—A bridge is to be built across the Cattaraugus Creek between the towns of Persia and Otto.

McKees Rocks, Pa.—Press reports state that the Pressed Steel Car Co. has under consideration the construction of a bridge across the Ohio River to cost $350,000.

Chicago, Ill.—The Mayor and Drainage Trustees have under consideration the construction of a bascule bridge at Canal St., to cost about $110,000.

Gorham, Me.—Press reports state that the building of an iron bridge across Presumpscot River at South Windham will be considered at the town meeting.

Carlton, N. Y.—At the town meeting to be held March 14 a vote will be taken on the proposition to build a high bridge over the gorge at Waterport.

St. Joseph, Mo.—Bids are wanted March 22 for several bridges. Theo. Steinacker, Co. Surveyor.

Kansas City, Mo.—The City Council has passed an ordinance granting to the Metropolitan Railway Co. the right to build a viaduct on 8th St.

Binghamton, N. Y.—S. D. Kane, City Clk., writes that it was voted on March 2 to raise, by special tax, the sum of $40,000 for the erection of a bridge across the Susquehanna River at or near the foot of Tompkins St.

North Adams, Mass.—Bids are wanted March 25 for building the steel superstructure of a plate girder bridge over the Hoosac River, as advertised in "The Engineering Record."

Yankton, S. D.—The President has signed the bill for a bridge across the Missouri River.

North Braddock, Pa.—Plans prepared by Samuel Taylor, Boro. Engr., for three steel bridges to be built by the Wilkinsburg & East Pittsburg Street Ry. Co. have been accepted. Cost, about $50,000.

Butler, Pa.—The Pittsburg & Western R.R. is stated to have awarded to the Riter-Conley Mfg. Co., Pittsburg, Pa., the contract for building nine bridges for $40,000. Each bridge will have an 80-ft. span, with plate girders and buckle plate floors.

Columbus, O.—Bids are wanted April 1 for the substructure, superstructure, paving and approaches for the bridge over Big Walnut Creek, in Madison township; for the substructure of bridges over Early Run, Franklin township, and over Run at Urbancrest, Jackson township; also for a bridge at the Carruthers Farm, Sharon township. W. H. Halliday, Co. Aud. & Clk. Bd. Co. Commrs.

Hancock, N. Y.—Wesley Gould, Village Clk., writes that an appropriation of $6,000 has been voted for a bridge at Harvard.

Washington, D. C.—The President has signed the following bills: Authorizing the St. Louis, Siloam & Southern R.R. Co. to construct a bridge across the White River, in Arkansas; the Pensacola & Northwestern Ry. Co, to build bridges in Alabama; the Grand Rapids Water Power & Room Co. to construct a dam and bridge across the Mississippi River.

Buffalo, N. Y.—Bids are wanted March 21 for the superstructure of a viaduct over the Lake Shore and Michigan Southern Ry. in Elk St., and over the Erie R.R. between Elk St. and Abbott road; also for masonry, paving and other work necessary for constructing piers, abutments and approaches to the same. Frank V. E. Bardol, Ch. Engr. of the Grade Crossing Commrs.

Columbus, O.—Bids are wanted April 5 for the substructure, superstructure, paving and approaches of a bridge over Big Walnut Creek, Truro Township; bridge over Indian Run, Washington Township, and for a bridge over run, Mifflin Township. W. H. Halliday, Co. Aud. and Clk. Bd. Co. Commrs.

New Kensington, Pa.—Herman Kaub, C. E., of Pittsburg, has prepared plans for a bridge over the Allegheny River.

Newark, N. J.—The Park Commissioners have ordered specifications prepared for a steel bridge over the canal at 6th Ave.

Boston, Mass.—The following bids were opened March 3 by City Engineer Jackson for two retractile draws for the bridge on Summer St. extension across Fort Point Channel: A. & P. Roberts Co., Philadelphia, $23,999; The Berlin Iron Bridge Co., East Berlin, Conn., *$23,820; Penn Bridge Co., Beaver Falls, Pa., $25,864; Edge Moor Bridge Wks., Wilmington, Del., $24,592; New Jersey Steel & Iron Co., Trenton, N. J., $24,600; Pittsburg Bridge Co., Pittsburg, Pa., $24,515; Massillon Bridge Co., Massillon, O., $26,546; Boston Bridge Wks., Boston, Mass., $27,600; Youngstown Bridge Co., Youngstown, O., $28,000; New England Structural Co., Boston, Mass., $26,640; Canton Bridge Co., Canton, O., $26,000; New Columbus Bridge Co., Columbus, O., $28,960; King Bridge Co., Cleveland, O., $24,982.

*Contract awarded.

New Haven, Conn.—The following bids for a steel bridge at Derby Ave. were opened Feb. 28 by City Engineer Kelly:

For the superstructure: The Youngstown Bridge Co., Youngstown, O., $12,500; F. R. Long & Co., New York City, $8,992; New Jersey Steel & Iron Co., Trenton, N. J., $8,160; New England Structural Co., East Everett, Mass., $10,024; John E. Buddington, New Haven, Conn., $8,877; Canton Bridge Co., Canton, O., $12,000; Massillon Bridge Co., Massillon, O., $9,438; Wrought Iron Bridge Co., Canton, O., $8,584; Horseheads Bridge Co., Horseheads, N. Y., $10,500; King Bridge Co., Cleveland, O., $9,700; Boston Bridge Wks., Boston, Mass., 9,346; Dean & Westbrook, N. Y. City, $12,500; Pittsburg Bridge Co., Pittsburg, Pa., $8,673; Rochester Bridge Co., Rochester, N. Y., $9,400; Stacey P. Opdyke, Philadelphia, Pa., $9,294; Berlin Iron Bridge Co., Berlin, Conn., *$7,436.

For the substructure: Clinton Stephens & Son, New York City, $15,192; C. W. Blakeslee & Sons, New Haven, Conn., $12,023.75; C. T. Tryon & Son, Meriden, Conn., $11,955.75; Daniel O'Connell & Co., Holyoke, Mass., $12,903.50; F. Brazos, New Haven, Conn., $12,306; John A. Doolittle & Co., New Haven, Conn., $11,445; John R. Walker & Co., Leete Island, Conn., $11,508.47; John E. Buddington, $12,705; F. R. Long & Co., $13,572; R. Redfield & Son, New Haven, Conn., *$10,083.

*Contract awarded.

Rutland, Vt.—The following bids were opened March 4 for bridges on the Rutland-Canadian Railroad; Stowell & Cunningham, Engineers, 51 State St., Albany, N. Y. The estimated quantities are: *a*, 997,500 lbs. riveted work for draw bridges; *b*, 36,300 lbs. machinery; *c*, 41,400 lbs. iron castings; *d*, $24,300 lbs. steel castings; *e*, 579,000 lbs. riveted work for fixed bridges.

Prices given are per pound, erected in place.

	a	*b*	*c*	*d*	*e*
King Bridge Co., Cleveland, O.	$3.80	10 00	5.00	6.00	3.80
New Jersey Steel & Iron Co., Trenton, N. J.	3.78	7.10	6.00	9.00	3.78
Berlin Iron Bridge Co., East Berlin, Conn.	3.77	8.00	6.50	8.00	3.75
Elmira Bridge Co., Elmira, N. Y.	3.75	7.00	6.00	8.50	3.75
Rochester Bridge & Iron Works, Rochester, N. Y.	3.72	6.80	5.625	9.00	3.67
*Edge Moor Bridge Works, Wilmington, Del.	3.66	7.10	6,00	9.00	3.63

* Contract awarded.

PAVING AND ROADMAKING.

Winnipeg, Man.—Bids are wanted March 22 for supplying the whole or any portion of the machinery for an asphalt plant, as advertised in "The Engineering Record."

Rock Island, Ill.—An appropriation of $10,500 is made by the Government sundry civil expense bill for paving Fort Armstrong Ave.

Washington, D. C.—Roadway east and south sides, State, War and Navy Building, appropriation of $14,300 by sundry civil expense bill.

Saginaw, Mich.—Bids are wanted March 17 for paving with asphalt Court and Hamilton Sts. Alfred Davies, Clk. Bd. Pub. Wks.

Columbus, O.—Bids are wanted March 14 for an asphalt, brick or block pavement on Wilson Ave., Grant, Atcheson and Mulberry Sts. James A. Fanning, Clk. Bd. Pub. Wks.

Baltimore, Md.—Bids are wanted March 15 for granite and asphalt blocks, brick stone and sand for the City Commissioner's Department during 1899. William W. Varney, City Commr.

Washington, D. C.—The sum of $130,000 has been appropriated by Congress for the construction of county roads and suburban streets. For current work of repairs of streets $180,000 has been appropriated, and for the repair of county roads $60,000.

Winnipeg, Man.—Bids are wanted April 5 for the supply of 330 tons of asphalt and six dump wagons, as advertised in "The Engineering Record."

Grand Rapids, Mich.—It is stated that bids are wanted March 17 for asphalt paving on Jefferson Ave. and Ottawa St. F. A. Twamley, Clk. Bd. Pub. Wks.

Huntington, Ind.—It is stated that bids are wanted April 11 for 16,000 sq. yds. brick paving, 12,000 cu. yds. earth excavation, curbing, etc. Frank Guthrie, City Engr.

Flint, Mich.—Bids are wanted March 15 for furnishing brick to pave 16,050 sq. yds. Fred. P. Baker, City Clk.

Scottsboro, Ala.—R. S. Skelton, Pres. Road Committee, writes that $125,000 road improvement bonds were sold March 1.

Albany, N. Y.—Bids are wanted March 20 for paving Rose Street with repressed, vitrified brick, also for a vitrified pipe sewer. Thos. J. Lanahan, Clk. Bd. of Contract and Apportionment.

Rome, N. Y.—See "Water."

Meadville, Pa.—A correspondent writes that 31,040 yds. of brick paving and 20,925 ft. of curbing are contemplated for 1899.

Joliet, Ill.—George W. Brown, City Engineer, writes that all bids received March 6 for asphalt paving, estimated to cost $141,229, were rejected and new bids will be opened March 20.

Trenton, N. J.—The Senate has passed the bill which appropriates $150,000 for the permanent improvement of public roads.

McConnelsville, O.—The proposition to issue $10,000 bonds for the paving of Center St. will be voted upon at the spring election.

Boone, Ia.—Local press reports state that the Likes Improvement Co. of Des Moines has secured a $12,115 contract for paving.

Easton, Pa.—The County Commissioners have adopted resolutions favoring the proposition to have the county accept and rebuild about 9 miles of public highway. Plans and specifications are to be prepared for macadamizing estimated to cost $40,000.

Marion, Ind.—It is stated that the City Clerk is about to advertise for paving East 3d St. with brick.

Schenectady, N. Y.—The Common Council has passed a bill providing for the issue of $15,000 street improvement bonds.

Huntington (L. I.), N. Y.—The proposition to issue $30,000 bonds for macadam pavements in certain streets will be voted upon at the coming election.

Bedford, Ind.—The County Commissioners have awarded the contracts for building pike roads in Shawswick Township to David C. Dehority & Co. of Elwood, Ind., for $48,357.

Bellefontaine, O.—Local press reports state that bids are wanted by the Clerk of the City Council until March 31 for paving Court Ave. and South Main St.

Fulton, N. Y.—The following bids were opened Feb. 23 for Second St. improvement, as advertised in "The Engineering Record;" O. C. Breed, Village Engr.:

Names of Bidders.	300 cu. yds. Excavation, per yd.	1,200 cu. yds. Embankment, per yd.	2,200 sq. yds. Vit. Brick Pavement, inc. Foundation, &c., per yd.	5,000 l. ft. Stone Curbing Set, inc Foundation, &c., per ft.	150 sq. yds. inc. Foundation, &c., per yd.	4 Sewer Manholes, each.	9 Sewer Inlets, each.	Sewer Pipe, per lin. ft., Furnished and Laid. 250 ft. 10-in.	940 ft. 15-in.	300 ft. 18-in.	2 Tons 10-in. Cast Iron Pipe, per net ton.	Grading 6 Street Intersections, Lump Sum.	1 cu. yd. Broken St'ne Surfaced in Place.	Total.
Eugene Fee, Olean, N. Y.	$ .30	$ .65	$2.26	$ .50	$ .40	$30	$30	$ .35	$ .42	$ .50	$24	$120.00	$1.25	$10,188.55
Frank Pidgeon, Saugerties, N. Y.	.35	.45	2.53	.85	1.50	75	20	.85	.95	1.10	120	50.00	1.55	14,058.95
J. A. Osborn, Fulton, N. Y.	.25	.80	2.50	.62	.60	28	28	.32	.45	.57	60	90.00	1 50	11,664.50
Edward Quirk, Fulton, N. Y.	.25	.60	2.05	.60	.40	25	10	.49	.61	.75	30	100.00	1 30	10 347.20
*John Hendricks, Oswego, N. Y.	.25	.35	1.88	.55	.60	30	8	.27	.39	.48	26	12.50	1.00	8,986 60
M. R. Grannis, Syracuse, N. Y.	.28	.87	2.15	.72	.45	30	15	.25	.37	.47	33	77.00	1.27	10 826.57
John W. Bustin and H. C. Allen, Syracuse, N. Y	.15	.34	2.09	.62	.50	20	6	.23	.40	.50	27	42.00	1.25	10,007 75
Thomas H. Marvin, Fulton, N. Y.	.25	.65	2.10	.65	.40	35	10	.40	.50	.60	30	50.00	1.20	10,416.20
Chas. J. Hookaway, Syracuse, N. Y	.30	1.00	2.35	.45	.80	20	30	.30	.45	.55	35	15.00	3.00	12,031 00
Connors and True, Fulton, N. Y.	.40	.80	2.25	.65	.50	30	20	.25	.60	.75	35	25.00	2.00	11 868.50

* Contract awarded. Engineer's estimate, $10,000.

Philadelphia, Pa.—The following bids were opened Feb. 23 by the Fairmount Park Commissioners for the completion of East Park Drive:

Bidder.	Address.	Earth Filling.	Stone Filling.	Rubble Masonry.	Dry Masonry.	Cinders.	Sodding.	Drain Basins.	Ten-inch Terra Cotta Pipe.	Condemned Cast Iron Pressure Pipe.	New Telford.	Allowance for Old Telford.
Thos. F. Reilly,	Harrison Bldg	.10	.65	2 75	2.39	.27	.10	9.00	.20	.38	.63	.15
John Lynch,	3900 Girard Ave	.10	.60	2.25	1.41	.15	.10	10.00	.22	.45	.73	.18
John McParland;	41st and Haverford Sts	.14	.71	2.55	1.54	.19	.12	8.00	.23	.48	.80	.09
J. B. Shanley,	14 S. Broad St	.14	1.00	2.50	1.50	.20	.06	15 00	.30	.75	.67	.20
McManus Const. Co.,	1430 S. Penn Sq	.23	1.20	3.04	1.70	.15	.11	11.00	.20	1 30	.77	.30
Robt. Patton,	624 N. 35th St	.28	.90	2.40	.98	.10	.13	14.00	.23	.50	.78	...

For the completion of Lincoln Ave. Drive bids received were as follows:

Bidders. Address.	Borrowed Material.	Rubble Masonry.	Terra Cotta Pipe.	Basin Complete.	Sodding.	Telford.
Frank J. Hill, Harrison Bldg	.23½	2.15	.22	10.00	.09	.58
J.B.Shanley,14 S. Broad St	.35	2.50	.30	15.00	.06	.72
McManus Construction Co , 1430 S. Penn Sq	.24½	2.85	20	9.50	.11	.58¼
T. F. Reilly	.27	2 95	.22	10 00	.09	.67
Robt.Patton,624 N. 35th St.	.23	2.30	.18	11.00	.13	.58
Am. Artificial Stone Pav. & Const. Co., 209 S. 9th St.	.21	2 50	.22	5.00	.12	.69

For other bids received on this date by the Fairmount Park Com., see "Miscellaneous" in our issue of Feb. 25.

Boston, Mass.—The following bids were opened March 6 by the Metropolitan Park Commission, Wm. T. Pierce, Engr., for building Blue Hills Parkway, Brook Road to Canton Ave. The work includes 29,000 cu. yds. of earth excavation, 1,000 cu. yds. of rock grading, 50,000 cu. yds. of filling material, 9,600 lin. ft. of 8, 10, 12, 15 and 18-in. pipe drain, 13,000 cu. yds. of loam surfacing, 8,000 tons of broken stone surfacing, 6,000 cu. yds. gravel roadway surfacing: Rowe & Hall, Boston, $106,324; Cogan Bros. & Forschner, Atlantic, $97,933; T. Stuart & Son, Newton, $93,000; P. H. Fitzgerald, New London, Conn., $86,366; Dennis F. O'Connell, Boston, $85,640; T. H. Gill & Co., Somerville, $83,964; James J. Welch & Co., Salem, $81,226; Mirick & Wentworth, Malden, $80,628; Joseph D. Gennaro, Boston, $79,733; Coleman Bros., Charlestown, $79,690; Bell & Co., Boston, *$69,221.

*Contract awarded.

Bedford, Ind.—Local press reports state that Porter, Bowlin & Hadley of Tipton, Ind., have secured a $35,000 contract for brick paving.

Bridgeport, O.—Paving bonds to the amount of $75,000 were sold March 1.

Paterson, N. J.—Bids are wanted March 20 for brick and asphalt paving, as advertised in "The Engineering Record."

POWER PLANTS GAS AND ELECTRICITY.

Fulton, Mo.—G. F. Yancey, City Clk. writes that at the election held Feb. 21, it was voted to issue $10,000 bonds, $4,000 of which to be used for the purchase of a new engine and necessary repairs for the electric light plant; the remainder is for a city hall.

Williamsport, Md.—At the election held March 6 the vote was in favor of electric lighting.

Santa, Fe, N. M.—See "Government Work."

Joplin, Mo.—E. C. Squire, City Clk., writes that it was voted on Feb. 28 to issue $30,000 bonds for an electric light plant.

Tarboro, N. C.—See "Water."

Mobile, Ala.—Watkins & Johnson, of Mobile, have prepared plans and specifications for a boiler house for the Mobile St. R. R. Co.

Dover, Del.—The House is stated to have passed a bill authorizing the Council to issue bonds to construct an electric light plant.

Portland, Me.—See "Government Work."

St. Louis, Mo.—Jas. C. Jones, John R. Manewahl and others are stated to have applied for a franchise to build and operate gas works.

New York, N. Y.—See "Public Buildings."

Syracuse, Neb.—It is reported that the Council has been petitioned to submit to a vote, in April, the question of constructing an electric light plant.

Summersville, Ga.—There is talk of constructing an electric light plant here.

Santa Rosa, Cal.—The Clear Lake Electric & Power Co. is stated to have petitioned for an electric light franchise.

Wadesboro, N. C.—See "Water."

Fayetteville, N. Y.—The Fayetteville Electric Light Co. has been incorporated to supply electric light, heat and power to Fayetteville and Manlius; capital, $12,000. Directors: Charles L. Collins and Amos Gillette, both of this place.

Moulton, Ia.—It is stated that the citizens will vote March 27 on granting an electric light and power franchise to H. H. Lohnes.

Maysville, Mo.—There is said to be a movement on foot to put in an electric light plant.

Seymour, Ia.—It is reported that the citizens will shortly vote on the issue of $10,000 bonds for an electric light system.

Salisbury, N. C.—It is stated that a $10,000 electric light plant will probably be constructed here.

Napoleon, O.—See "Water."

Kasson, Minn.—F. R. Lloyd, of Centerville, Wis., is stated to have received a franchise for an electric light plant.

Ward, S. D.—See "Water."

Hackensack, N. J.—The North Jersey Light, Heat & Power Co. has been incorporated to supply light and power in Bergen and Passaic counties; capital, $100,000. Incorporators: Cyrus O. Baker, Jr., of Newark; William A. Linn, of Hackensack, and George H. Guy and Herbert B. Coho, of New York.

Houma, La.—The General Electric Co., Schenectady, N. Y., is stated to have received the contract for an electric light plant of 1,000 light capacity for the Houma Lighting & Ice Mfg. Co.

New York, N. Y.—It is stated that the American Air Power Co. will erect a power plant on 13th Ave. and 24th St.

Williamstown, N. J.—See "Water."

Harbor Springs, Mich.—The House is stated to have passed a bill authorizing this city to extend its electric light plant.

Keota, Ia.—It is stated that Wm. J. Pugh, of Muscatine, proposes to establish an electric light plant in connection with an oatmeal mill here.

Rockwell, Ia.—See "Water."

Aberdeen, S. D.—J. A. Schlueter, City Aud., is desirous of receiving estimates for the construction of an electric light plant.

Newark, N. Y.—The item in our issue of March 4, headed from Newark, N. J., should have read Newark, N. Y.

Fort Wayne, Ind.—It is stated that the Yaryan Hot Water Construction Co., of Toledo, will shortly apply for a franchise to install a new system of heating.

Taunton, Mass.—The Common Council has adopted the order authorizing the appropriation of $5,000 for the purchase of a 350 h.-p. engine for the municipal electric lighting plant.

Utica, N. Y.—It is reported that plant of the Equitable Gas & Electric Co. has been sold; some improvements and extensions are said to be in contemplation.

Ashton, Ill.—It is reported that steps are being taken to construct an electric light plant.

Louisville, Ky.—Donald McDonald, Pres., writes that gas generators, blowers, piping, one or more gas engines, etc., will be added to the plant of the Kentucky Heating Co.

Meadville, Pa.—At a meeting of the Council March 3 it was decided to advertise for bids for 125 2,000 c. p. double differential arc lamps, to run 48 hours; also, how much will be allowed for 125 "American" lamps now in use.

Cullman, Ala.—See "Water."

Spokane, Wash.—The Washington Water Power Co. is said to be considering the construction of an addition of 2,000 h. p. to its plant.

Green Bay, Wis.—It is reported that the Green Bay Gas & Electric Light Co. will erect a new gas plant and lay about 16 miles of pipe. Wm. Mainland, Pres., Oshkosh.

Danville, Ill.—See "Sundry Civil Expense Appropriations."

Rock Island, Ill.—An appropriation has been made by the sundry civil expense bill for Rock Island Arsenal as follows: Machinery and shop fixtures, $10,000; power, house, machinery and electric plant, $9,851.24; three turbines, etc., $21,350; coal dumps, $18,000.

Ellendale, N. D.—F. L. Walker is stated to have applied for a franchise for an electric light plant.

Norfolk, Va.—See "Government Work.'

Cambridge, O.—T. R. Deselm, City Clk., writes that the contract for lighting the city with 75 arc lights for a period of 5 years has been awarded to the Cambridge Electric Energy Co., Cambridge, O., at $70 per light per year, all night and every night.

Springhill, N. S.—It is stated that bids are wanted March 31 for developing a water power, switchboard equipment, supply of generators, extension of line, wiring and all necessary material for 3,000 house lights. J. E. Simpson, Pres. Edison Electric Light & Power Co., Ltd.

Benica, Cal.—It is stated that bids are wanted April 4 for the purchase of a franchise for a transmission line. H. K. White, City Clk.

Martinsburg, W. Va.—The Council on March 2 is stated to have authorized Mr. Lambert to correspond with electrical companies as to the cost of constructing an electric light plant.

Belding, Mich.—It is reported that bids will soon be asked by the Citizens' Electric Co. for a water power plant. Probable cost, $20,000. M. A. Reed, Secy.

Marianna, Ark.—See "Water."

Baltimore, Md.—Bids were opened March 1 by William L. Kenly, Ch. Engr. Water Board, for an electric lighting plant at the Mount Royal Pumping Station, as advertised in "The Engineering Record." The following bids are for Part 1, which comprises foundations, foundation stones, dynamos, engines, switchboard, etc.: Morton, Reed & Co., Baltimore, Md., Skinner engine, Sprague dynamo, $3,690; McCoy Engineering Co., Baltimore, Md., Skinner engine, Crocker Wheeler dynamo, $3,870; Kingsbury, Samuels & Co., Ames engine, Eddy dynamo, $3,597.37; General Electric, H Standard engine, G. E. dynamo, $4,368; Fischer engine, G. E. dynamo, $4,550; Erie Ball engine, G. E. dynamo, $4,218; Buckeye engine, G. E. dynamo, $4,120; Straight Line engine, G. E. dynamo, $6,650. Westinghouse Elec. & Mfg. Co., H. Standard engine, Westinghouse dynamo, $4,068; Ellicott Machine Co., Ideal engine, G. E. dynamo, $4,826; Southern Electric Co., Baltimore, Md., Fischer engine, Triumph dynamo, $4,130; Siemens-Halske Co., H. Standard engine, S. H. dynamo, $4,052; Fischer engine, S. H. dynamo, $4,225; Ball engine, S. H. dynamo, $3,905; Buckeye engine, S. H. dynamo, $3,815; Alfree engine, S. H. dynamo, $3,805. J. F. Buchanan & Co., Philadelphia, Pa., Ideal engine, G. E. dynamo, $4,666; Fischer engine, G. E. dynamo, $4,466; Ball engine, G. E. dynamo, $4,466.

ELECTRIC RAILWAYS.

Derry, N. H.—C. S. Campbell, Pres. of the Chester & Derry R. R., writes that the Derry & Pelham Electric Ry. Co. has been organized by William H. Anderson, of Lowell, Mass., Pres.; Charles W. Hobbs, Pelham, N. H., Clerk. The road, which it is proposed to build this summer, will be about 15 miles long and connect with the Chester & Derry road at Derry, and with the Lowell & Merrimac River Valley system at Lowell.

Florence, Colo.—Thos. Robinson is stated to have applied for a franchise..

Bridgeton, N. J.—It is stated that at a meeting of the Directors of the Bridgeton & Millville Traction Co., March 6, it was decided to build the extension of the trolley road to Cedarville, and the treasurer, Walter H. Bacon, of this city, was instructed to enter into contracts for the work.

Waltham, Mass.—The Newton & Forest Hills St. Ry. Co. is stated to have applied for a franchise.

Neenah, Wis.—It is stated that the Fox River Electric Ry. Co., of Appleton, will build an extension from Neenah to Oshkosh.

Kansas City, Mo.—The Brooklyn Ave. St. Ry. Co. is stated to have received a franchise to build an electric railway on Grand Ave.

Indianapolis, Ind.—Chas. L. Harry, of Tipton, is stated to have petitioned the County Commissioners for a right-of-way in Marion county on the Indianapolis, Allisonville & Noblesville free gravel road. He proposes to build an electric line, connecting Tipton with Indianapolis by way of Allisonville.

New Rochelle, N. Y.—The Tarrytown, White Plains & Mamaroneck Trolley Co. is stated to have received a franchise on the Boston Post road between New Rochelle and Rye.

Cincinnati, O.—The Cincinnati, Lawrenceburg & Aurora St. Ry. Co. is stated to have petitioned the County Commissioners for a franchise on Lower River road.

Flint, Mich.—A. A. Talmadge & Co., of New York City, are stated to have received a franchise.

La Salle, Ill.—The La Salle County Interurban Electric Ry. Co. is stated to have applied for a franchise through this place.

Bristol, Tenn.—It is reported that the Bristol Belt Line Ry. Co. will build a new power plant on Shelby St. S. M. Vance, Supt.

Lansdowne, Pa.—A charter has been granted to the Arcadia Park Ry. Co., with a capital of $25,000, to construct a trolley road in the borough of Lansdowne. Henry W. Brennen, Pres., Philadelphia.

Burlington, N. J.—The Monmouth Traction Co. is stated to have received a franchise through this city. It is the intention of this company to build a line between Camden and Trenton.

Danville, Ind.—The County Commissioners are stated to have granted D. P. Erwin and Daniel Ransdell, of Indianapolis, a franchise for a trolley line along the National road to the Putnam county line and through Cartersburg to Danville.

Greenwich, N. Y.—The Greenwich & Schuylerville Electric Ry. Co. is stated to have filed a certificate of extension of its road from Schuylerville to Fort Edward.

Ann Arbor ,Mich.—Thos. D. Kearney and Arthur Brown, of Ann Arbor, are stated to have secured franchises for an electric railway from this place to Jackson.

Reading, Pa.—A correspondent writes that an electric railway is to be built from Reading to Temple, a distance of 5 miles, also from Womelsdorf to Myerstown, a distance of 7 miles. John Rigg, Pres., Reading, Pa.

Chicago, Ill.—The Northern Electric Co. has received a franchise to extend its lines in the 27th ward.

Albany, Ind.—There is talk of constructing an electric railway from this place to Sellersburg, a distance of about 10 miles. The New Albany Commercial Club is said to be interested.

Risingsun, Ind.—The Commissioners of Ohio County are stated to have granted a right-of-way to the Aurora, Lawrenceburg & Cincinnati Electric St. Ry. Co.

Hull, Que.—The Ottawa & Pontiac Ry. Co. is stated to have petitioned the Council for permission to build additional lines.

Seattle, Wash.—The Council, on Feb. 27, passed an ordinance granting A. F. Burleigh, Winthrop Smith and Albert Stone a franchise for a street railway on the same streets now occupied by the Yesler way cable line.

A petition was received at this meeting from Richard Chilcott for a franchise on a portion of Yesler way.

RAILROADS.

Springfield, Mo.—A charter has been granted to the Springfield, Harrison & Southern R. R. Co., with a capital of $2,000,000, to build and operate a railroad from Springfield through Christian and Stone counties into Boone county, Ark., about 265 miles long. Incorporators: D. B. Lott, A. Woods, A. T. Clark and others.

Goldsboro, N. C.—The Legislature is stated to have granted a charter to Julian S. Carr, W. J. Edwards and others to build the Atlantic & Western Railway from Goldsboro through Wayne, Johnston, Harnett, Moore and Montgomery counties. Capital, $1,000,000.

Purcell, I. T.—A charter has been granted to the Shawnee, Oklahoma & Missouri Coal & Ry. Co., with a capital of $1,000,000, to construct a railroad from Purcell 150 miles to Seneca, Mo. Incorporators: C. J. Benson, George McLogan and others.

Chicago, Ill.—It is reported that the recent purchasers of the Chicago & Alton Railroad will expend about $4,000,000 on improvements.

Atlanta, Ga.—A charter is stated to have been granted to the Seaboard & Gulf Ry. Co. to construct 447 miles of railroad through the eastern portion of the State. The line is to enter Georgia, in Elbert county, from its present northern terminal at Anderson, S. C. Incorporators: Geo. M. Brinson, J. S. Carling and others.

Marshall, Mich.—The Columbus, Marshall & Northeastern Ry. Co. has been incorporated, with a capital of $1,200,000, to construct, and operate a steam railway from Marshall to Bay City, about 140 miles long. Directors: C. W. Robinson, of Marshall; C. L. Bemis, of Carson City; W. E. Sawyer, of Deadwood, S. D., and others.

Huntington, W. Va.—A charter has been granted to the Guyandotte Valley Ry. Co. to build a road from this city to Pineville. J. L. Caldwell, of Huntington, is said to be interested.

St. Joseph, Mo.—The Kansas, Missouri & Northern R. R. Co. has been incorporated to build a railroad from St. Joseph, Mo., to Omaha, Neb., 160 miles long; capital, $400,000. Robt. S. Doubleday, Pres., New York City; R. A. Reese, St. Louis, Vice-Pres.; C. C. Brown, San Antonio, Tex., Sec.

St. Louis, Mo.—A charter has been granted to the Carter Coal & Ry. Co., of St. Louis, with a capital of $250,000. Incorporators: Richard Qrimenton, N. C. Robbins, of St. Louis; T. C. Stuart, of Winchester, Ky., and others.

Mobile, Ala.—It is stated that the stockholders of the Mobile & Bay Shore Railroad, at a meeting, Feb. 24, authorized the issue of $200,000 bonds to construct the road from the terminus of the Duncan branch of the Mobile & Ohio Railroad to Alabama City, on Mobile Bay, and Portersville, on the Mississippi sound.

Mexico, Mo.—A charter has been granted to the St. Louis, Iowa & Northern Ry. Co.; capital, $3,000,000. Incorporators: S. H. Sawyer and H. R. Barker, of Eldon, Ia.; J. J. Ready and H. R. Berry, of St. Louis, Mo., and others.

Savannah, Ga.—See "Miscellaneous."

Jersey City, N. J.—The International Docks Terminal Ry. Co. has been incorporated with a capital of $1,500,000, to construct and operate a railroad from a point adjoining the line of the West Side Connecting Railroad and extending 3 miles to a point on Oyster Island, in New York Bay. Incorporators: Daniel F. Appleton, New York; Solon Humphreys, Bergen Point; John H. Chilver, Roselle; Henry Hayes, Hackensack, and others.

Sioux City, Ia.—The Sioux City Transit Co. has been incorporated; capital, $200,000. Incorporators: A. W. Geihm, A. S. Wilson and others.

Kushequa, Pa.—A charter has been granted to the Smethport Railroad Co. to build a line 9 miles long, to connect the Kushequa Railroad and the Western New York & Pennsylvania Railroad; capital, $90,000. Elisha K. Kane, Pres., Kushequa.

PUBLIC BUILDINGS.

(See also Schools and Government Work.)

Washington, D. C.—President McKinley is stated to have signed the bill providing for a new building for the Department of Justice in Washington, to cost $1,000,000.

Saratoga, N. Y.—The Delaware & Hudson R. R. Co., is said to be considering the matter of erecting a depot here, at a probable cost of $200,000.

Uvalde, Tex.—Bids are wanted March 30 for a jail, cost not to exceed $12,000. Hy. J. Bowles, Co. Clk.

Pierz, Minn.—F. E. Kreatz, of St. Cloud, is stated to have received the contract for the steam heating plant for St. Joseph's R. C. Church at $4,000.

Ashland, Wis.—It is reported that a union depot will be erected here, at a probable cost of $100,000.

Jamestown, N. D.—The House is stated to have passed a bill authorizing the issue of $50,000 bonds for erecting additional buildings for the State Insane Hospital at this place.

Spartanburg, S. C.—The First Presbyterian Society is stated to have decided to build a $15,000 church. A. H. Twitchell, Chmn. Bldg. Com.

Battle Creek, Mich.—It is stated that a $40,000 library will be erected here.

Osawatomie, Kan.—The House is stated to have passed a bill appropriatng $50,000 for the erection of a laundry building and hospital at the Osawatomie Asylum.

Dayton, O.—The Board of City Affairs is stated to have approved the plans for a depot to be erected here by the Dayton Union Ry. Co.

Turtle Creek, Pa.—It is stated that the McMasters M. E. congregation will erect a $25,000 church. Rev. A. J. Ashe, Pastor.

Lawrence, Kan.—The Senate is stated to have passed a bill authorizing Douglas county to levy a tax to build a court house.

Cedar Rapids, Ia.—Plans are being prepared for two sub-fire stations. R. N. Burk, Chmn. of the Fire Com.

Turtle Creek, Pa.—It is reported that the United Presbyterian Society will soon let the contract for erecting a $20,000 church. Rev. Wm. McConnell, Pastor.

Junction City, Kan.—It is stated that an election will be held April 4 to vote on issuing $35,000 court house bonds.

Emporia, Kan.—The Senate is reported to have passed a bill granting permission to Lynn county to build a court house; the cost of the building and grounds is said to be about $75,000.

Louisville, Ky.—St. Boniface R. C. Church is to be built on Green St., between Jackson and Hancock, at a cost of $50,000. D. X. Murphy & Bro., Archts., Louisville.

Allegheny, Pa.—It is reported that the Allegheny Elks will erect a $100,000 building at Stockton Ave. and East Diamond St.

Beaver, Pa.—The Cleveland & Pittsburg Ry. Co. is said to be preparing to erect a $25,000 depot.

Keyser, W. Va.—Bids are wanted April 6 for a jail. J. V. Bell, Clk.

Rutland, Vt.—The citizens are stated to have voted on March 6 to issue $20,000 to repair city hall.

Woodstock, Vt.—The citizens are stated to have voted March 6 to erect a $20,000 town hall.

Jamestown, N. Y.—Bids are about to be asked for a heating apparatus for the First Lutheran Church. The church is a stone structure, erected at a cost of $80,000.

Columbus, O.—Bids are wanted March 15 for a brewery plant. Separate bids for excavating, stone work, ironwork, etc., and for the whole contract will be received. Henry Seibert, Pres. Bd. of Dir., Columbus Brewing Co.

NEW YORK CITY.

Bids are wanted April 4 for plumbing, constructing steel cells, installing a complete high and low pressure steam plant, electric lighting, dynamos, elevator, etc., in the new city prison. Francis J. Lantry, Commr. Dept. of Correction.

A permit has been issued to Dr. J. T. White, 20 W. 44th St., for a brick armory to be built at Madison Ave. and 49th St. Cost $25,000. Archt. C. C. Haight.

A permit has also been issued for the Academy of Design building, to be erected on Amsterdam Ave. between 109th and 110th Sts. at a cost of $22,000. Carrere & Hastings, 28 E. 41st. St., Archts.

Bids are wanted March 23 for installing a complete high-pressure steam plant in the workhouse and a complete pumping outfit for the stone quarry, Blackwell's Island. Francis J. Lantry, Commr. Dept. of Correction.

BUSINESS BUILDINGS.

Topeka, Kan.—The Senate is stated to have passed a bill granting permission to this city to issue bonds to build an auditorium; the estimated cost of the building is said to be $100,000.

Utica, N. Y.—L. H. Lampert & Son, of Rochester, are reported to have prepared plans for an $80,000 opera house to be erected here. Jesse L. Oberdorfer is said to be interested.

NEW YORK CITY.

Permits for the following buildings have been issued; o, signifies owner; a, architect; b, builder, and c, contractor.

250 and 252 E 4th st, 2 br stores and tenem'ts; cost, $44,000 all; o, John Kafka; a, M. Bernstein.

S w cor Warren st and Broadway, br stores and offices; cost, $150,000; o, Rev. Dr. E. A. Hoffman; a, John B. Snook & Sons.

Cor Common and Stanton sts, 3 br stores and flats; cost, $85,000 all; o, Rosenberg & Feinberg; a, Horenburger & Straub.

270 to 276 Madison st, 3 br stores and tenem'ts; cost, $90,000 all; o, Louis Frank; a, M. Bernstein.

214 to 218 Sullivan st, br factory; cost, $50,000; a, Eugene Gerbereux; a, J P Voelker.

119th st and 5th ave, 3 br stores and flats; cost, $64,000 all; o, Frances J. Schnugg; a, Martin Johnson.

102d st and Boulevard, br stores and flat; cost, $175,000; o, Daily & Carlson; a, Neville & Bagge.

140th to 141st st and 7th ave, 7 br stores and flats; cost, $210,000 all; o, G. Schreimer and others; a, John Hauser.

S w cor 132d st and Park ave, 4 br stores and flats; cost, $79,000 all; o, Jacob Wirth; a, John Hauser.

DWELLINGS.

Louisville, Ky.—R. J. Domeck is about to build an $18,000 residence. Edgar E. Albus, Archt.

Rochester, N. Y.—W. H. Miller is the architect for a $25,000 brick and stone building to be erected by Levi Ward.

Helena, Ark.—L. B. Jacks writes that he is constructing a modern dwelling, and wishes prices on plumbing and heating apparatus.

Reading, Pa.—Four 3-story stone buildings are to be built by A. L. Kretz at the corner of Franklin and Perkioemer Sts.; cost $26,000. Archts., Smith Bros.

Boston, Mass.—The Suffolk Real Estate Trust has secured, through Meridith & Grew, Boston, an option on a lot of 15,600 sq. ft. of land owned by the Boston & Albany Railroad Co. A 10-story steel frame fireproof apartment is to be built on this land at an estimated cost of $500,000.

NEW YORK CITY.

Permits for the following buildings have been issued; o signifies owner; a, architect; b, builder, and c, contractor.

105 and 107 E 10th st, 2 br flats; cost, $44,000 all; o, P. Kotlowsky and B. Levy; a, Schneider & Herter.

23 and 25 Goerck st, 2 br tenem'ts; cost, $40,000 all; o, Pauline Aronowitz; a, M. V. B. Ferdon.

678 and 680 Water st, 2 br tenem'ts; cost, $56,000 all; o, Julius Dreyfus; a, G. F. Pelham.

212 to 216 E 15th st, 3 br tenem'ts; cost, $54,000 all; o, Rudolph Hilbrand; a, Hubert Drosser.

16 E 84th st, br dwell'g; cost, $40,000; o, Geo. G. King; a, Clinton & Russell; b, D. C. Weeks & Son.

20 E 84th st, br dwell'g; cost, $40,000; o, Ethel Rhinelander King; a and b, same as last.

18 E 84th st, br dwell'g; cost, $40,000; o, Edith Edgar McCagg; a and b, same as last.

100th st and 2d ave, br flat; cost, $20,000; o, Weil & Mayer; a, Schneider & Herter.

96th st and 1st ave, 2 tenem'ts; cost, $60,000 all; o, C. M. Silverman; a, Neville & Bagge.

102d st. and Boulevard, br. flat; cost, $85,000; Daily & Carlson; a, Neville & Bagge.

254 to 258 W 70th st, 3 br dwell'gs; cost, $45,000 all; o, Isador Isaac; a, Julius Munckwitz.

90th st and Columbus ave, 4 br flats; cost, $88,000 all; o, S. Millershauson; a, M. V. B. Ferdon.

92d st and Amsterdam ave, 2 br and stone flats; cost, $48,000 all; o, Sauer, Gross & Herbener; a, Neville & Bagge.

93d st and Central Park West, br and stone flats; cost, $175,000; o, James Livingston; a, Neville & Bagge.

91st st and Amsterdam ave, br and stone flat; cost, $57,000; o, Sauer, Gross & Herbener; a, Neville & Bagge.

119th st and Madison ave, 4 br and stone tenem'ts; cost, $88,000 all; o, Heine Liebeskind; a, G. F. Pelham.

119 St. Nicholas ave, br flat; cost, $100,000; o, W. C. Hunter; a, Neville & Bagge.

118th st and St. Nicholas ave, br bachelor apartm'ts; cost, $100,000; o, W. C. Hunter; a, Neville & Bagge.

114th st and St. Nicholas ave, br flat; cost, $80,000; o, Leith & Glenn; a, Neville & Bagge.

141st st and 7th ave, 9 br flats; cost, $252,000; o, G Schreiner and others; a, John Hauser.

110 and 112 Ridge st, br tenem't; cost, $35,000; o, Goodman & Wallach; a, Schneider & Herter.

440 W 45th st, br flat; cost, $20,000; o, J D Krast, Jr.; a, Louis Korn.

BROOKLYN, N. Y.

Cook st and Manhattan ave, 2 br tenem'ts; cost, $20,000; o, Balleiser & Wexler; a, M. J. Smallheiser.

Pacific st and Nostrand ave, 4 br flats; cost, $48,000 all; o, E. J. Maguire; a, A. S. Hedman.

NEW INDUSTRIAL PLANTS.

A. F. McNeil, Redfield, Ark., will build a gin plant during the summer for which a 30 h.-p. power plant will be needed.

O. C. Benbow will put up a 40 to 50 barrel flour mill driven by water power at Jamestown, N. C.

The Sanford Ice Co., Sanford, Fla., will double the capacity of its ice plant.

A 50x100-ft. knitting mill will probably be erected by A. B. Jordan, Dillon, S. C., and others. It is to be driven by a gasoline engine and have from 10 to 15 machines at the beginning.

The Woodward Furniture Works, Owosso, Mich., will put up a factory employing about 200 men, and will want a complete outfit of machinery and a Corliss engine of about 200 h.-p.

Walter Harrington, Carthage, Mo., will put up a 2-story 50x80-ft. brick and stone laundry, and will use a 30 h.-p. engine and a 70 h.-p. horizontal boiler.

The Harriman Leather Co., Harriman, Tenn., will erect a large tannery with a 256x120-ft. 2-story main building and several smaller ones. The power plant will have two 100 h.-p. boilers and a 100 h.-p. engine. The company will own its bark cars. Gen. Man. S. P. Blair will place contracts for a complete tannery outfit in a short time.

Samuel M. Green, Mech. Eng., American Thread Co., states that the company will soon build a new power plant.

Steger & Co., Chicago, Ill., will erect a 165x145-ft. brick addition to the piano shops at Steger, and enlarge their old power plant to meet requirements.

The Cannon Mfg. Co., Concord, N. C., will erect another mill and install a complete steam plant, including a 600 H.-P. cross compound engine.

The Garry Iron & Steel Roofing Co., Cleveland, Ohio, will put up three brick and iron buildings, measuring 100x300 ft., 100x150 ft. and 40x60 ft., respectively.

The Pittsburg Horse Shoe Co., Pittsburg, Pa., will put up a horse-shoe plant at Glassport, Pa.

BUSINESS NOTES.

The Goodwin Car Co., New York, has received an order from a coal and coke company for 1,000 cars, to be delivered in 90 days. The cars are to be of 80,000 lbs. capacity and equipped with both hand and air apparatus for side and center dumping.

A bridge company, called the Dubuque & Wisconsin Bridge Co., has been organized at Dubuque, Ia., by the following parties: M. M. Walker, J. J. Dunn, C. H. Meyer, Alphons Rhomberg, George Keller, John Morrison, S. D. Ryan, George Fengler, L. H. Brede, M. Kirchberg and John Longbothom.

Collins & Norton, Springfield, Mass., have been awarded a contract for the steel roof trusses and framework for the Southbridge, Mass., Parochial School, of which Chickering & O'Connell of Springfield are the architects.

The Continental Cement Co. has been incorporated under the laws of New Jersey to manufacture all grades of cement. The company has an authorized capital of $10,000,000, and its incorporators were ex-Mayor Thomas F. Gilroy of New York, Ralph Peverly of the Commercial Wood & Cement Co., William H. Clark, James C. Young and Frank Stevens.

The C. S. Burt Co., Ltd., 726 Cravier St., New Orleans, has sent the Buffalo Forge Co. a certificate as to the character of its products, which reads: "We have been using in our work something over 100 of your blowers, mostly of the largest size, each and every one of which has given entire satisfaction."

PROPOSALS OPEN.

Bids Close. — See Eng Record.

WATER-WORKS.

Mar. 11. Washington, D. C. .... Feb. 18
Adv., Eng. RECORD, Feb. 18.
Mar. 11. Washington, D. C. .... Feb. 11
Adv., Eng. RECORD, Feb 11.
Mar. 11. Montgomery, Ala .... Mar. 4
Adv., Eng. RECORD, Mar. 4.
Mar. 12. Antelope, Ore .... Mar. 4
Mar. 13. Bonds, Reno, Nev .... Mar. 4
Mar. 14. Lexington, Ky .... Mar. 4
Mar. 14. Bonds, Prescott, Ariz .... Mar. 4
Mar. 14. Castings, Boston, Mass .... Mar. 11
Mar. 14. Waterbury, Conn .... Mar. 11
Mar. 15. Piping, Baltimore, Md .... Mar. 11
Mar. 15. Gates, etc., Oakland, Cal .... Mar. 4
Mar. 15. Belem, Para, Brazil .... Nov. 26
Mar. 15. Pipe, etc., Fayetteville, Ten .... Feb. 11
Adv., Eng. RECORD, Feb. 18.
Mar. 16. Cleveland, O .... Feb. 25
Mar. 20. Pipe, etc., Pueblo, Colo .... Mar. 11
Mar. 21. St. Louis, Mo .... Feb. 25
Mar. 23. Bloomington, Ind .... Mar. 4
Mar. 23. Brooklyn, N. Y .... Mar. 11
Mar. 23. Windsor, N. Y .... Mar. 11
Adv., Eng. RECORD, Mar. 11.
Mar. 28. Darlington, Okla .... Mar. 11
Mar. 29. Pump, South Bend, Ind .... Mar 11
Apr. 1. Cullman, Ala .... Mar. 11
Apr. 1. Fire hydrants, Washington, D. C .... Mar. 11
Adv., Eng. RECORD, Mar. 11.
Apr. 3. Winnepeg, Man .... Feb. 4
Adv., Eng. RECORD, Feb. 4 to 18.
Apr. 3. Winnipeg, Man .... Mar. 11
Adv., Eng. RECORD, Mar. 11.
Apr. 10. Tank, Washington, D. C .... Mar. 11
Apr. 11. Philadelphia, Pa .... Mar. 11
Apr. 11. Lakeport, Cal .... Feb. 25
Apr. 15. Forestport, N. Y .... Mar. 4
—— Engine, Marion, Ind .... Mar. 4
—— Pumps, etc., Dubuque, Ia .... Mar. 4

SEWERAGE AND SEWAGE DISPOSAL.

Mar. 13. Toledo, O .... Mar. 4
Mar. 13. Plainfield, N. J .... Mar. 4
Mar 14. Bonds, Prescott, Ariz .... Mar. 4
Mar 14. Ponca, Neb .... Feb. 25
Mar 14. Lexington, Ky .... Mar. 4
Mar. 14. Laurium, Mich .... Mar. 4
Mar. 14. Waterbury, Conn .... Mar. 11
Mar. 14. St. Paul, Minn .... Mar. 11
Mar. 15. Cleveland, O .... Feb. 18
Adv., Eng. RECORD, Feb. 18, 25.
Mar. 15. Boston, Mass .... Mar. 11
Mar. 16. Cleveland, O .... Feb. 18
Mar. 17. Cleveland, O .... Feb. 25
Mar. 20. Pipe, Bradford, Ont .... Mar. 11
Mar. 20. Albany, N. Y .... Mar. 11
Mar. 21. Mt. Vernon, N. Y .... Mar. 11
Mar. 21. Boston, Mass .... Mar 11
Adv., Eng. RECORD, Mar. 11.
Mar. 24. Pontiac, Mich .... Mar. 4
Mar. 25. Livingston, Mont .... Mar. 11
Mar. 28. Kearney, N. J .... Mar. 11
Apr. 1. Havana, Ill .... Mar. 11
Adv., Eng. RECORD, Mar. 11.
Apr. 6. Submerged sewer, New London, Conn .... Mar. 11
Adv., Eng. RECORD, Mar. 11.
Apr. 6. Vitrified pipe, New London, Conn .... Mar. 11
Adv., Eng. RECORD, Mar 11.
Apr. 15. Honolulu, H. I .... Feb. 25
Adv., Eng. RECORD, Feb. 25, Mar. 4.

BRIDGES.

Mar. 14. Macon, Ga .... Feb. 25
Mar. 14. Abutments, Denver, Colo .... Mar. 11
Mar. 15. Chicago, Ill .... Jan. 21
Adv., Eng. RECORD, Jan. 21.
Mar. 15. Leroy, N. Y .... Mar. 4
Mar. 18. Athens, Ga .... Mar. 11
Mar. 21. Superstructure, Bellefontaine, O .... Feb. 25
Mar. 21. Buffalo, N. Y .... Mar. 11
Mar. 22. St Joseph, Mo .... Mar. 11
Mar. 25. North Adams, Mass .... Mar. 11
Adv., Eng. RECORD, Mar. 11.
Apr. 1. Substructure, St. Joseph, Mo .... Jan. 7
Apr. 1. New Whatcom, Wash .... Mar. 4
Apr. 1. Columbus, O .... Mar. 11
Apr. 5. Columbus, O .... Mar. 11
Apr. 10. Chicago, Ill .... Feb. 18
Adv., Eng. RECORD, Feb. 18.
—— Quincy, Ill .... Feb. 25
Adv., Eng. RECORD, Feb. 25.

PAVING AND ROADMAKING.

Mar. 13. Kokomo, Ind .... Feb. 24
Mar. 14. Cleveland, O .... Feb. 14
Mar. 14. Georgetown, O .... Feb. 21
Mar. 14. Sioux City, Ia .... Mar. 2
Mar. 14. Columbus, O .... Mar. 11
Mar. 15. Brick, etc., Baltimore, Md .... Mar. 11
Mar. 15. Flint, Mich .... Mar. 11
Mar. 15. Georgetown, O .... Feb. 25
Mar. 16. Lebanon, Ind .... Feb. 18
Mar. 17. Saginaw, Mich .... Mar. 11
Mar. 17. Grand Rapids, Mich .... Mar. 11
Mar. 18. New Orleans, La .... Mar. 5
Mar. 18. Washington, D. C .... Mar. 4
Mar. 20. Albany, N. Y .... Mar. 11
Mar. 20. Joliet, Ill .... Mar. 11
Mar. 20. Paterson, N. J .... Mar. 11
Adv., Eng. RECORD, Mar 11.
Mar. 22. Machinery for plant, Winnipeg, Man .... Mar. 11
Adv. Eng. RECORD, Mar. 11.
Mar. 27. Toledo, O .... Mar. 4
Mar. 31. Bellefontaine, O .... Mar. 11
Apr. 5. Asphalt, Winnipeg, Man .... Mar. 11
Adv., Eng. RECORD, Mar. 11.
Apr. 11. Huntington, Ind .... Mar. 11

POWER, GAS AND ELECTRICITY.

Mar. 13. New York, N. Y .... Mar. 4
Mar. 14. Lexington, Ky .... Mar. 4
Mar. 20. San Diego, Cal .... Mar. 4
Mar. 31. Telephone, Shanghai, China .... Nov. 19
Mar. 31. Springhill, N. S .... Mar. 11
Mar. — Fonda, Ia .... Mar. 4
Apr. 1. Cullman, Ala .... Mar. 11
Apr. 4. New York, N. Y .... Mar. 11
Apr. 4. Transmission line, Benica, Cal .... Mar. 11
Apr 8. Norfolk, Va .... Mar. 11
Apr. 10. Dayton, O .... Mar. 4
Adv., Eng. RECORD, Mar. 4, 11.
—— Pleasantville, O .... Dec. 24

GOVERNMENT WORK.

Mar. 14. Plumbing, New York, N. Y .... Feb. 18
Mar. 14. San Francisco, Cal .... Mar. 4
Mar. 15. Rock Island, Ill .... Feb. 18
Adv., Eng. RECORD, Feb. 18 to Mar. 11.
Mar. 15. Baltimore, Md .... Feb. 18
Adv., Eng. RECORD, Feb. 25, Mar. 4.
Mar. 15. San Francisco, Cal .... Feb. 11
Mar. 27. Santa Fe, N. M .... Mar. 11
Mar. 28. Water, Darlington, Okla .... Mar. 11
Mar. 28. Chicago, Ill .... Mar. 4
Adv., Eng. RECORD, Mar. 4, 11.
Apr. 1. Rock Island, Ill .... Mar. 11
Adv., Eng. RECORD, Mar. 11.
Apr. 5. Vicksburg, Miss .... Mar. 4
Adv., Eng. RECORD, Mar. 4, 11.
Apr. 6. New Orleans, La .... Feb. 11
Adv., Eng. RECORD, Feb. 11 to 25.
Apr. 6. Wilmington, Del .... Mar. 11
Adv., Eng. RECORD, Mar. 11.
Apr. 8. Norfolk, Va .... Mar. 11
Apr. 10. Tank, Washington, D. C .... Mar. 11
Apr. 10. Kansas City, Mo .... Mar. 11
Adv., Eng. RECORD, Mar. 11.
Apr. 14. Louisville, Ky .... Mar. 11
Apr. 17. San Francisco, Cal .... Mar. 11
Adv., Eng. RECORD, Mar. 11.

BUILDINGS.

Mar. 13. School, Kansas City, Kan .... Mar. 4
Mar. 13. School, New York, N. Y .... Mar. 4
Mar. 13. New York, N. Y .... Mar. 4
Mar. 14. School, Algona, Ia .... Feb. 25
Mar. 13. Schools, Racine, Wis .... Mar. 11
Mar. 13. Vent., etc., schools, Boston, Mass. .... Mar. 11
Mar. 14. Htg. school, Algona, Ia .... Mar. 11
Mar. 14. Schools, New Durham, N. J .... Mar. 11
Mar. 15. Lancaster, Wis .... Feb. 25
Mar. 15. Mankato, Minn .... Feb. 25
Mar. 15. School, Louisville, Ky .... Feb. 25
Mar. 15. Canton, S. D .... Feb. 25
Mar. 15. Plans, Wilkesbarre, Pa .... Jan. 28
Mar. 15. Depot, Fort Worth, Tex .... Mar. 4
Mar. 15. School, Sioux Falls, S. D .... Mar. 4
Mar. 15. Columbus, O .... Mar. 11
Mar. 16. School, New York, N. Y .... Mar. 11
Mar. 16. School, Weehawken, N. J .... Mar. 11
Mar. 18 School, Chester, Ill .... Mar. 4
Mar. 20. Iowa City, Ia .... Feb. 18
Mar. 20. Vent. and htg. school, Lima, O .... Mar. 4
Mar. 20. Bloomington, Wis .... Mar. 4
Mar. 20. Appleton, Miss .... Mar. 4
Mar. 20. School, New York, N. Y .... Mar. 11
Mar. 20. Schools, Mattoon, Ill .... Mar. 11
Mar. 21. School, Annapolis, Md .... Mar. 11
Mar. 21. School, New York, N. Y .... Mar. 11
Mar. 22. Dallas, Ore .... Mar. 4
Mar. 23. Vault, Montgomery, Tex .... Mar. 4
Mar. 23. Steam plant, New York .... Mar. 11
Mar. 25. School, Cleveland, O .... Mar. 4
Mar. 25. School, York, N. D .... Mar. 4
Mar. 28. Mansfield, O .... Mar. 4
Mar. 30. Uvalde, Tex .... Mar. 11
Mar. — Portland, Ind .... Mar. 4
Apr. 1. School, Hannaford, N. D .... Mar. 4
Apr. 1. School, Cleveland, O .... Mar. 11
Apr. 3. Many, La .... Jan. 21
Apr. 3. School, Wells, Minn .... Mar. 11
Apr. 4. Plumbing, etc., New York, N. Y .... Mar. 11
Apr. 6. Jail, Keyser, W. Va .... Mar. 11
Apr. 14. Plans, Bradford, England .... Jan. 21
Apr. 15. Plans, etc., Birmingham, Ala .... Mar. 4

MISCELLANEOUS.

Mar. 11. Washington, D. C .... Feb. 18
Adv., Eng. RECORD, Feb. 18.
Mar. 13. Dredging, New York, N. Y .... Mar. 4
Mar. 13. Eng'rs' supplies, New York, N. Y. Mar. 4
Mar. 13. Garbage disposal, Dover, N. J .... Mar. 11
Mar. 18. Park work, New Orleans, La .... Mar. 4
Mar. 20. Street cleaning, Albany, N. Y .... Mar. 11
Mar. 21. Dredging, Buffalo, N. Y .... Mar. 11
Mar. 23. New York, N. Y .... Mar. 11
Mar. 30. Garbage disposal, Providence, R. I. Mar. 11
Mar. 31. Garbage disposal, Rochester, N. Y. Mar. 4
Apr. 3. Dredging, Philadelphia, Pa .... Mar. 11
Apr. 10. Ditch, etc., Fremont, Neb .... Mar. 4
June 30. El. Ry., Shanghai, China .... Mar.
Oct. 1. Railroad, Moscow, Russia .... Feb.

SCHOOLS.

Racine, Wis.—Bids are wanted March 13 for a school; also for remodeling and building an addition to the 6th Ward school. O. Burlingame, Chmn. Bd. Pub. Wks.

Charlottesville, Va.—The plans of Paul J. Pelz of Washington, D. C., have been accepted for a $17,000 dormitory for the University.

Morgantown, W. Va.—The mechanical hall at the West Virginia University was burned March 4; loss, about $50,000.

Philadelphia, Pa.—Edward F. Durang, Archt., 1200 Chestnut St., has awarded the contract for the new monastery and building for Villanova College to Jacob Myers & Sons, cor. Juniper and Sansom Sts., for $300,000.

Noblesville, Ind.—It is stated that a $20,000 high school will be erected here.

Pawtucket, R. I.—The plans of Stone, Carpenter & Willson of Providence have been accepted for a 12-room school on Hancock St. and those of Albert H. Humes of Pawtucket for a 6-room school on Broadway; cost of both, $52,000.

Carlyle, Ill.—It is stated that at the April election the question of erecting a $20,000 school will be voted upon.

Topeka, Kan.—The Senate on March 1 passed a bill appropriating $65,000 for a museum and $55,000 for a chemistry building at the State University.

Grand Rapids, Mich.—The St. Andrew's Cathedral Parish is reported to have decided to build a parochial school, to contain 16 rooms and an assembly hall. Rev. J. A. Schmitt, Pastor.

Kirksville, Mo.—It is stated that an election will be held April 4 to vote on issuing $35,000 school bonds.

Tarentum, Pa.—The citizens are stated to have voted to issue $25,000 bonds for a school.

Corry, Pa.—Michael Crowe of Meadville is said to be preparing plans for a parochial school to be erected by St. Thomas' Catholic Society. Rev. Thos. Lowegran, Pastor.

Bids are wanted March 16 for School No. 175 in Bronx Boro. and until March 21 for alterations, etc., to School No. 69. Richard H. Adams, Chmn. Com. on Bldgs.

McKeesport, Pa.—Daniel Stratton is stated to have received the contract for erecting the high school at $99,650.

Wells, Minn.—It is stated that bids are wanted April 3 for a school; also for a system of heating and plumbing. B. Bieri, Secy. Bd. Educ.

Orange, Mass.—The citizens are stated to have voted to appropriate $15,000 to enlarge the high school.

Anacostia, D. C.—Congress is stated to have passed a bill providing for a $30,000 school on Nicholas Ave.

Mattoon, Ill.—Bids are wanted March 20 for the West Side School; also for remodeling and repairing Central School. L. L. Lehman, Pres. Bd. of Educ.

Cleveland, O.—Bids are wanted April 1 for an addition to Union School. H. Q. Sargent, School Dir.

Canton, O.—The sum of $20,000 has been appropriated for a school. A. O. Slentz, Supt. of School Bldgs.

Annapolis, Md.—Bids are wanted March 21 for a school at Brooklyn. F. Eugene Wathen, School Examiner.

New Durham, N. J.—Bids are wanted March 14 for alterations and additions to Schools Nos. 3, 6 and 7 in the township of North Bergen. Gustav W. Scholp, Pres. Bd. of Educ.

Weehawken, N. J.—Bids are wanted March 16 for an addition to School No. 2. Christopher Roehr, Clk. Bd. of Educ.

Norristown, Pa.—The Board of Education has retained Seymour Davis, 907 Walnut St., Philadelphia, to prepare plans for a stone and brick high school, to be erected on the site of the old Oak St. structure.

Boston, Mass.—Bids are wanted March 13 (change of date) for a ventilating and heating apparatus in the East Boston High School. Edw. I. Aldrich, Chmn. Com. on New Bldgs., School Com.

Attleboro, Mass.—The citizens are stated to have voted March 5 to erect a $12,000 school.

Freeport, Ill.—It is stated that plans have been prepared for a $20,000 school. Ad N Y City—Under Schools

Homestead, Pa.—The citizens are stated to have voted to issue $35,000 bonds for a school.

Algona, Ia.—Bids are wanted March 14 for heating the high school. C. M. Doxsee, Secy. Bd. Directors of the Independent School Dist.

Lexington, Ky.—The General Council has appointed a committee to report upon the advisability of purchasing the water-works from the Lexington Hydraulic & Manufacturing Co. The plant is valued at $500,000.

New York City.—The Mayor on March 7 signed the resolution authorizing bonds to the amount of $7,673,640 for new schools and school sites.

Brick dormitories are to be built at 10th Ave. and 21st St. for the General Theological Seminary. C. C. Haight, Archt. Cost, $65,000.

A permit has been issued for a brick school for the city to be built at 133d St. and 8th Ave. C. B. J. Snyder, Archt., 585 B'way. Cost, $260,000.

The opening of bids for Schools 171 and 172 has been postponed until March 16 and 20 respectively.

The following bids were opened March 6 by the Committee on Buildings of the Board of Education for erecting Public School 109: Luke A. Burke, 401 W. 59th St., $307,700; P. Gallagher, 150 5th Ave., $317,000; Mapes-Reeve Const. Co., 150 Nassau St., $321,546; John J. Hopper, 217 W. 125th St., $328,697; P. J. Brennan, 63 W. 22d St., *$293,000; Murphy Bros., 407 E. 101st St., $305,000; John H. Parker Co., 256 Bway., $327,000; Thos. Cockerill & Son, 550 W. 51st St., $318,900; William S. Long, 1125 Bway., $298,890; Harry McNally, 287 4th Ave., $313,000.

*Contract awarded.

STREET CLEANING AND GARBAGE DISPOSAL.

Dover, N. J.—It is stated that bids are wanted March 13 for removing ashes and garbage for one year. Jos. V. Baker, City Clk.

Providence, R. I.—Bids are wanted March 30 for the collection and removal of garbage for a period of 5 years. Horace Remington, Chmn. Com. Health Dept.

Braddock, Pa.—Health Officer for 1898 F. E. Louis, in his report for the year, recommends the erection of a garbage furnace and a system of collecting refuse and garbage. Capt. Joseph Price has been elected Health Officer to succeed F. E. Louis.

Albany, N. Y.—Bids are wanted March 20 for the removal of street dirt during 1899. Thos. J. Lanahan, Clk. Bd. Contract and Apportionment.

Galveston, Tex.—There is talk of building a garbage disposal plant, but nothing definite has as yet been done.

Boston, Mass.—The Crematory Association has asked for an appropriation for the establishment of a crematory.

Bridgeport, Conn.—H. G. Scofield, City Engr., writes that an appropriation of $14,000 has been made for a garbage crematory, but no further action has been taken.

GOVERNMENT WORK.

Louisville, Ky.—Bids are wanted April 14 for a ventilating and heating apparatus in the U. S. Marine Hospital. James Knox Taylor, Superv. Archt., Treas. Dept., Washington, D. C.

Darlington, Okla.—Bids are wanted March 28 for a water system in the Arapahoe Boarding School at Cheyenne and Arapahoe Indian Agency. W. A. Jones, Commr. Indian Affairs, Dept. of the Interior, Washington, D. C.

Norfolk, Va.—Bids are wanted April 8 for enlarging the electric light and power plant at the Navy Yard. Mordecai T. Endicott, Ch. Bureau Yards & Docks, Navy Dept., Washington, D. C.

Washington, D. C.—Bids are wanted April 10 for a water tank and tower at Fort Mojave, Ariz. W. A. Jones, Commr. of Indian Affairs.

Santa Fe, N. M.—Bids are wanted March 27 for an electric light system at the U. S. Indian School. W. A. Jones, Commr. Indian Affairs, Dept. of the Interior, Washington, D. C.

Kansas City, Mo.—Bids are wanted April 10 (change of date) by the Superv. Archt., Treas. Dept., Washington, D. C., for the interior finish, plumbing, etc., for the U. S. Post Office and Court House, as advertised in "The Engineering Record."

San Francisco, Cal.—Bids are wanted April 17 (change of date) by the Superv. Archt., Treas. Dept., Washington, D. C., for masonry work, roof covering, etc., for the U. S. Post Office and Court House, as advertised in "The Engineering Record."

Rock Island, Ill.—Bids are wanted April 1 at the U. S. Engineer Office for a hydraulic dredge, as advertised in "The Engineering Record."

Wilmington, Del.—Bids are wanted April 6 at the U. S. Engineer Office for the removal of wreck of pungy "Cornelia Ann" in Crisfield Harbor, Md., as advertised in "The Engineering Record."

Fort Hancock, N. J.—The following bids for constructing a rip-rap wall were opened March 8 by Capt. G. G. Bailey, A. Q. M., U. S. V., New York City, as advertised in "The Engineering Record": Price per ton of 2,000 lbs.: Saml. E. Bouker, 110 Wall St., $1.57; Julian C. Smith, 146 Broadway, $1.17; Eugene Lentilhon, 11 Broadway, $1.21½; C. H. Connell, 2 Cortlandt St., $1.45; Lynton S. McNeal, 80 Reade St., $2.12.

Bidders all of N. Y. City.

MISCELLANEOUS.

Cheboygan, Mich.—A bill has passed the Senate authorizing the city to borrow $50,000 for public improvements and park purposes.

Ocean City, N. J.—Press reports state that it is proposed to build a pier 35 ft. wide and extending 1,200 ft. seaward; estimated cost, $25,000. R. W. Edwards and W. E. Massey, of Philadelphia, are said to be interested.

Cleveland, O.—The Board of Control has passed favorably on the resolution instructing Director Warden to have plans and specifications prepared for docks at the foot of Willson Ave. The proposed docks will cost about $40,000.

Owosso, Mich.—The R. N. & M. L. Parshall Milling Co. is said to be considering the matter of constructing a dam in the Shiawassee River, to cost about $7,000.

Savannah, Ga.—Hegeman & Co. of Pittsburg have secured the following contracts for work in connection with the establishment of the Georgia & Alabama terminals on Hutchinson's Island; dredging at $135 per cu. ft., piling $1.65 per lin. ft. and lumber $19.50 per 1,000. Approximate amount of contracts, $400,000. A. Hunter Johnson, Ch. Engr. Georgia Construction Co.

New York, N. Y.—Bids are wanted March 23 for engineers' supplies. Francis J. Lantry, Commr. of Correction.

Cleveland, O.—Bids are wanted April 5 for $500,000 Park bonds. J. H. McBride, Pres. Bd. Park Commrs.

Philadelphia, Pa.—Bids are wanted April 3 for dredging docks and in front of bulkheads not belonging to the city. Joel Cook, Pres. Bd. of Park Wardens.

Salinas, Cal.—Bids are wanted March 16 for $30,000 improvement bonds. John J. Kelly, City Clk.

Philadelphia, Pa.—The Councils' City Property Committee has adopted the report of the jury of experts appointed to pass upon the competitive plans for the laying out of League Island Park. The first prize was awarded to Samuel Parsons, New York City.

Boston, Mass.—The people of Roxbury are endeavoring to obtain a loan of $500,000 for an extension of Stony Brook Channel, beyond Boylston Station.

Buffalo, N. Y.—Bids are wanted March 21 for dredging Buffalo River and Harbor, Blackwell Canal and Peck Slip. R. G. Parsons, Secy. Bd. Pub. Wks.

Kansas City, Mo.—North Terrace Park bonds amounting to $550,000 have been sold.

PROPOSALS.

Proposals for Submerged Sewer.

Office of the Board of Sewer Commissioners, City Hall, NEW LONDON, CONN.

Sealed proposals, endorsed as above, for building and laying about 700 feet of 24-inch wooden, submerged sewer, will be received by the Board of Sewer Commissioners at the above office until 8.00 o'clock p. m., April 6th, 1899.

Plans and specifications may be seen at the office of the Engineer.

By order of the Board of Sewer Commissioners, W. H. RICHARDS, Engineer.

Proposals for Sewer.

Office of the Board of Sewer Commissioners, City Hall, NEW LONDON, CONN., March 9th, 1899.

Sealed proposals, endorsed as above, for furnishing and laying about

1,100 lineal feet of 24-inch,
165 " " " 20- "
92 " " " 18- "
1,300 " " " 15- "
1,500 " " " 12- " and
850 " " " 8- " salt glazed, vitrified pipe sewer and the necessary specials and manholes, will be received by the Board of Sewer Commissioners at the above office until 8.00 o'clock p. m., April 6th, 1899.

Plans may be seen and specifications obtained at the office of the Engineer.

By order of the Board of Sewer Commissioners, W. H. RICHARDS, Engineer.

COMMONWEALTH OF MASSACHUSETTS.

METROPOLITAN WATER BOARD.

SEWERAGE SYSTEM.

Sealed proposals will be received at the office of the Metropolitan Water Board, 3 Mt. Vernon Street, Boston, Mass., until 2.30 o'clock p. m. of Tuesday, March 21, 1899, for continuing and completing Section 2 of the Clinton Sewerage System. The work to be done includes about 3,600 feet of intercepting sewer, 20, 24 and 30 inches in diameter; the completion of a masonry reservoir having a capacity of 600,000 gallons, and the foundations for a pumping station. Pamphlets containing further information for bidders and form of proposal will be mailed to contractors who apply to the Chief Engineer, or may be obtained at his office, 3 Mt. Vernon Street, and at the office of the Metropolitan Water Board, Clinton, Mass. Plans and specifications may be seen at both these offices. The printed form must be used in making proposals. The Board reserves the right to reject any or all bids and to accept the proposal deemed best for the Commonwealth.

HENRY H. SPRAGUE, Chairman.
WILMOT R. EVANS,
HENRY P. WALCOTT,
Metropolitan Water Board.
FREDERIC P. STEARNS,
Chief Engineer.
WILLIAM N. DAVENPORT, Secretary.
Boston, March 7, 1899.

Notice to Contractors.

Department of Streets and Sewers, Office of the City Street Commissioner, Room No. 2, City Hall, PATERSON, N. J., March 9th, 1899.

Sealed proposals will be received by the Board of Aldermen of the City of Paterson until Monday evening, March 20th, at Eight o'clock, in the Office of the City Street Commissioner, Room No. 2, City Hall, for the following work:

To pave with brick pavement—

Broadway, from East 18th Street to East 33d Street; Van Houten Street, from Prospect Street to Main Street; Prospect Street from Van Houten Street to Market Street; Paterson Street, from Market Street to River Street, and Grand Street from Erie Railroad to Spruce Street.

To pave with asphalt pavement—

Mill Street, from Market Street to Grand Street; Washington Street, from Broadway to River Street; Church Street, from Broadway to Market Street, and Ellison Street from Church Street to Straight Street.

Plans, specifications and information can be obtained upon application at Room No. 2, City Hall.

THOMAS McLEAN,
City Street Commissioner.

Proposals continued on pages xi and xii.

THE ENGINEERING RECORD.
Volume XXXIX. Number 16

TABLE OF LEADING ARTICLES.

The Engineering Record, conducted by Henry C. Meyer, is published every Saturday at 100 William Street, New York. Its opinions on technical subjects are either prepared or revised by specialists. Subscriptions are received and single copies supplied by the International News Company, Breams Building, Chancery Lane, London.
The subscription rate is $5 a year for the United States, Canada and Mexico, and $6 for other countries in the Postal Union. Remittances should be made by check, New York draft or money order in favor of The Engineering Record. No responsibility is assumed for payments made otherwise, except those for subscriptions to the International News Company.

JUNIOR MEETINGS OF ENGINEERING SOCIETIES.

Engineers who have attended the meetings of national engineering societies with anything approaching regularity will probably be pleased to notice the prospect of associating the younger members of these organizations more intimately than has heretofore been the practice in this country. There has been a feeling among some of the elders that if the juniors were allowed to take a prominent part in the proceedings of regular sessions, the meetings might degenerate into something approaching class-room exercises of post-graduate students in technical schools. An equally important fact has apparently been overlooked, namely, that it is the young men who are most anxious to obtain information concerning all the details of engineering work, it is they who form a large proportion of the attendance at the meetings, and it is they who will eventually be the older members of the societies and form their main reliance. The American Society of Civil Engineers has been particularly unlucky in having the reputation of discountenancing the attempts of young members to obtain information at the regular meetings. To a certain extent this feeling has been a mere matter of conjecture, but it is nevertheless true that on a few occasions juniors and associate members of this society have been treated in a rather unpleasant manner by their elders. In the American Society of Mechanical Engineers there has not been such a feeling towards the juniors, but the two regular sessions of that organization are so filled with regular business that it is impracticable for the young men to do much talking about matters which appeal to them more strongly than the set papers.

The Institution of Civil Engineers has long conducted in an apparently successful manner a series of students' meetings in various portions of Great Britain. About 10 per cent. of the membership of the Institution are students, and for the purpose of holding these special meetings they have students' associations, with headquarters at Manchester, Glasgow, Birmingham, Newcastle and in Yorkshire. These organizations hold entirely independent meetings, and many interesting papers are presented before them. The discussions, as reported in the British journals, are frequently of much value, and the papers occasionally printed in the "Proceedings" of the Institution are by no means the least valuable they contain. Whether such an organization would be of much usefulness in this country is somewhat doubtful, because the local engineering societies already afford means of intercourse between the young engineers in various sections of the country, and their sessions, which are largely attended, are marked by evidences of interest too frequently lacking in some of the older associations. Apparently nothing further has been done than to suggest that the two national societies devoted to civil and mechanical engineering respectively, should hold sessions in New York for their junior members, and it may be well to see how these meetings prosper before endeavoring to hold similar sessions elsewhere. This is particularly desirable in the case of the civil engineers, because the juniors already have the advantages of the Brooklyn Engineers' Club, a thriving organization of about 150 members, holding one regular meeting and three informal meetings each month, which are largely attended by young members of the profession and arouse among them considerable more interest than has been manifested by them in the presence of their elders at the rooms of the American Society of Civil Engineers.

These students' meetings should be encouraged by all the members of the societies. The young men entering the profession to-day have, as a rule, a theoretical training far greater than that possessed by most of their elders. It is this theoretical training which enables them to accomplish many things more rapidly and expeditiously than would be possible under the methods which depend upon plain algebra and a little trigonometry. If this knowledge is of no use then the American technical schools are of no value; a proposition which no sane man will defend. It is only natural that the theoretical side of engineering appeals to those who have studied it carefully much more than to people unacquainted with its details, and it is highly desirable that this knowledge should not be allowed to go to waste through neglect. Meetings of the kind which have been proposed would allow young graduates of technical schools to keep up this knowledge as well as to interchange their views and experiences on more practical subjects. But the main object of the meetings should not be the reading or discussion of set papers, at least at first. Informal interchange of ideas on engineering subjects will interest more young men than elaborate papers like those of the regular meetings of the societies. Very few men have the gift of reading a written or printed technical article in an interesting manner, while most engineers, even if they are young, can discuss professional subjects in an entertaining way. If the junior meetings will give them an opportunity to take part in oral discussions of this sort and they will take advantage of it, important results should follow. The work of the engineer is usually so correlated with the work of others, that to-day professional knowledge is but a small part of the requirements for success. The engineer simply plans and builds; there is also the financier to manage the whole enterprise, the counsel to keep it clear of legal difficulties, and very often the business manager to attend to the sales. Unless the engineer can explain his needs to these men in every-day, clear, forcible English, free from technicalities, he will not be successful, and there are few men who can do this without training. For this reason the junior meetings, if not too formal, will afford a training to young engineers which will be of great value to them when, later in life, they are called upon to describe their projects to men to whom hysteresis losses, cylinder condensation and compensating grades are equally meaningless terms.

THE NEW MASSACHUSETTS METROPOLITAN SEWERAGE PROJECT.

The Metropolitan Sewerage Commission of Massachusetts has just made public a new project for rounding out at a cost of about $4,600,000 the sewerage works begun by the City of Boston, under the direction of Mr. Joseph P. Davis, M. Am. Soc. C. E., and supplemented on a grand scale by the commissioners themselves in the famous metropolitan system. This system has three divisions. The northern one is entirely independent of any other, and has its own outlet at Deer Island. The remaining two are in the valleys of the Charles and Neponset Rivers, and their common outlet is that of the drainage system owned by the City of Boston, which is paid an annual rental for the service it renders.

The sewerage system of Boston comprises a number of district sewers, which discharge into interceptors conveying the sewage to a main outfall leading to a pumping station. Here the sewage is raised and discharged through a long tunnel under a part of the harbor to a reservoir on Moon Island, which has an outlet into the harbor at a point where there are strong tidal currents. When these works were designed it was estimated that the total area eventually tributary to them would be about 58 square miles. The portion of this area less than 40 feet above mean low-water, 12 square miles in extent, and 3 square miles of territory at a higher elevation and needing drainage facilities, was taken as the district properly tributary to the low-level interceptors, from which sewage would always have to be pumped. The remaining territory would be drained by a high-level system, to be built at some future time, which would connect with the outlet of the low-level works at some point beyond the pumping station, thus saving the expense of raising the sewage from the high-level district.

These plans were not carried out. The high-level system was never built, and the low-level system constructed in 1877 to 1884 has not only been forced to handle by pumping the sewage of the 15 square miles for which it was intended, but also that from the remaining sewered portion of the original 58-mile district and 63 square miles more added by arrangement with the Metropolitan Sewerage Commissioners and the City of Quincy. As a result, the Boston system is now unable at times to meet the demands upon its capacity. This has been estimated independently by Mr. F. P. Stearns, while chief engineer of the Massachusetts Board of Health, and Mr. William M. Brown, Jr., chief engineer and superintendent of the Metropolitan works, as 122,000,000 gallons in 24 hours, which may be raised by certain changes to a maximum of 154,000,000 gallons.

The present facilities belonging to the City of Boston being inadequate for handling the sewage from the territory tributary to them, the commissioners advise organizing a south metropolitan sewerage district, embracing Waltham, Newton, Watertown, Brighton, Brookline, Dedham, Hyde Park, Milton, Quincy, parts of Boston, West Roxbury and Dorchester. This district is to have an entirely new intercepting system, forming an outlet for the present metropolitan sewers in the territory and their future extensions and additions. There will be an entirely new outfall in the harbor at a point where there are strong tidal currents, a pumping station for raising the sewage of the Charles River Valley system, and a pumping station for a part of the sewage of Quincy, all designed to meet the needs of the district until 1940. Further details of this great undertaking will be given later; for the present it is merely desirable to point out two marked advantages of the plan, the construction of a third outfall sewer through which sewage will be discharged into the tidal currents of the harbor, thus avoiding the emission of an enormous quantity at any one point, and the control of the entire system of works from their head to their outlet by a single responsible authority.

THE POLLUTION OF THE PASSAIC RIVER.

Chancellor McGill, of New Jersey, has recently issued a temporary injunction restraining the City of Paterson from "doing anything that will increase the quantity of its sewage" discharged into the Passaic River until the final hearing of the suit brought against it in the Court of Chancery by the Attorney General of New Jersey, the Mayor and Aldermen of Jersey City, and a number of owners of riparian lands. The case has been in the chancellor's hands about a year, and his decision, although of but temporary force, has attracted much attention because of the magnitude of the interests involved.

The complainants who are landowners along the non-tidal portion of the stream, whose ownership extends to the middle of the river, are declared to be "entitled to have the water flow for them unpolluted, that they may use it for their ordinary domestic purposes, and, within reasonable limits, for business or other purposes." The corporation of Jersey City is not so fortunate in this respect, according to the chancellor, for its property is much farther downstream and it is merely a riparian owner along a tidal river, of which the water and submerged land is the property of the State. On the other hand, as grantee of the State of the right to take "pure and wholesome water" from the river at its pumping station, the city is held to suffer special injury from the pollution of the stream, because the expenditure for the station is made useless and the citizens are deprived of a water supply granted by the Legislature.

The city claimed that it has a right to discharge its sewage into the river, no matter what the consequences may be, because this is a natural and reasonable use of the stream, and because the legislative authority for constructing its sewers contemplated their discharge into the Passaic. The chancellor held, however, that there are no tenable grounds for classing such drainage as a reasonable or natural use of the river. Another claim made by the city was that the complainants were so tardy in applying for an injunction, that none should be granted. This was overruled because the mere discharge of sewage into the river by the city, presumably acting under legal advice, did not justify an assumption that this discharge would increase so as to become a nuisance. Moreover the Legislature had taken the matter under consideration in 1896, and the complainants were justified for this additional reason in their delay in bringing the suit. The court decided that the potability of the river water was destroyed unless it was purified, and that noxious odors arose from it which caused general discomfort to the people living along the banks. The temporary injunction was accordingly granted.

Following close on this decision comes another, by Vice-Chancellor Reed, which enjoined the City of Newark from constructing an outlet sewer discharging into the tidal portion of the river about 55 feet from the premises of the complainant in the case. The decision contains the following description of the present condition of the river: "The natural beauty of the stream has been destroyed by the filth emptied into it from Paterson to the Bay. Its banks, which should be a favorite site for handsome residences, have become unfit for residential purposes. A driveway projected to run along its banks was abandoned because of the offensive odors from the foul river." The construction of the sewer would, it was held, result in a continuing injury to the complainants' property, and was therefore enjoined. "It is clearly proved," said the vice-chancellor, "that at certain seasons the discharged sewage will cause a stench, which will be very annoying to those near the sewer's outlet. It is probably true that during those portions of the year when the flow of water is undiminished by drought and the weather is cool, the odors from the river, even at the point of the sewer's discharge, will not be markedly offensive. When, however, the flow of the river becomes diminished by summer droughts, then this diminution of water, coupled with midsummer heat, will undoubtedly cause the exhalation of extremely nauseating odors. I draw these conclusions, not so much from the testimony which exhibits the quantity of fresh water that is likely to flow in the river and the quantity of tidal water which flows and ebbs past the point of discharge of the sewer, and the quantity, character and density of the sewage itself, as I do from what is proved in regard to the effect of similar conditions existing elsewhere along the river within the limits of the city." While a city may empty some sewage, it was held, into a stream of water which flows through it, it cannot do so to an extent which will create a nuisance, nor does it matter whether the stream is tidal or non-tidal.

MECHANICAL PLANT OF THE BOSTON SOUTHERN TERMINAL STATION.

At various times during the past year different details of the new Southern Terminal Station, recently opened in Boston, were described in these columns. The station, it will be remembered, was built by The Boston Terminal Company, formed by the New York, New Haven & Hartford Railroad and the Boston & Albany Railroad Companies, which will use the depot as a terminal for their local and through trains. In the design and construction of the station the owners were represented by Mr. George B. Francis, M. Am. Soc. C. E., resident engineer. The buildings were constructed from the plans of Messrs. Shepley, Rutan and Coolidge, architects, of Boston, Mass. The men who were in control of the enterprise were sufficiently far-sighted to appreciate the importance of giving early and comprehensive attention to the entire operating equipment of the Terminal, in order that the requirements imposed by the unique features of the station might be met to the best advantage, and in a manner that would secure the greatest economy in first cost and expense of operation. It was evident that the needs of the station would involve many varied kinds of service, each of which would have to be harmonized to all the rest to an unusual degree in order to accomplish these results. Long before other portions of the work were advanced to that point which renders difficult any minor modifications that might be desirable in connection with the operating apparatus, Westinghouse, Church, Kerr & Company were invited to consider and report upon the most suitable equipment. Extended investigations were made of all important railroad terminals, both in this country and abroad, and detailed plans and specifications were finally prepared for the new Terminal for a complete installation more comprehensive than for any railway station in the world. The project included an extensive interlocking system for switches and signalling, a large power plant, passenger elevators and baggage lifts, a ventilating and warming plant for the buildings, an ice and refrigerating plant for cooling provision boxes and storage rooms, a plant for filtering and cooling drinking water, a steam service for car heating, appliances for charging air brakes previous to the departure of trains, a fire protective system, a pumping plant for freeing portions of the premises which are below tide level with storm water, etc., provision for preventing the stoppage of train-shed leader pipes by frost, furnishing steam supply in the head house, etc. Arrangements were finally made with Westinghouse, Church, Kerr & Company to install the entire work.

Many of the other engineering features of the station were described in a series of articles published in four consecutive issues, beginning December 31, 1898. A general account of the site was given, dealing largely with the problems due to the high ground-water level. The head house, the minor buildings, and the steel trainshed, both its design and erection, were also described at considerable length. The

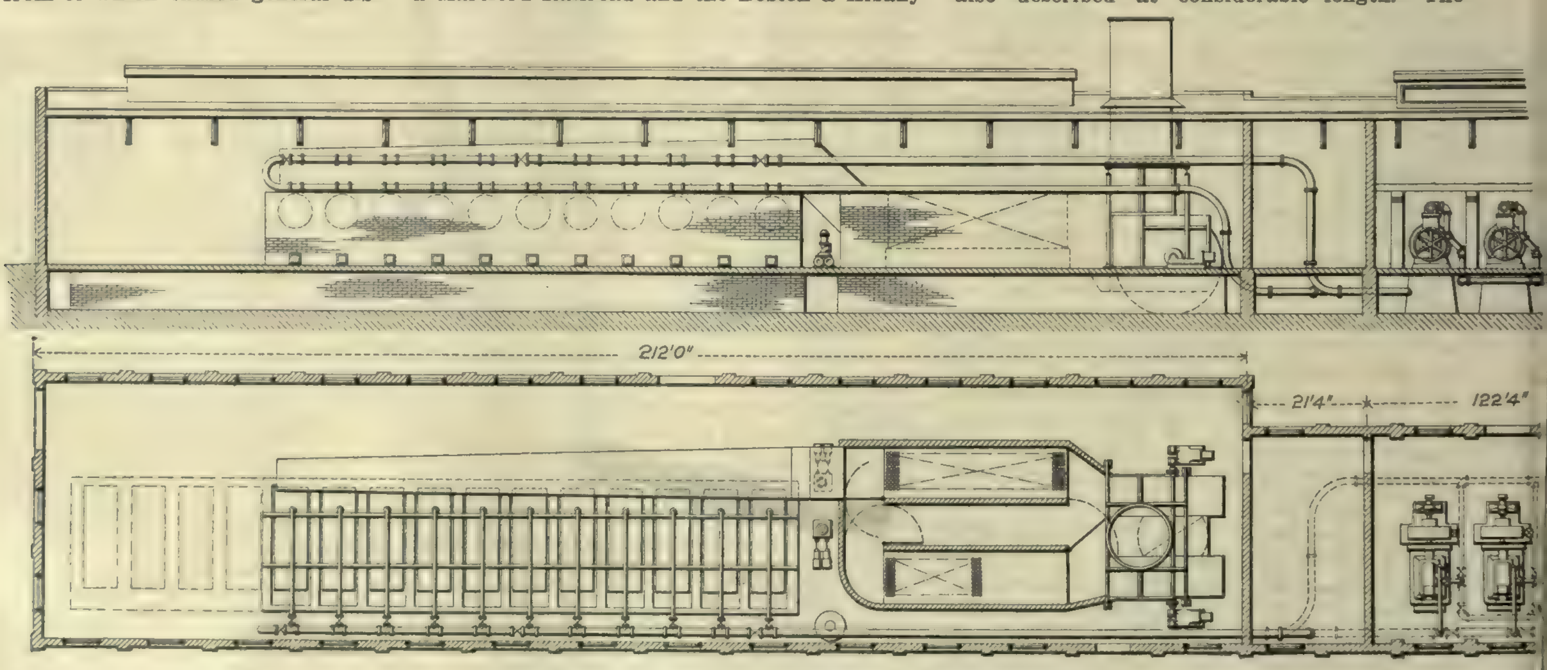


Figure 1a.—Plan and Longitudinal Section of Boiler Room.

SOUTHERN TERMINAL RAILROAD STATION
GEORGE B. FRANCIS, M. AM. SOC. C. E., RESIDENT ENGINEER

earliest extended reference to the subject was in the issue of January 2, 1897.

The power house is a one-story brick structure, extending along Dorchester Avenue for a distance of 445 feet, and bounding the tracks entering the train shed on the south. Figure 1 shows a plan and section of the power house. It is divided into a boiler, pump and engine room and an ice plant, these being 212 feet, 21 feet, 122 feet and 89 feet in length respectively. The boiler room has an extreme width of about 48 feet, and the remainder of the building, 40 feet.

The boiler room is designed for an ultimate capacity of 15 horizontal return-tubular boilers. Ten, built by Messrs. Edward Kendall & Sons, Cambridgeport, Mass., under the inspection of Westinghouse, Church, Kerr & Company, have been installed up to the present time. The boiler room floor is about 10 feet below track level, and coal on cars is brought to the north wall of the boiler house and dumped into pockets, from which chutes lead to the boiler-room floor in front of the furnaces. The boilers are equipped with Roney mechanical stokers. Figure 2 is a view of the boiler room, showing the stoker fronts and the small engine driving them. Each boiler is 18 feet in length and 72 inches in diameter, and contains 130 3-inch tubes. The boilers are designed for a steam pressure of 145 pounds, and the specifications were therefore unusual. The shell plates are ½ of an inch thick, of acid open-hearth fire-box steel. The heads of the boiler are 9/16 inches thick. The longitudinal seams of the boiler are of the quadruple-riveted butt joints; the girth seams, single-riveted lap joints. The rivet holes were punched small, the plates rolled, bolted in position and the holes drilled out to full size. After drilling, the plates were taken apart and the burr removed before riveting. The heads above the tubes were strengthened by means of 3 x 3 x ½-inch angles, braced by means of five 1¾-inch through braces. The furnace has a fire brick lining 9 inches thick. In the rear of the bridge wall the fire brick is 4½ inches thick. It was required that the fire brick used in the furnace lining should be capable of being heated to a red heat and plunged into cold water without being shattered.

Two economizers are provided for absorbing the waste heat of the flue gases. As will be seen in Figure 1, the gases may pass through either of the economizers, through both in succession, or both economizers may be by-passed, the flues and dampers being constructed so as to make this possible. The economizers were of Westinghouse, Church, Kerr & Company's im-

FIGURE 2.—MECHANICAL STOKER PLANT IN BOILER ROOM.

proved circulating type, and were manufactured by the Fuel Economizer Company, of Matteawan, N. Y. One contains 520 pipes and the other 240 pipes, presenting 7,600 square feet of heating surface. Each section contains 10 4½-inch tubes 9 feet in length. The economizer settings are for an ultimate installation of 1,040 square feet of surface.

Draft for the boiler plant is produced by two blowers with wheels 14 feet in diameter and 7 feet wide set in steel housings. Each fan is driven by a steam engine, and is designed to produce draft for an ultimate installation of 19 boilers, equal to the draft that would be obtained from a properly proportioned chimney 250 feet high. The fans discharge the gases into a ⅜-inch steel stack, 11 feet in diameter and extending 44 feet above the engine room floor, and only a short distance above the power house roof. The fans were built by the B. F. Sturtevant Company, Boston, Mass., in accordance with detailed drawings and specifications prepared by the engineers.

Each boiler is connected by pipe bends to the side of two steam mains, arranged on the loop system, both of them 12 inches in diameter. The arrangement is such that no water pockets can exist in the steam piping, whether the valves are open or closed, except in the case of the main steam pipe, which is arranged for handling water. The south ends of both mains are also connected. The necessary valves for cutting out any section are provided. The water intercepted by all high pressure drips is returned to the boilers by the steam loop. Expansion in the piping is taken care of by long

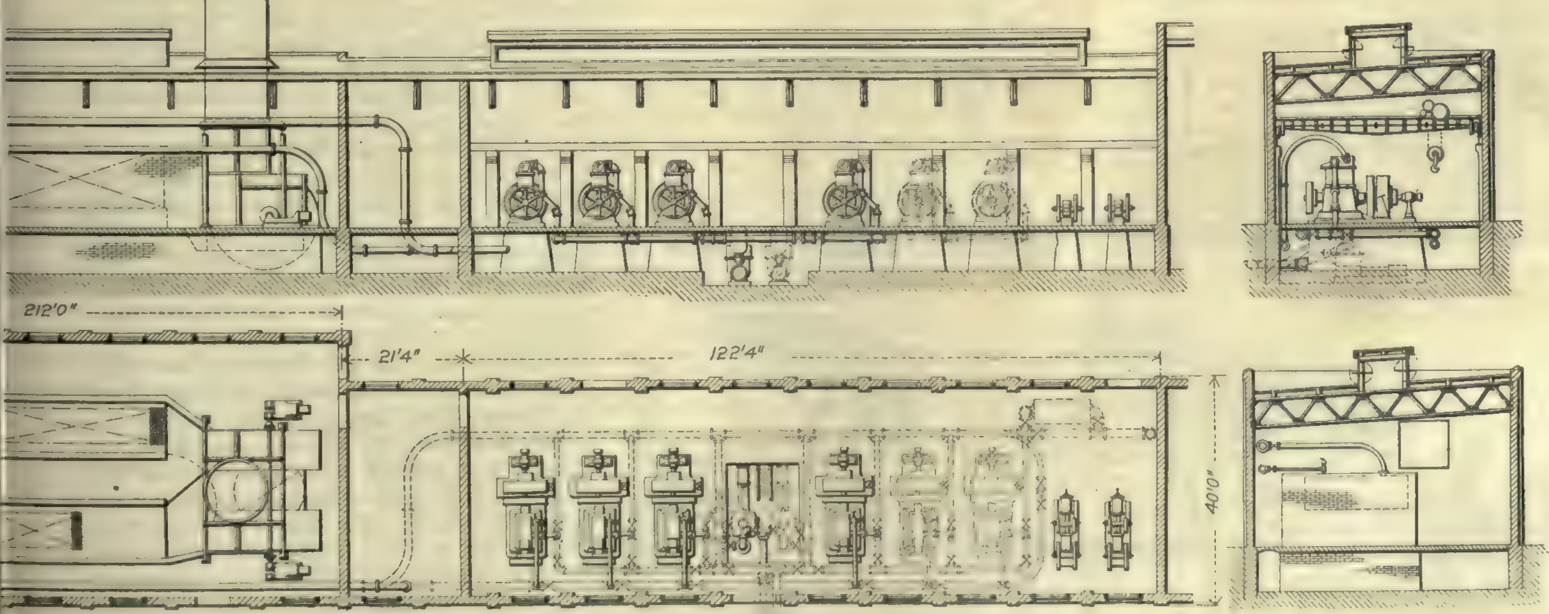


Figure 1b.—Plan and Longitudinal Section of Engine Room, and Cross Sections of Boiler and Engine Rooms.

POWER PLANT INSTALLATION, BOSTON MASS.

WESTINGHOUSE, CHURCH, KERR & CO., DESIGNERS AND BUILDERS.

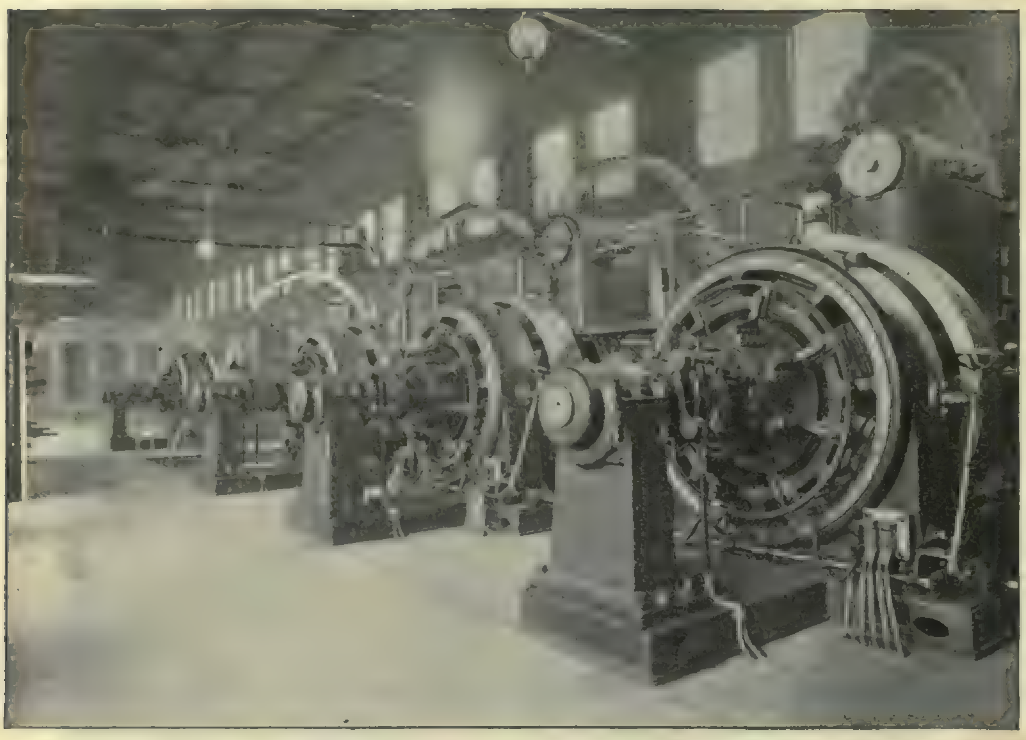


FIGURE 3.—THE ENGINE ROOM, SHOWING GENERATOR UNITS.

bends of copper or iron. The steam mains are anchored in the middle of the engine and boiler rooms. The anchors consist of straps fastened to the mains and connected by rods to anchor plates embedded in the brick walls at points on points on both sides of the strap. The pipe flanges are welded to the ends of the pipe, and the piping was supplied by the National Tube Works Company. The power-house piping is covered with Johns' "fire-felt."

The exhaust pipe for each engine runs into a tee branching into a connection which leads to the condenser main, and into another, which leads to a free exhaust line. Branches from the free exhaust system are connected with a National feed-water heater and also with two specially constructed exhaust heaters in the central heating plants, for warming water to heat the head house. The feed water is taken from the city main, and after being metered passes to one of two Worthington compound duplex outside-packed plunger-pumps which force the water through the feed-water heater and the economizers to the boilers in the order named. The heater or the economizers may be by-passed, or the water passed through the two economizers in series if desired. Up to the heater the pipe is of wrought iron, and beyond it heavy brass tubing.

The electric plant consists of four Westinghouse compound engines directly connected to Westinghouse generators. Figure 3 is a view of these units. Provision has been made for the ultimate installation of six units. The engines have cylinders 18 and 30 inches in diameter with 16-inch stroke. At their rated speed of 250 revolutions per minute and with a steam pressure of 135 pounds, each engine will develop 375 horse-power. Each engine may run condensing or non-condensing, one 14 and 18 by 24-inch independent jet condenser built by the Deane Steam Pump Company, of Holyoke, Mass., being provided. The condensers draw their injection water from the nearby tide water. The three-wire system of distribution is used and the plant has the novel feature that the pressure between the outside legs, which is 240 volts, is maintained by each one of the generators, the electric connection of the neutral wire with the armature being effected tnrough a device consisting essentially of collector rings. quarter phases apart. A brush rests on each of these four collector rings, and conductors, in pairs, lead from the brushes to the terminals of a set of balance coils.

A view of the switchboard may be had from the accompanying reproduction of a photograph, Figure 4. It consists of 13 panels, four of which are for feeders, eight in pairs for the generators, and one for the station instruments, such as wattmeters, voltmeters, etc. One of each pair of generator panels is for the positive side, and the other for the negative. The former contains an ammeter, an automatic circuit-breaker controlling the positive feeder and positive equalizer, and a four-pole double-throw switch connected with both sides of the machine and capable of throwing it upon the high or the low bus-bars. The negative panel also contains an ammeter and a circuit-breaker, and has a double-throw switch connecting the balance coils with the collector rings on the machine. The high and low bus-bars mentioned permit of carrying two voltages. The feeder switches are double-throw, making it possible to connect with the high or the low bus-bars.

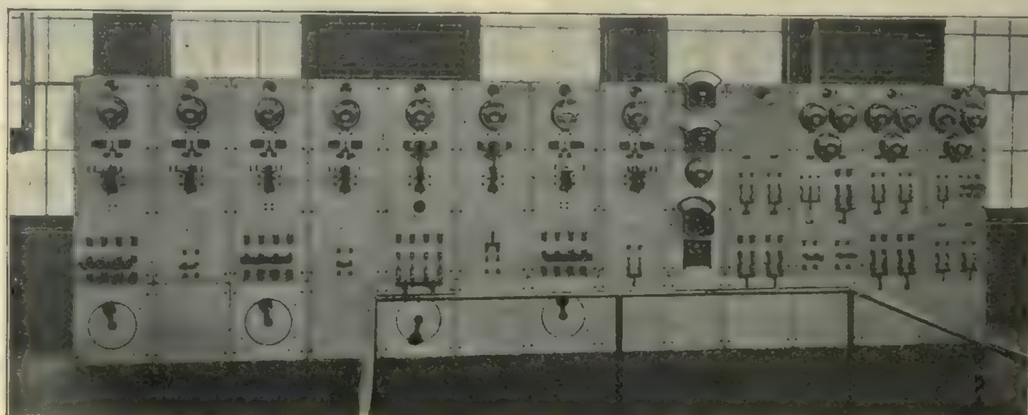


FIGURE 4.—THE SWITCHBOARD OF THE BOSTON SOUTHERN TERMINAL.

Feeders controlled by independent switches are run from the switch board in the power house to the distributing points in the building, from which branch circuits radiate. These feeders terminate in cabinets and cut-out boxes in which are located safety fuses and cut-out switches. The location of each distributing center was selected with a view of having all lights controlled from it render as nearly the same service as possible. From each distributing center a push button is connected electrically with an annunciator in the power house, so that notification may be received at the power house in advance of a demand for power from that center, and a proper number of units put in service to meet the demand. In general the feeders are carried on porcelain insulators bolted to iron hangers and suspended in the basements from the floor beams above or in interior conduits run in the walls and floors. From each center of distribution, a pressure wire is carried back to a voltmeter on the switchboard to show the pressure at that center.

Twelve sets of feeders are run from the switch board for lighting the following: Public lights in the head house; basement lights in

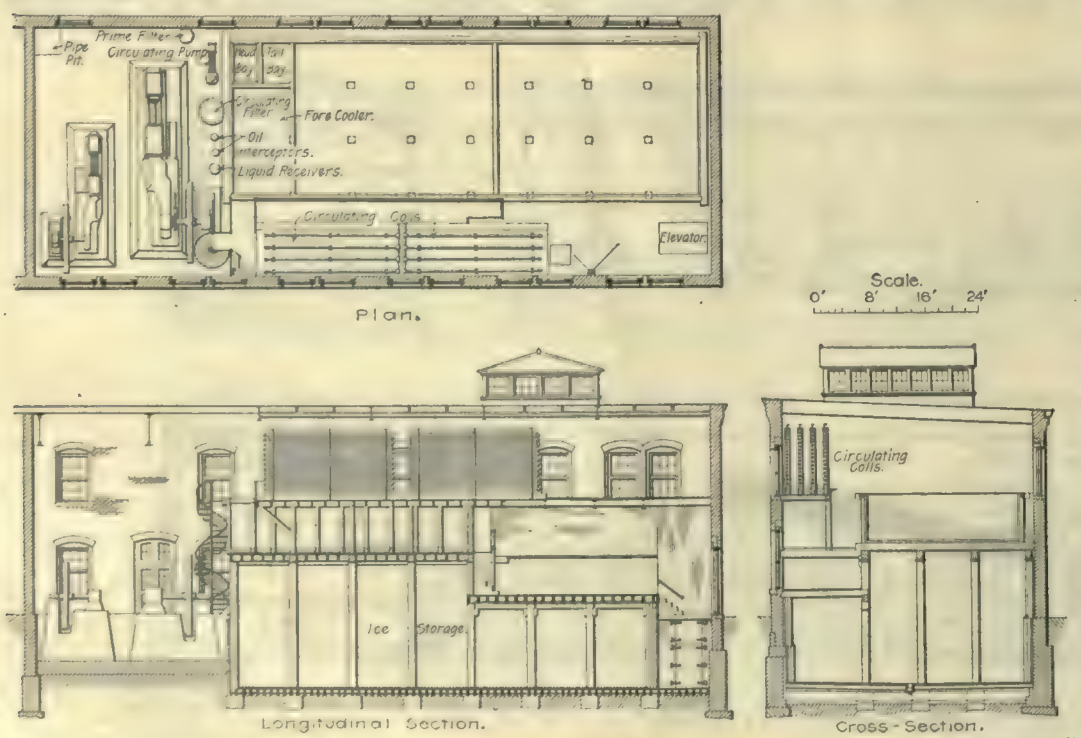


FIGURE 5.—PLAN AND SECTIONS OF REFRIGERATING PLANT.

the head house; restaurant, barber shop, etc.; inward baggage room; outward baggage room; midway, train sheds, front of building and entrance; suburban platform; general offices; suburban tunnel; express offices and platform; power house; ice house, interlocking towers, trainmen's house and sump. There are also four motor circuits.

The main waiting room, which measures 225 by 65 feet in plan and 35 feet high, is illuminated by means of 975 16-candle-power lights. The ceiling is paneled and in the center of each of the 33 panels is a cluster of 15 lights, and at the 48 points of intersection of the panels and girders a cluster of 10 lights is provided. Each cluster is suspended from the ceiling by ornamental fixtures. These lights are controlled by four switches, half of the 10-light and 15-light clusters being wired on alternate circuits. Between the windows and on the wainscoating about 8 feet above the floor and 4 feet apart are 5-light clusters.

The train-shed lights are controlled from a cabinet placed at the train-shed gates. The train shed is lighted by six and five arc lamps on alternate passenger platforms, spaced 120 feet apart, the 5-light rows having a light in line with them, and over the midway, making a total of 77 lamps. The lamps are suspended from wooden strips supporting the three wire feeders, and in turn suspended from the roof trusses by a wire.

The entire heating and ventilating system was worked out in detail, simultaneously with other portions of the equipment, by Westinghouse, Church, Kerr & Company, who associated with them, for this part of the work, as heating and ventilating expert, Prof. S. Homer Woodbridge.

In general, the head house and its Dorchester Avenue and Cove Street wings is heated by indirect methods. A few parts, such as the corridors and staircases, lavatories and the baggage room, and portions of the wings, are heated by direct radiators, with a supply of tempered air for ventilation; other rooms, such as the large waiting rooms and nearly all of the offices are provided with indirect heat.

The warmed air is supplied by a blower system, and hot water is used in coils and radiators. A modification of the Evans system, controlled by Evans, Almirall & Company, is used, the exhaust steam at the power house being utilized to warm water, which is pumped through flow pipes, radiators and returns. The exhaust steam from the engine is led to two specially designed heaters. The 8-inch return pipe from the heating system is connected to one of two 8-inch Lawrence centrifugal pumps driven by an 8 x 8-inch Westinghouse Standard engine, and the water forced through either one of the exhaust-steam heaters, and in case of defficiency in the supply of exhaust steam or in case of very severe weather, is afterward passed through a live steam heater where the required temperature of the water is obtained. The water may pass through the heaters in series or any one may be by-passed if desired. The 8-inch flow main passes northward through a pipe and wire subway to the basement of the Dorchester Avenue wing of the head house, thence toward the head house. The first eight or ten branches that supply the radiators on the floors above are arranged on the single-circuit-main principle that is frequently used in hot-water warming. The flow branch is taken from the top of the main and the return is let into the side of the main about 30 feet beyond the point at which the supply is drawn. About 500 feet from the power house, a return riser connects into the beginning of the main return pipe, which is carried around from that point parallel to the flow main to the extremity of the Cove Street wing. From the Cove Street wing the return main is carried in a tunnel under the entering railway tracks to the power house. From the point where the return main begins, it gradually begins to increase in size, while the flow main decreases. Each branch, flow and return pipe is provided with a valve to regulate the flow and to entirely cut it out if necessary. The flow and return mains are mainly suspended from the ceilings of the basements through which they pass, although in some cases they rest upon the floor. No elbows are used on the floor and return mains. Long pipe bends are used whenever a change of direction was necessary, and the free use of these very materially reduces frictional losses; and by a careful design of the whole system, expansion has been provided for, without the use of expansion joints, by throwing the strains in a suitable manner on the flexible bends. The entire system of piping throughout the heating system is covered with the H. W. Johns Manufacturing Company's moulded sectional covering. Chapman gate valves were used in the power house, and Jenkins valves on the radiators.

The ventilation of the building is almost entirely by mechanical means, as has been said. There is a total of seven large supply fans located at different points in the basement of the head house and its wings, and the foul air is exhausted by means of eleven disc fans driven by electric motors and located in fan chambers in the attic. The air supply is drawn from points above the roof through indirect radiators in the fan chambers and forced through the duct system to flues communicating in some instances with side wall registers, and in others to corridor ducts, which are in turn connected to registers in the offices.

The air supply to the main waiting room is admitted to it through numerous 12 x 48-inch register faces beneath the alternate window openings and about 8 feet above the floor. At the floor under the remaining windows, similar vent registers are placed. The foul air passes downwards to vent ducts in the basement which lead to a vent shaft connecting with an exhaust fan in a chamber in the attic.

The ventilation of the offices in the upper floors of the wings of the head house is accomplished by means of fans blowing tempered air into flues which connect with ducts over false ceilings in the corridors. In the case of the rooms warmed by the indirect method, the system is in duplicate, there being a fan, flue and duct for tempered air and a separate system for hot air. The ducts extend along the space above the corridor ceiling, gradually reducing in size as the branches connect with them. Short horizontal branches from the hot and cold-air ducts extend to the upper end of flues in the walls dividing the offices from the corridors, the ducts terminating in a mixing damper controlled by a cord from the room they supply with air. The supply register is placed about 8 feet above the floor, and is fitted with the diffuser that Prof. Woodbridge frequently uses in his practice. It was illustrated in "The Engineering Record" of January 2, 1897. The exhaust register is just above the base board and connects with a flue leading up to the attic space, where it unites with a foul-air duct leading to a fan chamber. The hot-air ducts and flues are covered with two thicknesses of Cabot's 2-ply quilt paper to prevent the loss of heat. In the case of rooms warmed by direct radiation and supplied with tempered air for ventilating purposes, there is, of course, only one duct over the corridor.

The elevator plant consists of 19 electric elevators and lifts, all of the Sprague make. These are supplied with power from a circuit run from the power switch-board. There are seven double worm-gear machines in use in the head house and general offices. There is one passenger elevator for the restaurant and two lifts. Eleven special baggage lifts designed to meet the unusual conditions presented connect the express building, baggage room and station platforms with the baggage subway and facilitate the handling of baggage between the suburban and train-shed levels.

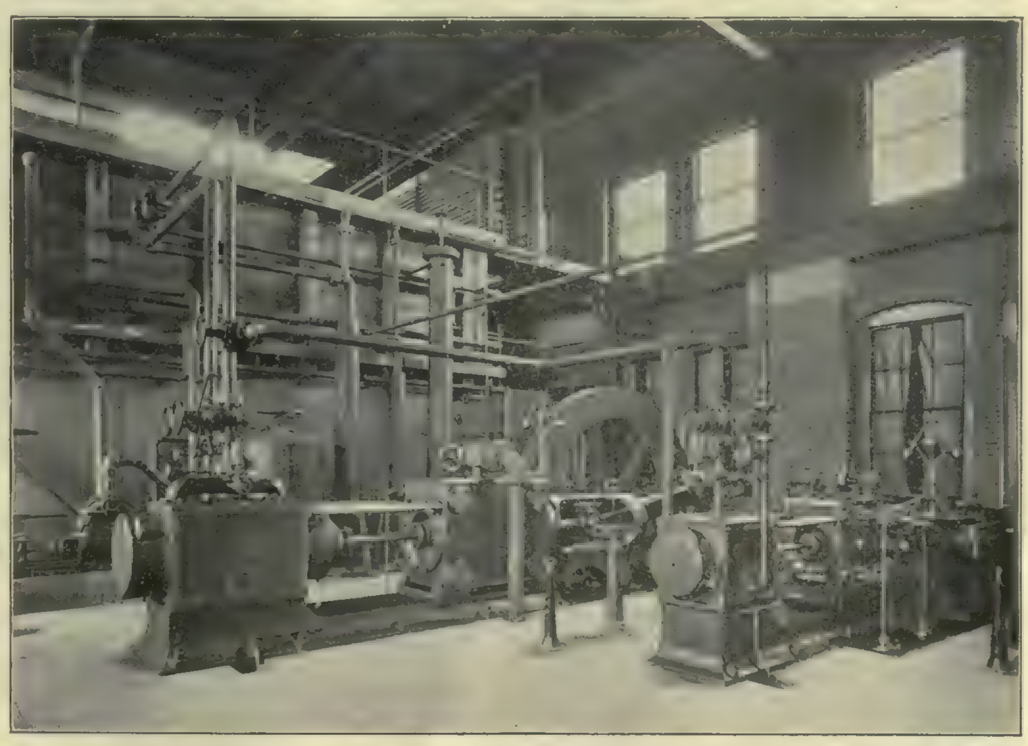


FIGURE 6.—VIEW OF THE REFRIGERATING AND ICE PLANT.

The ice plant has a capacity of 20 tons of ice per day of 24 hours. Ice is made from city water first passed through a prime filter. The "block system" of freezing is used. This was described quite fully in "The Engineering Record" of April 18, 1896. Briefly, it consists of expanding ammonia within pipes in vertical rows 24 inches apart in a freezing tank filled with filtered water. The ice forms on the coils, and thickening as it freezes, extends sideways in both directions toward the plates of ice that form on the adjacent coils. At one end of the tank is a weir, over which the water flows into a tail bay, as it is called, from which a circulating pump draws the water and pumps it through a filter to the fore-cooler, from which it flows to the freezing tank after having been purified in the circuit. Water is admitted by a ball cock to the tail bay as the ice is harvested. Harvesting is accomplished by means of steam cutters. This consists practically of a knife with a small steam pipe on the lower edge. The heat in the steam causes the ice to melt, the

cutter following the slot as fast as the ice melts away.

The ice and refrigerating plant is in a separate room, shown in plan and section by Figure 5. Figure 6 is a view of the machinery. At one end are two ammonia compressors, pumps, filters, etc., while adjacent to them is the freezing tank. Beneath the ice tank is an 800-ton ice-storage vault, reached by an electric platform elevator. In front of the freezing tank is the ammonia condenser, consisting of heavy Kalamined pipe-coils in which the ammonia gas is condensed. The coils are cooled by salt water drawn from tide water by a Deane pump. A pneumatic hoist traveling on a track is employed to raise the ice from the freezing tank and conveys it to the elevator. There are two ammonia compressors of Westinghouse design. Both have a double-acting cylinder driven by a Corliss engine. The larger of the compressors is sufficient to run the ice and refrigerating plants, while the smaller will run the refrigerating plant in case of an accident to the larger machine. Should this occur, ice could be purchased and hence it was not necessary to duplicate that part of the larger compressor's capacity that was devoted to the manufacture of ice.

The refrigerating plant is employed to compress ammonia gas, condense it and circulate the liquid to various parts of the station property, where it is expanded in coils submerged in brine, thereby cooled by the expansion of the ammonia. The brine is then circulated by a pump and system of piping through coils in refrigerating boxes in the restaurant. In other instances the ammonia-expansion coils are submerged in drinking water tanks from which a pump draws the cool water and forces it through a circuit connecting with numerous faucets for the supply of filtered drinking water. The cool water after making the circuit returns to the tank, which is open at the top. Any deficiency owing to the draft of water is met by admitting water from the city mains to this tank, the supply being automatically controlled by a ball cock.

The hot-water supply for the restaurant and other purposes in the head house is warmed by high-pressure steam and piped from the power house. Where needed a hot-water storage heater is located in the basement. The heater contains a copper coil, to which the steam is admitted by a Davis and Roesch thermostat provided for controlling the temperature of the water. The hot water is circulated by gravity.

The car-heating system comprises a pipe conveying steam at 30 to 50 pounds pressure in a covered trench across the ends of the 28 tracks that enter the station. The pipe gradually reduces in size from the beginning. It rests upon spool expansion rollers, and the pipe line is broken into four sections by horizontal off-sets or loops. Each section is anchored in the middle. The pipe pitches slightly toward each off-set, rising abruptly in steps. The off-sets were made to get around obstructions. They also permit expansion of the pipe line. At the three low points the condensation is drawn off by means of traps. As the pipe passes each track a branch that may be connected to the cars is provided.

The leader pipes, of which there are 24, carrying the roof water to the sewer, are protected from frost in an interesting manner. There are 2 12-inch and 22 8-inch leaders, and all are enclosed in wire lathing, so as to leave a 1¼-inch air space around the leader. Inside of the wire lath are two 1-inch pipes, supplied with steam at the top and at the bottom, connected to a steam trap. The wire lathing was then enclosed in an asbestos covering surrounded with painted canvas.

Certain parts of the subway and part of the basement of the head house and wings is lower than the tide water level, and to keep out this water a most thorough system of water proofing was resorted to, as was described very fully in "The Engineering Record" of December 31, 1898. It amounted to digging an immense rectangular excavation in which a continuous water-proof lining was laid around the bottom and sides, and on this the foundations of the building were constructed. As some leakage might occur, and as it was necessary to remove the rain water that entered the subway, which is an inclined loop passing under the midway, it was necessary to provide means for collecting and removing this water. For this purpose a deep circular well, or sump, was constructed alongside of the power house. The bottom of the sump is lower than the bottom of the adjacent subway, as shown in Figure 7, a sectional view through both. All the drainage of the house, the tracks, yard, subway, etc., is led to the sump, and from there it is removed by either one of two centrifugal pumps. One pump has a capacity of 4,000 gallons and the other 1,000 gallons per minute when working against a head of about 16 feet. Each is driven by a vertical shaft on the upper end of which is the armature of a special vertical enclosed electric motor. Both pumps were supplied by the Lawrence Machine Company, Lawrence, Mass. The smaller pump is to handle the seepage and the larger one to free the subway from storm water. The pumps discharge into the sewer. The controller operating the motor that drives the small pump is governed automatically by a float. The larger pump is governed by hand.

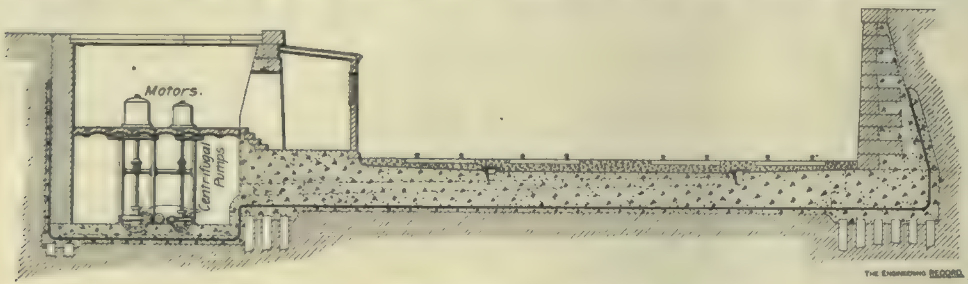


FIGURE 7.—ARRANGEMENT OF DRAINAGE SUMP.

THE TRANSFER OF THE WATERTOWN WATER-WORKS.

The water department of the town of Watertown, Mass., has prepared a report of the proceedings involved in the transfer of the local water-works from the company that built and operated them, which is one of the most interesting documents of the sort issued for some time. The water subject has been before the residents of this town ever since 1869, when it was first proposed to construct public works. In 1870 a committee reported that a plant might be started with an appropriation of $20,000, but recommended further investigations before any definite steps were taken. For about fifteen years the subject continued to be discussed and was finally settled temporarily by a contract made with a private company in 1884. The act of incorporation of this company limited its capital stock to $200,000, and gave authority to the corporation to issue bonds, secured by a mortgage on the franchise and other property, to an amount equal to the actually paid-in capital. The act of incorporation also provided: "Said town of Watertown shall have the right at any time during the continuance of the charter hereby granted, to purchase the franchise, corporation property and all the rights and privileges of said corporation at a price which may be mutually agreed upon betwen said corporation and said town; and the said corporation is authorized to make sale of the same to said town. In case said corporation and said town are unable to agree then the compensation to be paid shall be determined by three commissioners, to be appointed by the Supreme Judicial Court upon the application of either party and notice to the other, whose award when accepted by said court shall be binding upon all parties; and the purchase of and payment for this franchise and property shall be in conformity to the requirements of the public statutes." This contract ran until April 1, 1900.

Watertown was included within the district of the Metropolitan Water Supply act of 1895 and became liable for its annual dues, whether it made use of the Metropolitan supply or not. The State tax for this supply for the years 1898 to 1904, inclusive, would amount to $42,400 for all purposes, while for the public use of water alone, it was estimated that the town would have to pay to the water company during the same period about $73,600. It therefore seemed prudent to take advantage of the Metropolitan act and save the $31,200 difference between the two charges. This the act would not allow, however, except the private company was first bought out by the town, so in April, 1897, a town meeting appointed a committee to investigate the subject. The committee reported in favor of taking the company's property and in June of the same year the town voted by a ballot of 535 to 17 to complete the purchase of the property, placing the negotiations in the hands of the committee, which took possession of the plant in August of that year.

In June, 1897, the company offered to sell the plant for $550,000, a proposition which was declined by the committee. Mr. Percy M. Blake was then retained by the town to examine the plant and books of the company, which extended him every facility for the purpose. On receiving his report the committee offered in December, 1897, to pay $311,346. This was declined by the company. A few months later the committee was informed that the company would accept $425,000 and nothing less, a sum which the committee did not think proper to offer. In order to save the great expense of a hearing before commissioners, however, as well as the 6 per cent. interest on the amount of the award, which would run from the time the town voted to take possession of the plant, the committee's counsel, Albert E. Pillsbury, Esq., who had been retained on many such cases and was familiar with the expense incident to long negotiations, strongly advised making a final offer of $400,000 to settle the case. This was done on March 21, 1898, but was declined two days later by the company. There seemed nothing further after this than to apply for a commission, and after considerable consultation one was appointed by the court, counsel was retained, and Messrs. Desmond FitzGerald and George A. Kimball engaged to assist Mr. Blake in the engineering features of the proceedings. Late in January, 1899, however, the company changed its mind and accepted the offer of $400,000. The final agreement between the company and the town was as follows: "The town shall pay as the purchase price of all the property of the company purchased by vote of the town on June 5, 1897, including all meters in Belmont then owned by the company, the sum of $400,000, with interest at 6 per cent, per annum from June 5, 1897, to date of payment; less $150,000, the amount of the principal of the outstanding bonds of the company, plus interest then accrued and unpaid thereon, which bonds the town is to assume and pay; the company to account to the town for and credit upon and as part of such purchase price $6,691.65 of the $9,839.85 collected by the company on account of water rates; and the town to abate or remit the tax of 1897 assessed upon the company. If

any charges or expenses have accrued to the commission appointed to determine the case, they are to be assumed and paid by the town. Any accrued charges of the trust company under the mortgage are to be assumed and paid by the company."

The plant which was acquired in this manner cost, according to the books of the company, $273,979 on June 1, 1897. The company's paid-in capital stock was $150,000, and its assets in May, 1897, were stated in a report to the Secretary of State of Massachusetts to be as follows: Land and water power, $21,000; buildings, $17,500; machinery, $17,000; stand-pipe, $7,000; filter galleries, $14,500; cash and debts receivable, $4,110; pipes, gates, hydrants, easements, etc., $217,756; balance, profit and loss, $13,134; a total of $312,000. Mr. Blake stated that the sources of supply of the water company have been gradually deteriorating, but under the Metropolitan Water act it had the right at the time its works were taken by the town to supplement its sources of supply with water furnished by the Metropolitan Water Commissioners. This right was valuable to the company and one which, if not superseded by the taking of the plant by the town, enabled the company to furnish its patrons with a supply equal to that of adjoining municipalities. By using this Metropolitan water the company could have saved the expense of operating a pumping station and might have sold its real estate on which the station, filter galleries and driven wells were located. This would probably have resulted in an increase in the company's profits. The total amount of pipe belonging to the distribution system and services was a trifle over 31 miles, of which amount about 18¾ miles was cement-lined. The valuation of this pipe is generally regarded as a difficult problem. As a rule, its life is estimated at between twenty and thirty years, but in the present case it seems destined to be much longer. Mr. Blake reports that to all appearances the pipes are in as good condition as when first laid, in 1884, and the books of the company and the superintendent's statements indicate no gradual increase in leakages or expenditures for repairs. The books show that at the end of 1897 the total cost of construction had been $278,667.40, the total maintenance charges had been $74,555.59, and the total income, $377,811.85. These figures include the company's plant in the adjoining town of Belmont as well as in Watertown proper. The maintenance charges include taxes and all operating expenses.

Since the works have been operated by the town, the annual receipts have fallen off in a marked degree because nothing has been charged for water used by the city itself. On this subject the commissioners make the following pertinent suggestions:

"The town should in justice to its separate departments return a credit of at least $18,000 to its water department for the past eighteen months' use of water, charging the proper portionate parts thereof to the different municipal departments which have consumed this worth of water. And it should again begin to pay or credit to the water department a gross amount of at least $10,000 per year for the municipal use of water, charging to the separate other departments their proper proportionate share for this use of water, that they may not appear to have cost the town less than they really have. Unless the town's property as a whole makes this general contribution from the tax levy, there will be much property in town which will escape bearing its due proportionate share in the general expense for the privilege of a public water supply. Such property, for instance, as the manufacturing interests which enjoy hydrants and sprinklers for the lowering of their insurance rates, yet pay in little, if anything, in water rates, since they pump their own water from their own private sources. Such property, also, as the large tracts of unimproved land, held by out-of-town owners for speculative purposes, the value of which is enhanced by the public water supply, yet which pay in no water rates. It is unjust to throw the cost of this general public benefit entirely upon the water-rate payers. If the town contributed its due proper portion, the water rates charged to water takers could doubtless before long be materially lowered from the present rate of 26 cents per 100 cubic feet. It may not be prudent, however, to make any reduction in rate until practical experience in the operation of the public water plant demonstrates just what the expenses are to be for construction and maintenance. It will evidently be safe enough, however, to call for only $10,000 from the municipality instead of for the $12,000, which it is at present more than consuming, in order to make the Water Department self-supporting and providing for all of its liabilities. In the case of the public sewers, the entire expense was placed upon the town, while by this proposed plan only about one-quarter part of the expense of the public water supply would be thus placed. In the city of Marlboro, just one-half of the cost of the public sewers is taxed upon the municipality, while the other half is taxed upon the separate estates in proportion to the quantity of water supplied to each of such estates, the idea being that the prime service of the sewers is the removal of the water consumed, and the measure of the water supplied is that of the water to be removed. This appears to be a very equitable plan, and it would be well if some adaptation of it could be used in our town.

A Curious Accident to a Steam Engine occurred February 16 at the Eagle Cotton Mill, at Woonsocket, R. I. A 20x48-inch Corliss engine had just been started and had not attained full speed when the main pillow-block broke. This allowed the 15-foot fly-wheel to grind against the brick pier supporting the outside pillow-block, and resulted in a collapse of the wheel. According to the agents of the mill, the accident was caused by water in the engine cylinder.

Special Pipe Laying Methods have been necessary in caring for the water mains along the line of Pennsylvania Avenue in Philadelphia in connection with the subway work now in progress. At one place two lines of 36-inch pipe had to be inserted in a 48-inch main and bedded in the masonry arch of the subway in order to keep below the street pavement. At another crossing a 48-inch main was furnished with a special reduced pipe, 36 feet 7 inches long, with a flat, horizontal surface on top and 18 inches higher on the bottom at the center than at the ends. This peculiar shape permitted the section to straddle the arch and still allow room for the pavement. The difference in head due to the velocity in the throat and in the main was measured by mercury columns, and the loss in head due to the contraction was found to range between 0.018 and 0.233 pounds with velocities in the throat of 4.5 to 16.38 feet per second. An interesting account of the work, by Mr. Allan J. Fuller, will be found in the "Proceedings" of the Engineers' Club of Philadelphia for October, 1898.

STANDPIPE FAILURE AT MURPHYSBORO, ILL.

The steel stand-pipe of the Murphysboro Water-Works, Electric & Gas Light Company, at Murphysboro, Ill., failed during the latter part of February. It was 15 feet in diameter, 145 feet high and was built on a foundation of stone masonry. According to an eye witness the first or initial break occurred in the upright double riveted seam in the lowest ring on the south side of the tower, when standing, which is shown between the fragments numbered 7 and 8 in Figure 2, and in the middle sheet of the bottom, number 21, at a crack shown near the lower end of the broken ladder in Figure 1. The lower five rings opened from this break and were thrown around to the east and west, fragment No. 7 being the first thrown out. The pieces all fell with the concave side up, except No. 16, to which brackets Nos. 4 and 5 were attached, and No. 15, which was on top of No. 16, all lying close to the east corner of the foundation and attached to it by the unbroken anchor bolts. Fragment No. 16 with attachments weighs more than 7 tons, and at this east corner is the only place where the anchor plate seems to be torn loose.

FIGURE 6.—LOOKING NORTH.

FIGURE 7.—LOOKING SOUTH.

The north side of the 15-foot circle of the foundation on which the bottom of the tank rested was found to be 1½ inches lower than the south side, which indicates that the top of the stand-pipe was 15 inches out of the vertical. This had been apparent before the failure and was also known from the fact that, of late, when the tank was full to overflowing, the water ran very rapidly over the north side and not at all over the south side. The foundation was apparently unbroken, except where the anchor bolts tore away the outside stones at the corners and on the north side, where the falling tower broke off that part outside the opening where the valve on the force main was located.

After the breaking away of the lowest five rings, the tower, which was full or had been within a short time, settled almost vertically for 25 feet, and then fell over to the north. That the tank emptied before falling was shown by the run-washed stone in the center of the foundation, and by broken pieces of ice on the foundation. That it settled 25 feet was shown by the fact that the lower edge of the sixth ring came in contact with and cut into the angle iron on the bottom and the lower part of the fifth ring on the south side punched through

the bottom and into the masonry foundation to a distance of about 3 feet. This part of the fifth ring was bent, and when the tower fell over it tore the bottom loose from the foundation and turned it bottom side up, as shown in Figure 4.

Figure 1 shows the location of the broken pieces of steel and stones with reference to the original site, and also the neighboring buildings, which were affected by the accident. Figure 2 represents the five lowest rings of the tower, showing the original position of the several pieces. Six of the smaller pieces are not accounted for in Figure 1, but being small, their exact location is of little moment. Figure 3 is a view of the foundation of the stand-pipe looking north. Figure 4 is a view of the bottom of the tower looking north from the south side of the foundation. Figure 5 is a view looking northwest, and shows the complete failure of the lower part of the stand-pipe. Figure 6 is a view looking north along the stand-pipe from its lower end. Figure 7 is a view looking south along the stand-pipe from its top, and also shows the lumber sheds across which it fell. The ice on the north or lower side of the wreck was found comparatively unbroken, and 4 inches thick; that on the top was so broken as to be not easily located. A few pieces about 2 inches thick were found toward the lower end, but they may have been thrown from above the twenty-first ring, where, for a distance of 10 or 12 feet, the ice was only 2 inches thick. No ice had formed above 115 feet. This information and the photographs for the illustrations were furnished by Mr. Chas. L. Ritter, superintendent of the company.

FIGURE 3.—FOUNDATION, LOOKING NORTH.

FIGURE 4.—BOTTOM OF STANDPIPE.

FIGURE 5—LOWER PORTION OF STANDPIPE.

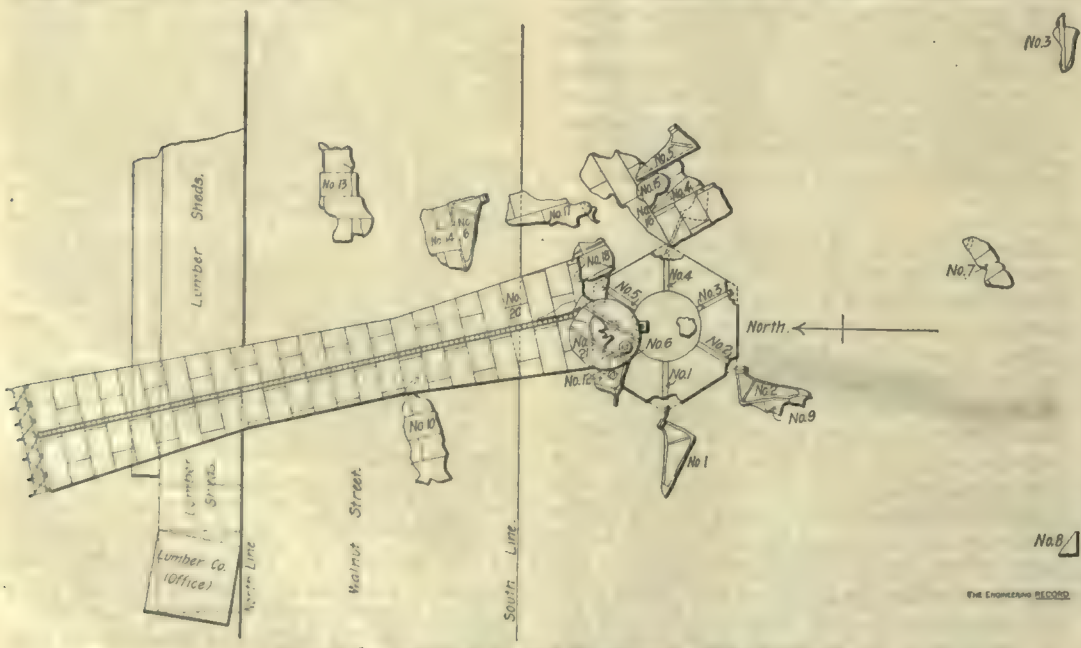


FIGURE 1.—POSITION OF THE STANDPIPE AFTER FAILURE.

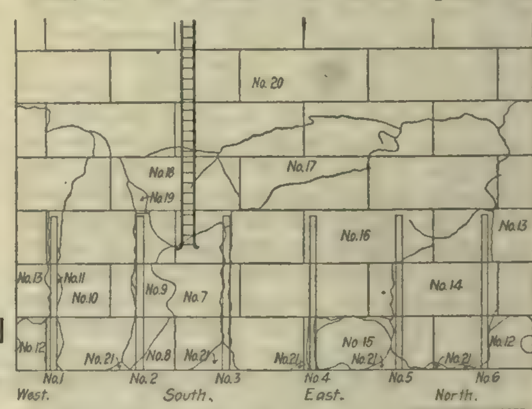


FIGURE 2.—ORIGINAL LOCATION OF PIECES.

STANDPIPE FAILURE AT MURPHYSBORO, ILL.

THE NEW ROCKFORD PUMPING PLANT.

The history of the Rockford, Ill., water-works plant affords an interesting instance of the development of a large supply from an underground source. The first plant was built in 1875, and furnished water which was too muddy and polluted for domestic use. Later a large well was sunk into a bed of porous gravel underlying a portion of the city, but the supply obtained in this way was contaminated by leaching from all the cesspools within a radius of 2,000 feet, and proved unsatisfactory in consequence. Finally the city undertook the construction of artesian wells, but before doing so consulted Prof. T. C. Chamberlain, of the U. S. Geological Survey. He reported that the site of the city was underlain by Trenton, St. Peter, Lower Magnesian and Potsdam formations in the order mentioned. The Potsdam outcrop occurs in Wisconsin, its southern limit being in the vicinity of Portage, and a test well showed that a large supply could be drawn from it. In 1885 and subsequently, five wells, from 1,300 to 2,000 feet deep, were sunk, and from them water of an excellent quality was obtained. The quantity, however, was insufficient, and about 1890 Col. J. T. Fanning, of Minneapolis, and Messrs. Daniel W. Mead and D. C. Dunlap, of Rockford, were consulted concerning plans for further development. They reported in favor of sinking a shaft 100 or more feet deep through the surface clay and drilling wells from the base of the shaft into the St. Peter and Potsdam sandstones. The City Council considered this inexpedient for financial reasons, and the only work undertaken was the sinking of four wells into the St. Peter formation to a depth of about 400 feet.

In 1892 the demand for water had increased to such an amount that four direct-acting deep well pumps were installed at the St. Peter wells. The cost of pumping had originally been $8.34 per million gallons, but this was increased by the addition of these pumps to $10.90, and the total delivery was soon inadequate for the draft on the works. An air-lift plant was

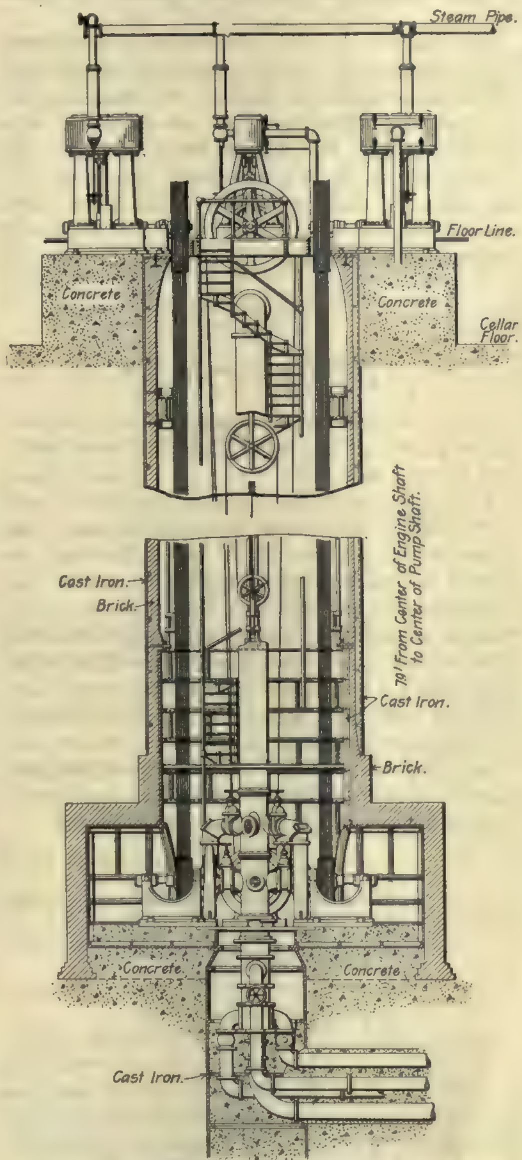
then installed, but while a larger supply, 3,000,000 gallons, was obtained, by its use the cost of pumping was increased to $11.52 per million gallons. In 1896 the works were just about able to meet the demand during the period of maximum consumption, and it became evident that a larger supply was needed. At this time Mr. Daniel W. Mead made a proposition to carry out in an interesting manner a modification of the plan recommended by the engineers in 1890.

His plan was, in substance, to sink a shaft about 100 feet deep and drive tunnels from its bottom to as many of the existing wells as he considered desirable and such new ones as he might drill. These wells were to be connected by pipes in the tunnels with three pumps at the bottom of the shaft, driven by three engines at the surface. The discharge from this plant was to be into the pumping pit and reservoir then in service, from which the water was forced into the distributing mains by a 6,000,000-gallon Gaskill pump. This proposition was accepted in January, 1897, and construction began a little later.

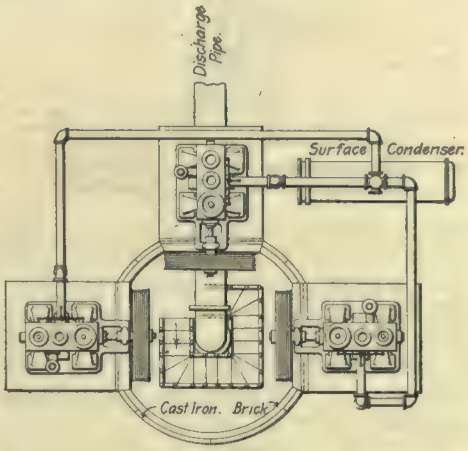
The subcontractors for the shaft sunk it through 55 feet of water-bearing sand and gravel into a poor quality of clay and through that to a depth of 80 feet, where the alcoves for the pumps are located. The shaft was built of cast-iron sections lined with 8 inches of brickwork, and has a clear diameter of about 12½ feet. It was sunk under air pressure, and, after the alcoves for the pumps were built, the air lock was removed in the expectation that the small shaft and tunnel could be driven in the open, as the material to be penetrated was clay. While sinking this small shaft, however, water was encountered at a depth of about 100 feet, and the shaft was flooded to within 10 feet of the surface. The subcontractors gave up the work then, declaring it impossible, and Mr. Mead took personal charge of the undertaking. He lowered the water level by pumping so that a new air-lock could be built about 30 feet from the top of the shaft, and was then able to blow out the water and drive the tunnels under air pressure. The work was very difficult, for the clay was full of sand seams and large quantities of water were encountered. Finally the main tunnel was completed and small branch tunnels driven to the different wells, the last work of this sort being done with but 4 feet of clay between the top of the tunnel and 90 feet of water-bearing sand and gravel. Three Potsdam wells about 1,300 feet deep and five St. Peter wells averaging about 400 feet have been connected in this way with the main shaft. For about eight months it was necessary to work under 35 to 42 pounds air pressure, which caused some illness among the men. The plant yielded about 6,500,000 gallons in 24 hours when completed and is expected to yield 7,000,000 gallons as soon as the last deep well has been reamed out.

The pumps and engines were furnished by the Byron Jackson Machine Company, San Francisco, Cal. The engines are of the compound condensing type, the Worthington surface condenser being set in the pit shown in the view of the engine room. This engine-room affords a striking contrast to the engine rooms of deep-well plants where the water-ends are driven by heavy rods and ponderous bell-crank levers operated by slow-speed horizontal engines. The shaft is provided with an iron stairway winding around the discharge pipe, which furnishes a means of ready access to the pumps.

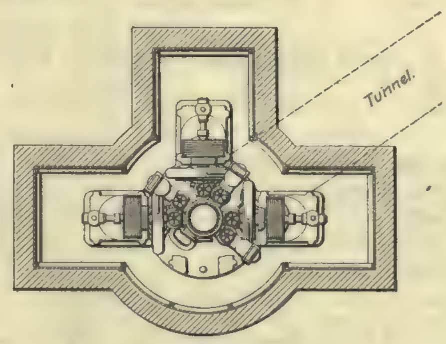
The tests of the plant showed that it had a duty of 58,000,000 foot-pounds per 1,000 pounds of dry steam. Concerning these trials, Mr. Mead has furnished the following facts: "On test these pumps worked under an 80-foot discharge head, with a suction measured at the pumps of 26 feet, making a total lift of 106 feet. The pumps were tested under various loads, and have given extraordinary results. Under various conditions, from the indicated horse-power of the engine to the actual horse-power of water raised, efficiencies of from 65 to 70 per cent. have been obtained, the pumps alone giving efficiencies of from 70 to very nearly 75 per cent., the greater efficiencies being on the high lift. I believe these results are unprecedented in centrifugal pump work. The pump impellers are of the hollow type, are made of bronze, cast in sections and very carefully worked out through the runners, so that the water spaces are all perfectly true and very smooth."



Vertical Section of Shaft.

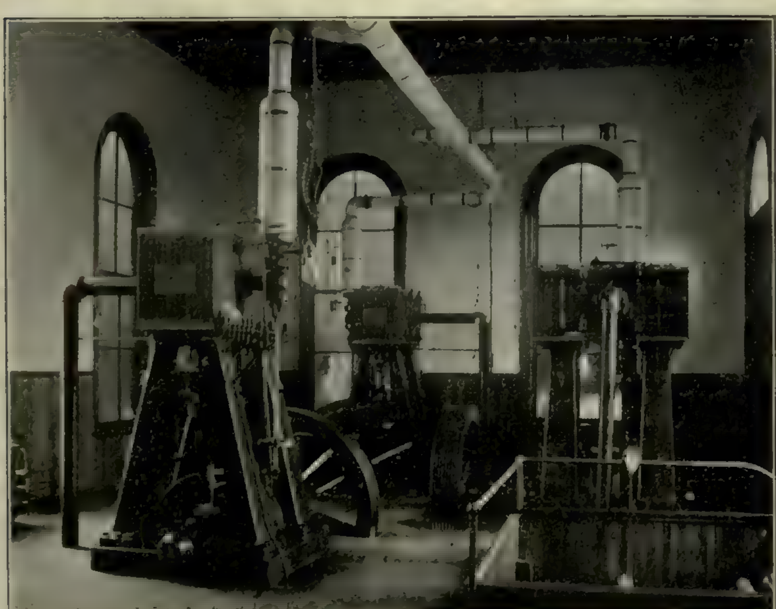


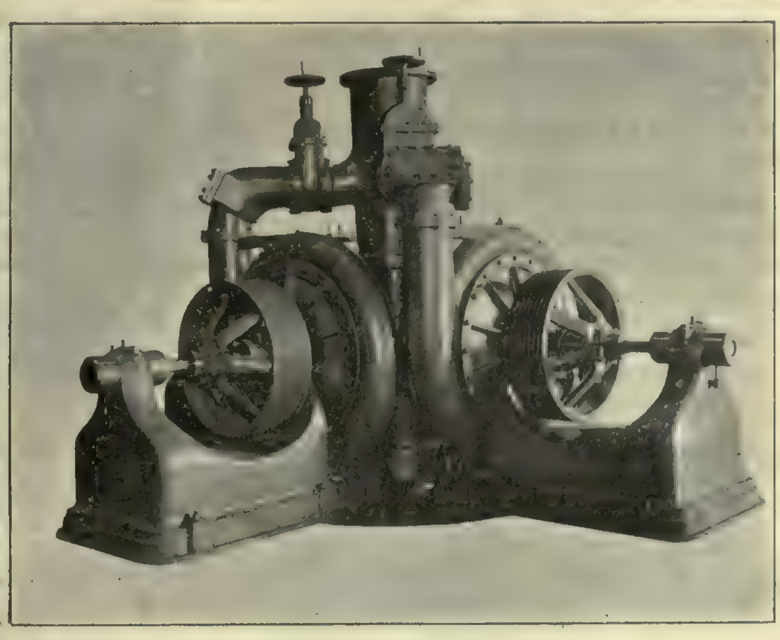
Plan of Shaft showing arrangement of Engines.



Section of Shaft showing arrangement of Pumps.

THE ENGINEERING RECORD.





THE NEW PUMPING PLANT OF THE ROCKFORD, ILL., WATER-WORKS.

D. W. MEAD, M. AM. SOC. C. E., ENGINEER AND CONTRACTOR.

STRESSES IN STEEL FOUNDATIONS.—II.

[By Samuel B. Durand.]

If Figure 3 represents the plan of any footing and Figure 4 a section of the same, it is plain that the solution of this problem according to the theory of the bending of beams must resolve itself into a discussion of the combined action of continuous girders with supports upon different levels. An elaborate discussion of the

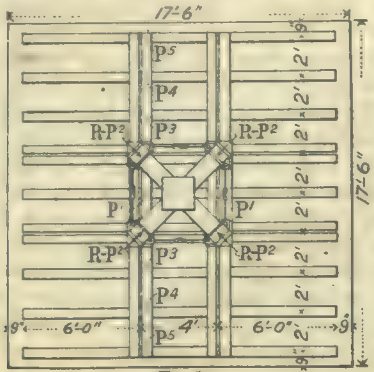


FIG. 3

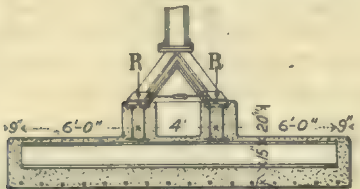


FIG. 4

general theory of continuous structures can be found in Prof. A. J. Dubois' book entitled "Strains in Framed Structures." This especial case, however, will have its solution much simplified by using the following formulas, which are special forms of the general theory of three moments, and from which the general formula can be proved, as will be seen.

Let Figure 2 represent a single span of a continuous girder loaded with an evenly distributed load of w pounds per unit of length. Let M_1 and M_2 equal the values of the bending moments at the left and right supports respectively, and V_1 equal the vertical shear at a point just to the right of the left support. Let y_1 and y_2 be the heights of the left and right supports respectively, measured from the horizontal axis $x - x$ as zero. Let x be the distance from the left support to any section, where the bending moment is M. The equation of the elastic curve for this point is therefore:

FIG. 2

$$(1)\quad EI\frac{d^2y}{dx^2} = M = M_1 + V_1x - \frac{wx^2}{2}.$$

Integrating with respect to x, and letting the values of $dy \div dx$ at the left and right supports be q_1 and q_2 respectively, we get:

$$(2)\quad EI\frac{dy}{dx} = M_1x + \frac{v_1x^2}{2} - \frac{wx^3}{6} + C = EIq.$$

When $x = o$ in (2), $dy \div dx = q_1$, therefore $C_1 = EIq_1$.

Integrating a second time with respect to x, we get:

$$(3)\quad EIy = \frac{M_1x^2}{2} + \frac{v\ x^3}{6} - \frac{wx^4}{24} + EIq_1x + C_2.$$

Since y_1 is the value of y at the left support, when $x = o$ in (3), $y = y_1$ and $C_2 = EIy_1$. Also putting $x = l$ in (3) we get:

$$(4)\quad EIy_2 = \frac{M_1l^2}{2} + \frac{v_1l^3}{6} - \frac{wl^4}{24} + EI[q_1l + y_1].$$

Substituting the value of

$$V = \frac{M_2 - M}{l} + \frac{wl}{2}$$

and multiplying by $6 \div l$, we get:

$$(5)\quad \frac{6\ EIy_2}{l} = 2\ M_1l + M_2l + \frac{wl^3}{4} + 6\ EI\left[q_1 + \frac{y_1}{l}\right]$$

or by uniting terms:

$$(6)\quad 2\ M_1 + M_2l + \frac{wl^3}{4} + 6\ EI\left[q_1 + \frac{y_1 - y_2}{l}\right] = o.$$

This equation is a general equation for a uniformly loaded continuous girder with supports of uneven heights and might be called an equation of two moments. A second equation of two moments can be written for this span by changing the condition which determined the value of C_1 in equation (2) from $x = o$ to $x = l$. Then C_1 will have the value EIq_2, where q_2 is the value of $dy \div dx$ at the right support. By pursuing an exactly similar course of reasoning as in the proof above, from this point on, the second equation of two moments will be found to be:

$$(6')\quad M_1l + 2\ M_2l + \frac{wl^3}{4} + 6\,EI\left[-q_2 + \frac{y_2 - y_1}{l}\right] = o.$$

If equation (6') now be written for any span of a continuous girder uniformly loaded and with supports equally spaced, and equation (6) for the span adjoining it on the right, the subscripts of the Ms and ys being properly inserted, the q_2 of (6') will equal the q_1 of (6). By equating their values as found from these two equations and simplifying, the following general equation results:

$$(7)\quad M_1l + 4\ M_2l + M_3l + \frac{wl^3}{2} + \frac{6\ EI}{l}\left[2\ y_2 - y_1 - y_3\right] = o$$

which is the general equation of three moments for a girder acting under the conditions specified for (6) and (6').

In order to simplify the applications of these formulas to the special problem at hand, the structure is considered as being inverted, as shown by the section of Figure 5, and in the remainder of the discussion this section only will be referred to, unless otherwise specified. The column must therefore be looked upon as supporting a structure with a load evenly distributed over its upper surface; and hereafter the concrete base will be spoken of as the first or upper beam; the row of beams next to it, the second or intermediate course; and the second row of beams, as the third or lower course.

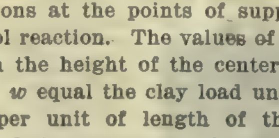


FIG. 5

Referring now to Figure 5, the Ms are the values of the bending moments in the upper or first course at its points of support, while the Ns are the same for the third course. The Ps are the reactions at the points of support, and R is the stool reaction. The values of y are measured from the height of the center support as zero. Let w equal the clay load uniformly distributed per unit of length of the concrete. Note that but one-quarter of the area of the footing is now being considered, for both the plan and the loadings are symmetrical about the two main axes. General equation (7) can be written three times for the four spans of the upper beam as follows:

$$(8)\quad M_1l + 4\ M_2l + M_3l + \frac{wl^3}{2} + 6\ E_0I_0\left[\frac{y_2 - y_1}{l} + \frac{y_2 - y_3}{l}\right] = o.$$

$$(9)\quad M_2l + 4\ M_3l + M_4l + \frac{wl^3}{2} + 6\ E_0I_0\left[\frac{y_3 - y_2}{l} + \frac{y_3 - y_4}{l}\right] = o.$$

$$(10)\quad M_3l + 4\ M_4l + M_5l + \frac{wl^3}{2} + 6\ E_0I_0\left[\frac{y_4 - y_3}{l} + \frac{y_4 - y_5}{l}\right] = o.$$

where E_0 is the modulus of elasticity of the first or upper beam, and I_0 is its moment of inertia.

Since the design and loadings are symmetrical about P_1 for both the first and third courses, the tangent to the elastic curve here is horizontal and therefore the value of $dy \div dx$ is zero. Hence if equation (6) be written for the span to the right of P_1 the term q_1 will equal zero and the equation can be used with the three just written without introducing any new unknown quantities.

$$(11)\quad 2\ M_1l + M_2l + \frac{wl^3}{4} + 6\ E_0I_0\left[\frac{y - y_2}{l}\right] = o.$$

If the intermediate course of beams be considered as forming a system of supports instead of loads for the lower beams, equations similar to these can be written for this third course, much simplifying the whole solution. In all these equations, forces are reckoned as giving positive bending moments, when they tend to produce compression in the upper flanges of the beams. The equations for the lower beam are as follows:

$$(12)\quad N_1l + 4N_2l + N_3l + 6\ E_1\left[I_1\frac{y_2 - y_1}{l} + I_2\frac{y_2 - y_3}{l}\right] = o.$$

$$(13)\quad N_2l + 4N_3l + N_4l + 6\ E_1\left[I_2\frac{y_3 - y_2}{l} + I_3\frac{y_3 - y_4}{l}\right] = o.$$

$$(14)\quad N_3l + 4N_4l + N_5l + 6\ E_1\left[I_3\frac{y_4 - y_3}{l} + I_4\frac{y_4 - y_5}{l}\right] = o.$$

$$(15)\quad 2\ N_1l + N_2l + 6\ E_1I_1\left[\frac{y_1 - y_2}{l}\right] = o.$$

where E_1 is the modulus of elasticity for the third or lower beam and I_1 is the moment of inertia for the several spans of the third or lower course, the subscripts indicating that they are of the span at whose left support the reaction has a like subscript. Since the deflections of the first and third courses at each support must be equal when bending occurs, the ys with like subscripts in the two sets of equations must be equal and therefore their values found from one set of equations can be equated with those found from the second set, thus eliminating all the deflection terms from the solution. The resulting equations will then contain but five unknown quantities, as the bending moments, M_1 to M_5, N_1 to N_5, can be expressed in terms of the clay loadings and the five unknown reactions, P_1 to P_5. Since the stool load must equal the sum of the five reactions, a fifth equation can be written and the solution of the problem becomes determinate.

Solving the first set of equations the following values of the deflections are found:

$$(a)\quad y_1 = o$$

$$(b)\quad y_2 = \frac{l^2}{6\ E_0I_0}\left[2\ M_1 + M_2 + \frac{wl^2}{4}\right]$$

$$(c)\quad y_3 = \frac{l}{6\ E_0I_0}\left[5\ M_1 + 6\ M_2 + M_3 + wl^2\right]$$

$$(d)\quad y_4 = \frac{l^2}{6\ E_0I_0}\left[8\ M_1 + 12\ M_2 + 6\ M_3 + M_4 + \frac{9\ w\ l^2}{4}\right]$$

$$(e)\quad y_5 = \frac{l^2}{6\ E_0I_0}\left[11\ M_1 + 18\ M_2 + 12\ M_3 + 6\ M_4 + M_5 + 4\ w\ l^2\right]$$

Solving the second set of equations the values are found to be:

$$(a^1)\quad y_1 = o$$

$$(b^1)\quad y_2 = \frac{l^2}{6\,E_1I_1}\left[2\ N_1 + N_2\right]$$

$$(c^1).\quad y_3 = \frac{l^2}{6\,E_1\,I_2}\left[N_1 + 4\,N_2 + N_3\right] + y_2\left[\frac{I_1 + I_2}{I_2}\right]$$

$$(d^1)\quad y = \frac{l^2}{6\,E_1\,I_3}\left[N_2 + 4\ N_3 + N_4\right] + y_3 + \frac{I_2}{I_3}\left[y - y_2\right]$$

$$(e^1)\quad y_5 = \frac{l^2}{6\,E_1\,I_4}\Big[N_3 + 4\,N_4 + N_5\Big] + y_4 + \frac{I_3}{I_4}\Big[y - y_3\Big]$$

In practice the most economical design for the lower beam will be a combination of the standard sizes of steel I-beams or a plate girder, whose moments of inertia are constant throughout their length, therefore the terms I_4, I_3 and I_2 can be put equal to I_1. Substituting this value in the last set of equations and reducing, they become:

From (a^1) $y_1 = o$

" (b^1) $y_2 = \frac{l^2}{6\,E_1\,I_1}\Big[2\,N_1 + N_2\Big]$

" (c^1) $y_3 = \frac{l^2}{6\,E_1\,I_1}\Big[5\,N_1 + 6\,N_2 + N_3\Big]$

" (d^1) $y_4 = \frac{l^2}{6\,E_1\,I_1}\Big[8\,N_1 + 12\,N_2 + 6\,N_3 + N_4\Big]$

From (e^1) $y_5 = \frac{l^2}{6\,E_1\,I_1}\Big[11\,N_1 + 18\,N_2 + 12\,N_3 + 6\,N_4 + N_5\Big]$

Equating the values of the like *ys* in the first and last sets, the four following equations result:

$$(I.)\quad E_1\,I_1\Big[2\,M_1 + M_2 + \frac{wl^2}{4}\Big] = E\,I_0\Big[2N_1 + N_2\Big]$$

$$(II.)\quad E_1\,I_1\Big[5\,M_1 + 6\,M_2 + M_3 + wl^2\Big] = E_0\,I_0\Big[5\,N_1 + 6\,N_2 + N_3\Big]$$

$$(III.)\quad E_1\,I_1\Big[8\,M_1 + 12\,M_2 + 6\,M_3 + M_4 + \frac{9\,wl^2}{4}\Big] = E_0\,I_0\Big[8\,N_1 + 12\,N_2 + 6\,N_3 + N_4\Big]$$

$$(IV.)\quad E_1\,I_1\Big[11\,M_1 + 18\,M_2 + 12\,M_3 + 6\,M_4 + M_5 + 4\,wl^2\Big] = E_0\,I_0\Big[11\,N_1 + 18\,N_2 + 12\,N_3 + 6\,N_4 + N_5\Big]$$

The values of the *Ms* and *Ns* in terms of the reactions P_2 to P_5 are as follows:

$$M_1 = l\Big[P + 2\,P_3 + 3\,P_4 + 4\,P_5 - 8\,wl - whl\Big(4 + \frac{h}{2}\Big)\Big]$$

$$M_2 = l\Big[P_3 + 2\,P_4 + 3\,P_5 - \frac{9}{2}\,wl - whl\Big(3 + \frac{h}{2}\Big)\Big]$$

$$M_3 = l\Big[P_4 + 2\,P_5 - 2\,wl - whl\Big(2 + \frac{h}{2}\Big)\Big]$$

$$M_4 = l\Big[P_5 - \frac{wl}{2} - whl\Big(1 + \frac{h}{2}\Big)\Big]$$

$$M_5 = -\frac{wh^2l^2}{2}$$

Where hl is the length of the projection of the first course beyond the outside beam of the second course.

$N_1 = l\,[R - P_2 - 2P_3 - 3P_4 - 4P_5]$
$N_2 = -\,l\,[P_3 + 2P_4 + 3P_5]$
$N_3 = -\,l\,[P_4 + 2P_5]$
$N_4 = -\,lP_5$ and $N_5 = o$

Substituting these values in Equations (I.) to (IV.) and putting the ratio $E_1I_1 \div E_0I_0 = K$, a constant, the equations become:

$$(16)\quad 2\,P_2 + 5\,P_3 + 8\,P_4 + 11\,P_5 = \frac{2\,R}{1+K} + \frac{K}{1+K}\Big[\frac{81}{4}\,wl + 11\,whl + \frac{3}{2}\,wh^2l\Big]$$

$$(17)\quad 5\,P_2 + 16\,P_3 + 28\,P_4 + 40\,P_5 = \frac{5\,R}{1+K} + \frac{K}{1+K}\Big[68\,wl + 40\,whl + 6\,wh^2l\Big]$$

$$(18)\quad 8\,P_2 + 28\,P_3 + 54\,P_4 + 81\,P_5 = \frac{8\,R}{1+K} + \frac{K}{1+K}\Big[\frac{513}{4}\,wl + 81\,whl + \frac{27}{2}\,wh^2l\Big]$$

$$(19)\quad 11\,P_2 + 40\,P_3 + 81\,P_4 + 128\,P_5 = \frac{11\,R}{1+K} + \frac{K}{1+K}\Big[192\,wl + 128\,whl + 24\,wh^2l\Big]$$

(20) $R = \frac{P_1}{2} + P_2 + P_3 + P_4 + P_5$ from the fifth condition.

The values of the *Ps* can be found from these five equations as follows, from equation (16):

$$(21)\quad P_2 = -\frac{5}{2}\,P_3 - 4\,P_4 - \frac{11}{2}\,P_5 + \frac{R}{1+K} + \frac{Kwl}{1+K}\Big[\frac{81}{8} + \frac{11}{2}h + \frac{3}{4}h^2\Big]$$

Substituting this value in (17), (18) and (19) respectively:

$$(22)\quad \frac{7}{2}P_3 + 8\,P_4 + \frac{25}{2}\,P_5 = \frac{Kwl}{1+K}\Big[\frac{139}{8} + \frac{25}{2}\,h + \frac{9}{4}\,h^2\Big]$$

$$(23)\quad 8\,P_3 + 22\,P_4 + 37\,P_5 = \frac{Kwl}{1+K}\Big[\frac{189}{4} + 37\,h + \frac{15}{2}\,h^2\Big]$$

$$(24)\quad \frac{25}{2}P_3 + 37\,P_4 + \frac{135}{2}\,P_5 = \frac{Kwl}{1+K}\Big[\frac{645}{8} + \frac{135}{2}\,h + \frac{63}{4}\,h^2\Big]$$

from equation (22),

$$(25)\quad P_3 = -\frac{16}{7}\,P_4 - \frac{25}{7}\,P_5 + \frac{Kwl}{1+K}\Big[\frac{139}{28} + \frac{25}{7}\,h + \frac{9}{14}\,h^2\Big]$$

Substituting this value of P_3 in (23) and (24) respectively, we get:

$$(26)\quad 26\,P_4 + 59\,P_5 = \frac{Kwl}{1+K}\Big[\frac{211}{4} + 59\,h + \frac{33}{2}\,h^2\Big]$$

$$(27)\quad 59\,P_4 + 160\,P_5 = \frac{Kwl}{1+K}\Big[130 + 160\,h + 54\,h^2\Big]$$

From equation (26),

$$(28)\quad P_4 = -\frac{59}{26}\,P_5 + \frac{Kwl}{1+K}\Big[\frac{211}{104} + \frac{59}{26}\,h + \frac{33}{52}\,h^2\Big]$$

Substituting this value in (27):

$$(29)\quad 679\,P_5 = \frac{Kwl}{1+K}\Big[\frac{1071}{4} + 679\,h + \frac{861}{2}h^2\Big]$$

From equations (29), (28), (25) and (21) the following values of the reactions are found: Let $K \div (1 + K) = d$.

(VI.) $P_5 = dwl\,[0.3943 + h + 0.634h^2]$
(VII.) $P_4 = dwl\,[1.134 - 0.8041h^2]$
(VIII.) $P_3 = dwl\,[0.9641 + 0.2165h^2]$
(IX.) $P_2 = \frac{R}{1+K} + dwl\,[1.0101 - 0.0618\,h^2]$
(X.) $P_1 = 2dR - dwl\,[7.005 + 2h - 0.0308h^2]$

The value of P_1 is obtained from equation (20). It will be noticed that the term K contains the two unknown quantities I_0 and I_1. Having no condition for proportioning the relative strengths of the upper and lower beams, the design of one of them must be assumed, and that of the other made to depend upon it. Assuming the design of the lower or third course in this case, as in practice this will usually be found to be the better assumption to make as will be seen, the value of I_1 becomes established and the value of I_0 can be determined by using the formula, bending moment = resisting moment. $M = SI \div C$. Let $C \div S = f$, then $I_1 = N_2f = dwl\,[4.415 + 3h + 0.51h^2] \times f$. Substituting the values of the *Ks* in the term d and solving for I_1, we get:

$$(XI.)\quad I_1 = fwl^2\Big[4.415 + 3\,h + 0.51\,h^2\Big] - \frac{E_0\,I_0}{E_1}$$

from which I_0 can be found when I_1 is known.

This value of I_1, which it will be noticed is in terms of the same quantites as the values of the reactions, fully determines the designs of the first and third courses, but the values of the *Ps* must be found for the designing of the beams in the intermediate layer, which although evenly spaced, do not carry the same loads on account of the bending of the upper and lower beams. For designing this course of beams the fundamental formula, moment of bending = moment of resistance, can again be made use of, the maximum moment of bending in this case being at the point where the reaction from the third course is applied. Under the conditions assumed in the foregoing treatment of the problem the action of the steel and concrete together must prevent any bending taking place in this direction, but if a maximum deflection of ⅛ inch be allowed in practice, the resulting conditions will be close enough to those assumed to permit of the general equations being used without sensible error.

In practice it will be found that the ordinary concrete base, on account of its small and very uncertain transverse strength, will need to be made excessively thick, if the greatest economy in the steel is to be gained; but by introducing steel tension rods into the upper part of this course, not only will the practical advantage of saving steel without increasing the thickness of the base be gained, but from the theoretical side the further advantage of producing a structure, which on account of its far greater elastic properties, will be much better fitted to the conditions upon which the design is based. It must be a general disinclination to adopt new and novel methods of construction that has kept this method thus far out of practical use, for it was demonstrated over twenty years ago that it was possible to so unite the tensile strength of iron with the compressive strength of concrete, as to secure the full value of each material in its respective position.

(To be continued.)

THE ACKER, MERRALL & CONDIT STABLES, NEW YORK.

The grocery firm of Acker, Merrall & Condit have several wholesale and retail stores in New York City, and employ a large number of horses and wagons in their business. These are sheltered in two large stables, one built some 25 years ago and the other in 1894. The older stable shows the construction of 1874, with slight modifications, introduced from time to time. It is still in satisfactory service, and operated under the same conditions as the recent structure, which was intended to have the most convenient, substantial and sanitary type of equipment for commercial business.

The first stable, Figures 1, 2 and 3, has a frontage of 40 feet on West Tenth Street, and is 98 feet deep, with a wide private court running from the rear to an entrance on Ninth Street; this doubles the facility with which 40 to 50 wagons can be received and sent out night and morning. The building has three stories and a basement, with brick walls and wooden floors and columns. There is a wagon entrance to the basement on both front and rear, and an inclined gangway for horses from the Tenth Street pavement to the first floor, which is several feet above the curb. The basement floor is a little below the curb, and is paved with Belgian blocks, except where there is a concrete platform 20 feet square, supplied with hose for washing wagons. Twenty-nine large wagons are stored in the basement every night, while the horses are led up through the rear gangway to their stalls above, and there stripped of their harness. The large trucks are stored outside in the rear court, where they are packed in the order of arrival, filling the space so completely that they must be sent out in reverse order in the morning. At the rear of the base-

ment some light wooden frames about 8 feet wide and 3 feet deep are hinged at one end, like gates, to the side wall so they can be swung out normal to the wall and secured there to form temporary stalls for a few extra horses or provide specially quiet, cool places in summer for sick horses.

A narrow two-story shed is built across the rear of the building, and contains the inclined gangways for the horses to pass between the different stories. The first floor is occupied entirely by stalls, the second by stalls and hay storage, and the third by grain bins, general storage and the foreman's apartments. The arrangement of the first floor is shown in Figure 1, which is not drawn to scale. All the stories are lighted by windows in the north and south ends only, and by gas fixtures. There is no heating apparatus of any kind, and ventilation is secured through the doors and windows. Water is piped to both ends of each floor, and buckets are provided for fire service. On the first floor the aisles are wide, especially on the east side where two rows of stalls are served, and there is considerable open space around the elevator and north ends of the rows of stalls, so that a good many horses can be taken in or out at once, or could be brought to an exit through the north gangway in emergency. This gangway opens on the sidewalk, but is seldom used as the horses usually come in and out through the basement and the south gangway. Between the end of the center row of stalls and the south end of the building there is a space used for a large stall or for temporarily hitching horses. The floor here was formerly covered with asphalt, but as it proved too soft, an experimental coat of cement concrete 2 inches thick has been recently laid on top of it, and is now covered with loose boards. The elevator well is protected with a wooden curb, and there is a row of wooden columns near the center of the building. These columns are not spaced symmetrically, but are arranged so that most of them come in the partitions between stalls. The second story is used both for the storage of baled hay and for stabling, a row of stalls being arranged along one side and end, as shown in Figure 2. The third story is devoted to general storage; it is used as a repository for unused vehicles and contains the grain bins and a five-room apartment for the foreman's family. There is also a blanket room here which is provided with a water-tight zinc-covered floor and racks on which wet blankets are hung to drip and are dried by a stove provided there for that purpose.

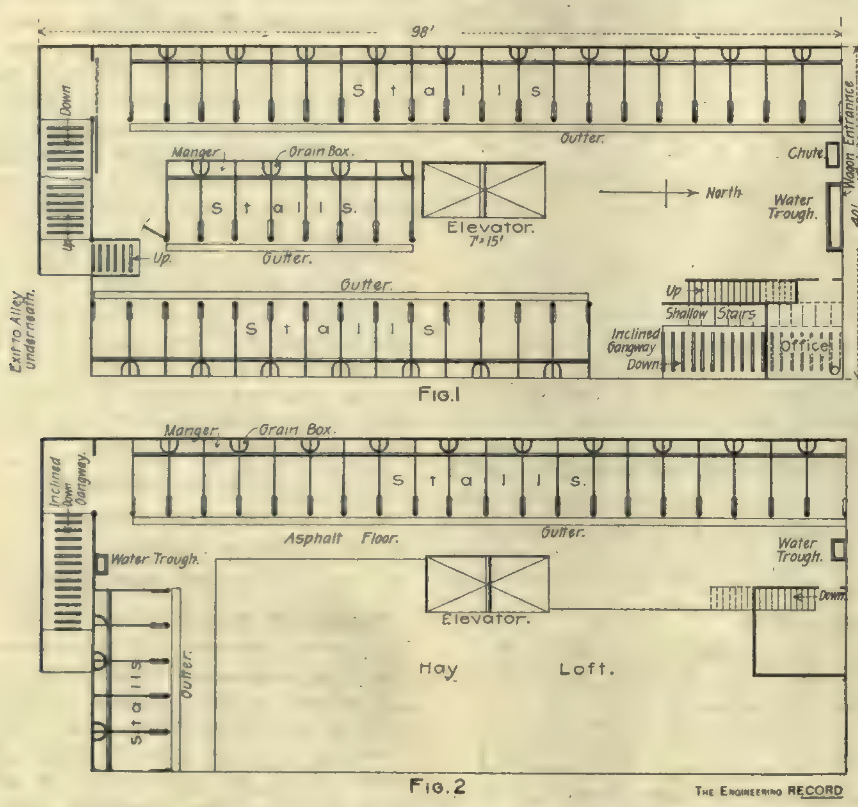
The beams and girders are of timber throughout, and for the first floor are covered with 2-inch yellow pine boards protected by a ½-inch layer of cement concrete and a 1-inch layer of asphalt. Originally this floor was simply calked, but the concrete and asphalt layers were added in 1879, and have given excellent satisfaction ever since. The second floor is ceiled under the bottom of the beams, and has a platform of 1-inch white-pine matched boards. It was not intended at first to stable any horses here, and when it was found necessary in 1882 to do so, all that portion of the floor not reserved for the hay loft, was covered with 1 inch of concrete and 1 inch of asphalt. The third floor is of ordinary matched boards. The stalls are about 9 x 4½ feet, and have partitions 40 inches high, made of horizontal 2-inch plank finished on top with iron guards, 30 inches high, and made with a welded frame and vertical ⅝-inch rods 2¼ inches apart. Some of these screens are curved in front and braced with a light strut A, as shown in Figure 3. The iron frame and the ends of the partition boards fit into rebates slotted into the stall posts, and the front of the partition is protected by 2-inch vertical kicking pieces on each side, which can be easily and cheaply replaced when worn out without disturbing the partitions. Originally elevated iron hay racks were used, but they have now been replaced in most cases by wooden mangers, covered with zinc when necessary to prevent cribbing, which are cheaper and allow the horses to feed in a more natural position and without breathing so much dust. Two horizontal 6 x 4-inch pieces are run continuously through each row of stalls to make a framework to which light vertical boards are attached for the fronts of the mangers, the bottoms being left partly open to allow dust, seed and fine stuff to fall through to the floor below, where there is a 6-in. open space which is frequently cleaned out. Above one end of each manger is a rounded iron grain box; these boxes are set in pairs at alternate partitions.

All of the asphalt floor surface is covered with boards battened together in sections conveniently handled. In the stalls these floor boards are removed and the asphalt surface beneath swept and washed daily. Elsewhere the floor boards are removed and the asphalt swept and washed once a week. The stall floors pitch slightly to open shallow gutters molded in the asphalt, which run across the fronts of each row of stalls and pitch to strainer plates and traps discharging into sewer pipes carried on the ceilings of the stories below. These gutters are covered by loose longitudinal planks kept in place against the ends of the stall platforms by wooden side strips spiked down through the concrete to the floor timbers. The inclined gangways are made with an easy slope and are built of planks running lengthwise and having 3 x 4-inch transverse battens 14 inches apart on the upper side. The spaces between these battens are filled with white sand, occasionally replaced. Tan bark was at first used, but was quickly ground to dust and became offensive, then leather clippings were tried, but they became decomposed and saturated with moisture and were also unsatisfactory.

The elevator has a platform about 7 x 15 feet and is operated by hand. It is chiefly used to take wagons and sleighs back and forth from the third story, and to hoist grain and hay, the latter being rolled up the front incline. The third-story grain bins have a capacity of over 1,000 bags of oats, and have a zinc lining over the bottom and 1 foot high on all sides, besides zinc corner pieces to keep out rats. From the bottoms of the bins, galvanized iron pipe chutes deliver the grain to the 20-bushel zinc-lined bins on the first and second stories. These chutes are open at the top and bottom, and the grain flows through them until it fills the lower bin to the bottom of the chute which is near the top of the bin and seals it; then the flow stops until enough grain is dipped out of the bin to free the bottom of the chute again. The arrangement is satisfactory, except that the storage bins are not provided with hopper bottoms, and when they are nearly empty the grain has to be shoveled to the chutes. The manure is scraped along the floor and pitched into a vertical wooden chute at the north end of the building. This chute was originally set close against the brick wall, but it was noticed that the mortar there became softened and the wall showed indications of settling, so the chute was moved back 6 inches clear of the wall. It discharges into a manure pit about 12 x 15 x 6 feet, located under the sidewalk, and covered with a counter-balanced hinged wooden trapdoor made in sections. The pit was at first lined only with boards, but the rats gnawed through them and infested the manure, so, to make it vermin proof, it was paved and provided with brick walls lined with two rows of flag stones, set on edge, vertically, in an iron frame. The manure is pitched out of the pit every day to the basement floor, and thence again pitched into wagons. At each end of each stable floor there is a large deep rectangular iron water trough supplied with hot and cold water, the former being furnished from a 60-gallon kitchen boiler in the foreman's office, which is connected to a small greenhouse heater.

The stable accommodates about 70 horses, and its arrangements are considered satisfactory by its foreman, except that there is no place to hang the harness when removed from the horses, other than on pins and hooks on the walls and stable posts, where the moist air affects them injuriously.

The new stable on West Forty-seventh Street is a four-story and basement brick building, 100 feet deep and 50 feet front, which accommodates about 90 horses and half as many wagons. The columns and girders are of iron and most of the other interior construction is of wood, finished plain and intended to be clean and durable. The building was designed especially for commercial purposes and to provide for the shelter and suitable care of a large number of trucking horses and vehicles without causing annoyance to the occupants of adjacent buildings. It is equipped with modern apparatus and presents a spacious and attractive interior. The entrance for wagons and horses is by a gently-sloped paved approach 14 feet wide



FIRST AND SECOND FLOORS OF OLD STABLES.

which rises from the sidewalk to the house line and thence continues by an inside wooden incline 20 feet long, to the first floor, about 3 feet above grade. The main door, 10 feet wide, is of white pine 3 inches thick, glazed and hung on rollers. The front door alongside gives entrance to a private hall and staircase to the superintendent's apartments without communicating with the intermediate stories.

In the basement there are five extra large box stalls intended to be used in emergency or for sick horses; ordinarily they are used for storage. The location of the stalls and the general arrangement of the basement are shown in Figure 4. In the blanket room is a wall coil of hot-water pipe to dry wet blankets, which are hung on ceiling hooks. The horse entrance from the first floor is by a wooden inclined gangway, and under the upper end of it a small room is enclosed containing a hot-water heater, from which supply pipes run to the upper stories. At first hot water for washing harness, mixing feed and tempering the drinking water in very cold weather and for other stable purposes was supplied from the kitchen boiler in the fourth floor, but this arrangement was found inconvenient and inadequate. In the engine room there is a 10 horse-power gas engine to operate the five-ton Morse & Williams elevator, which has a platform about 8 x 16 feet, and is equipped with safety appliances and automatic gates. The elevator runs in a well deep enough to permit it to descend to the level of the basement floor, about 8 feet below grade, and raise and lower unused wagons, sleighs and miscellaneous articles for the storage of which the basement is chiefly used. The wagon wash is 10 x 18 feet, with its cement floor pitched from each side to the large floor strainer. The sidewalk vault is not lighted and is only used for storing the supply of coal required.

The first floor, shown in Figure 5, is unobstructed except by the center row of cast-iron columns, and is devoted entirely to the shelter of the wagons and trucks used daily. In front there is a room for storing, cleaning and repairing harnesses, which are hung on wall hooks, and there is a 12 x 20-foot washing platform pitched to a large center strainer plate. The wagons are washed at night and two can be cleaned here at once. Horses can reach the floors above and below by the inclined gangway, which has adjacent shallow stairs with low side partitions or bulkheads. The second and third floors have each three longitudinal and one transverse row of stalls, arranged as shown in Figure 6. The aisles between the rows are 10 feet wide, and one stall is omitted in the center of the middle row, so as to give a direct passage to the head of the down incline. A 7 x 11-foot washing platform is provided at one end of the middle row of stalls and there is a drinking trough at each end of the room. The elevator shaft is enclosed by solid brick walls, but communicates with each story by a 5-foot opening, protected by an iron-covered fire door which is always kept locked. On the second and third floors the passage to the elevator door is narrow, but suffices as it is rarely used, except by the employees and for occasional sick horses. The fourth story is used entirely for hay and grain and miscellaneous storage except in the front part, which is occupied by the foreman's rooms, as shown in Figure 7. It is lighted by turret skylights with galvanized iron frames 24 inches high, with horizontally pivoted sash all around the sides operated by ratchets. The skylight over the elevator well is not turreted. The arrangement of columns and girders is shown in Figure 8, which is a longitudinal section through the front of the building.

The basement floor is made of concrete 6 inches thick, covered with 1 inch of asphalt. The upper floors are all of wood with timber joists supported by the side walls and on longitudinal riveted plate girders in the center, which rest on cast-iron columns 1¼ inches thick, 10 inches in diameter in the basement and 6 inches in diameter in the fourth story. The floor beams are 3 x 14-inch spruce 12 inches apart. All headers 15 feet or more in length have a ⅝-inch iron flitch plate bolted between beams and all headers are hung in flat wrought iron stirrups. All window and door openings have wooden lintels, and the window sills are of wood. The first floor is laid with 3-inch quartered Georgia pine 3 inches wide, with beveled edges forming joints which are tight on the bottom and open ⅛ inch on top to receive the calking, which was done with one thread of cotton and three threads of oakum, well pitched, which was driven into all joints and against 4 x 8-inch calking beams around the walls. Holes were bored for all the floor spikes which were set down below the surface and plugged on top with hard wood driven in with white lead and with the grain parallel to that of the planks. The fourth floor is laid with clear 1¼-inch tongued and grooved spruce 4½ inches wide, breaking joints, blind nailed and scribed dust-tight against the walls, where there is also a 2-inch quarter-round bead on top, fitted tight all around. The second and third floors are laid with 1¼-inch tongued and grooved spruce 4½ inches wide, blind nailed, with 3-inch cant boards all around to receive the asphalt. The second and third floor beams under the stalls are furred up with wedge-shaped pieces 6¾ inches high at the heels and 8¼ inches high at the heads, so as to raise the stall floors above the gutter and pitch them 1½ inches towards it. Behind the stalls the floor was furred up level with the top of the gutter timber, 7 inches high. The whole of the second and third floors were covered with three thicknesses of building paper, on which was laid a continuous bed 1 inch thick of the Moens Asphalt Company's rock asphalt turned up or flashed 3 inches high against all walls, columns, stall posts, etc. Everywhere except in the stalls the asphalt is protected by a wearing surface of rough 2-inch spruce plank 9 inches wide battened with 2 x 6-inch clamp pieces, spiked down and having the joints filled with hot asphalt.

The inclined gangway from the front entrance to the first floor is a sloping platform built and calked like the first floor and covered with a wearing surface of 2-inch white maple and has in the center 3 x 3-inch horizontal slats 5 feet long and spaced 12 inches apart. The inside inclined gangways from the cellar to third floor are platforms of 2-inch tongued and grooved spruce 5 inches wide on 4 x 14-inch pine beams 12 inches apart, which are hung from the carriage beams by 3 x ½-inch iron straps, hooked and bolted. White oak 3 x 5-inch cleats are nailed on top and the underside is ceiled with ½-inch tongued and beaded Georgia pine 2½ inches wide. The sides of these gangways are enclosed with low bulkheads of the same beaded pine, with a solid rounded cap on top to receive the partition, and have 6-inch locust posts running to the ceiling on all landings. The underside of the second-story floor beams is ceiled the same as the gangway inclines. The blanket room, harness room and closet partitions and the enclosures for feed chutes, etc., are similarly ceiled, and all inside woodwork except stall partitions and floors is painted three coats of white lead. The roof is nearly flat, sloping from both ends to the middle and is made with 3 x 12-inch beams 16 inches apart, covered with 1¼-inch blind nailed, tongued and grooved plank 5 inches wide, on which is laid heavy tarred roofing felt. On the felt is nailed the best quality of Pontmeyster tin in small square sheets with solder

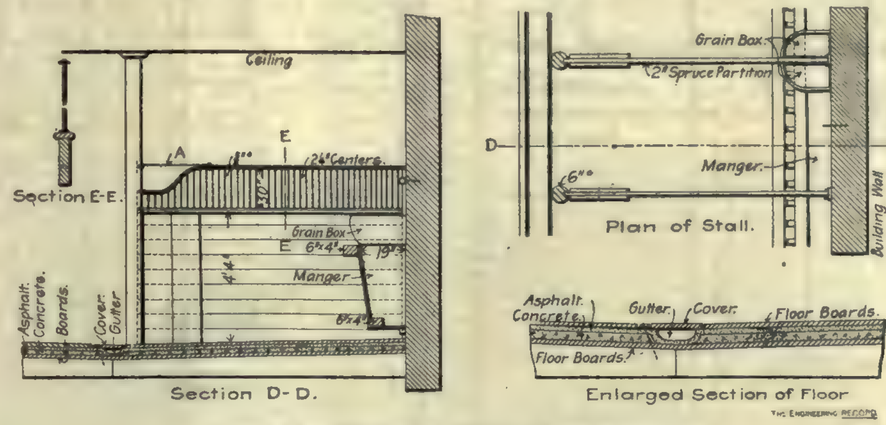


FIGURE 3.—DETAILS OF STALLS IN OLD STABLES.

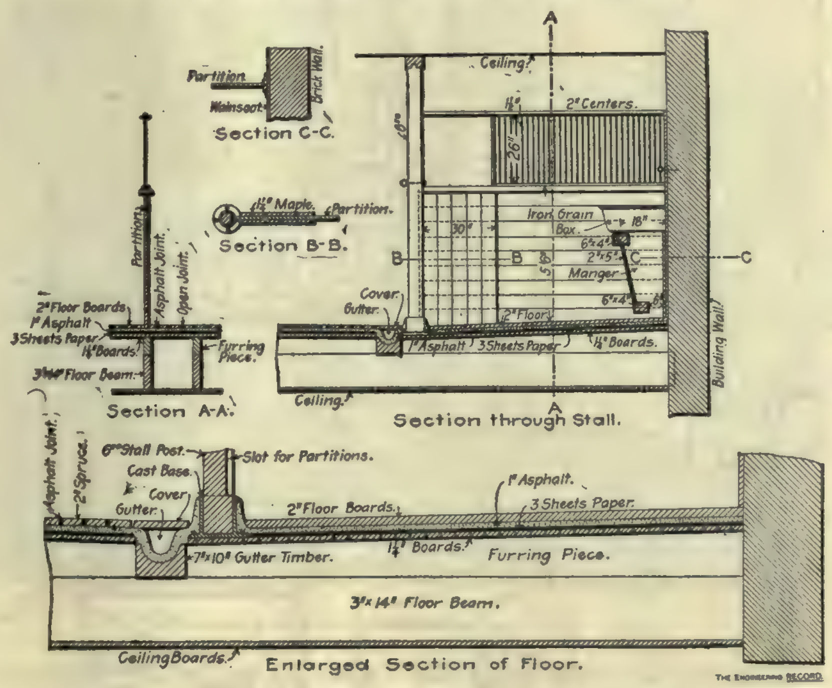


FIGURE 9.—DETAILS OF STALLS IN NEW STABLES.

soaked joints and painted three coats on both sides.

The open stalls are 9 feet long and 5 feet wide, except those in the cross rows at the end of the building, which are 8 feet long and 4 feet 10 inches and 4 feet 11 inches in width at centers. The asphalt floor surface of all stalls is covered with 2-inch rough spruce plank 5 inches wide, battened at the head and heels and nailed down solid with tight joints, except for a 2 x 5-foot panel in the center of each stall. Here the planks are about 4 inches wide, with planed edges, and are securely spiked down half an inch apart so as to leave narrow gutters between them through which the drainage runs off on the smooth asphalt surface to the collecting gutter across the heels of the stalls. These ½-inch spaces are unobstructed by cleats, bolts or tie rods, and are cleaned out daily by raking them with a special iron bar bent like a poker. The stall partitions are secured to 6-inch heel posts of turned locust, which are set with white lead in cast-iron flanged sockets screwed to the floor and covered with the asphalt, which is flashed up around their sides. The tops of the stall posts are mortised 2 inches into a continuous 6 x 8-inch string piece bolted flatways on the under side of the floor beams above. The stall partitions, 56 inches high, are made of 2-inch Georgia pine 6 inches wide, tongued, grooved and beaded. It is laid up horizontally with one end fitted into a slot rebated into the side of the heel post, and the other end into a vertical wall cleat of 3-inch spruce 6 inches wide. At the heels each partition is faced for 30 inches on each side with vertical pieces of 1¼-inch planed white maple kicking strips, easily renewed when necessary without interfering with the partitions. The partitions are capped with 3 x 6-inch rounded Georgia pine rails surmounted by wrought iron stall guards 6 feet long by 26 inches high with their 1½ x ¼-inch frames screwed to the cap every 6 inches. The ½-inch round vertical bars of the stall guards are spaced 2 inches apart and riveted to the top of the frame, which is extended to the stall post and bolted at both ends. Similar iron guards are placed across the heads of the center stalls, all around box stalls and their doors, and at windows. The mangers are built as shown in cross-section in Figure 9 with 4 x 6-inch rails running through three stalls and covered on top with No. 14 galvanized iron. The bottoms of the mangers are open to let the dirt and dust fall through on the floor. In each stall is a cast-iron corner grain box 14 x 20 x 12 inches.

There is a hitching ring at the head of each stall, and another and a large collar hook on each stall post. In the harness room, 3 x 10-inch Georgia pine timbers planed and rounded are horizontally suspended 3 feet apart by iron rods so as to be 8 feet above the floor and carry heavy harness hooks 12 inches apart. There are also heavy harness cleaning hooks suspended from the ceiling, and in the blanket room there are 75 ceiling hooks. The watering troughs are about 3 feet long and 2 feet wide, made of 2-inch clear pine put together with tongues, grooves, white lead and cotton wick and strongly bolted with iron rods. The upper edges are covered with 2 x ¼-inch flat iron, and the troughs set on locust blocks. The large grain bins are made with double board walls of matched stuff on both sides of vertical struts run up to the ceiling. There are hinged doors opening downwards in the upper parts of the walls, and the insides of the bins are lined with zinc and have sloping bottoms pitched to 10-inch galvanized tubes conveying the grain to

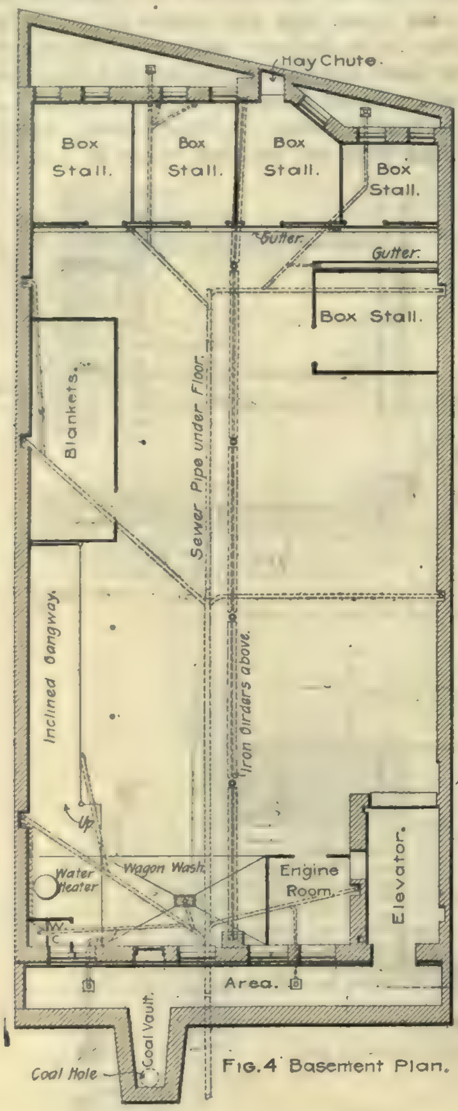


FIG. 4 Basement Plan.

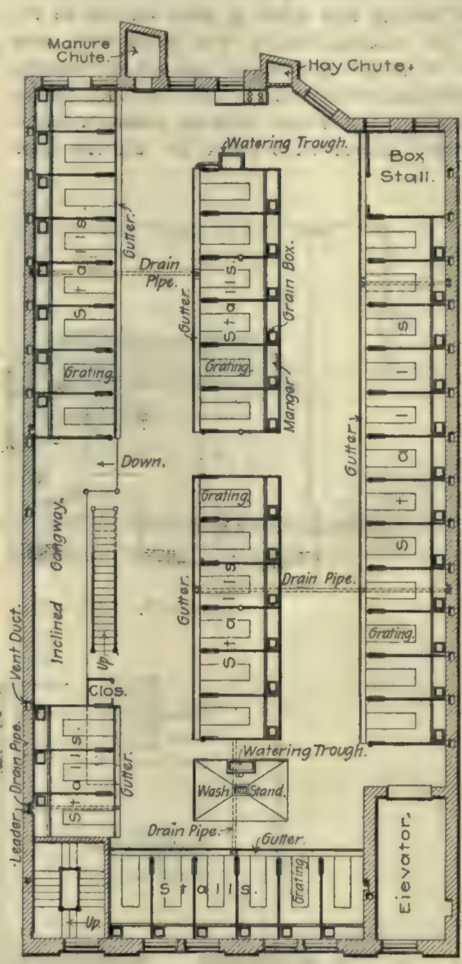


FIG. 6 Third Floor Plan.

THE ENGINEERING RECORD.

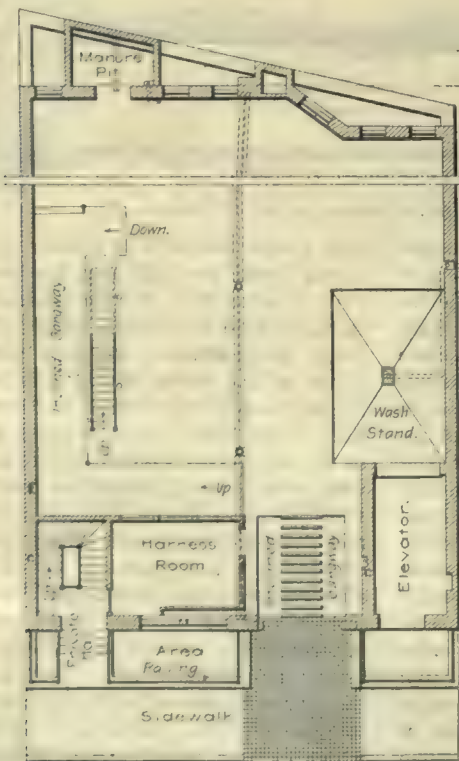


FIG 5 First Floor Plan.

FIG 7 Fourth Floor Plan.

Scale
0' 4' 8' 12' 16' 20' 24'

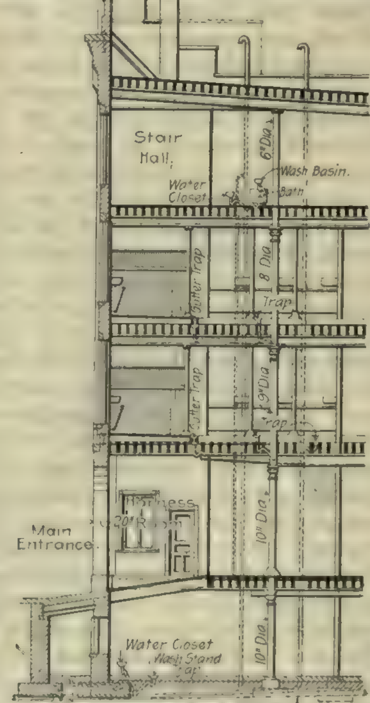


FIG. 8 Part Longitudinal Section.

THE ENGINEERING RECORD.

THE NEW STABLES OF ACKER, MERRALL & CONDIT, NEW YORK CITY.

MR. MORTIMER C. MERRITT, ARCHITECT.

small covered bins in the second and third stories, where the grain fills them automatically to the bottoms of the open chutes. These bins are made of 1¼-inch pine, lined with 14-ounce zinc and have shut off slides to close the chutes when the small bins are emptied and cleaned every week.

In the rear of the building vertical brick shafts are built outside of the main walls for hay and manure chutes. The former is about 3 x 2½ feet, and the latter 5 x 4 feet, inside dimensions. In each chute there is a full-size doorway through the stable wall at each floor. In the second and third stories, the hay-chute doors are hinged at the bottom to the floor and when closed are in a vertical position, leaving the chute unobstructed; when one is opened it revolves about the lower edge as a horizontal axis until the upper edge strikes the outer wall of the chute, and the door thus forms a stop, closing the chute below and discharging the hay on the stable floor at this point. The manure chute has vertically sliding doors through which the manure is pushed or scraped. It falls into a chamber with an iron and brick arched floor in the first story, whence it is daily forked into wagons and removed. The wash-stands are pitched to central cast-iron gratings over trapped drains, and have wooden platforms asphalted and curbed with white oak. The roof water drains through short lead pipe connections into iron leader pipes carried up in wall chases. The stalls drain into open gutters made of 7 x 10-inch pine timbers in long lengths hollowed out on top, tarred inside, painted and butt jointed. They are pitched both ways to cast-iron boxes containing traps and strainers connecting with soil pipes suspended from the ceiling below. The top of the gutter timber is flush with the floor plank and the asphalt surface is laid continuous over both, making a smooth surface and waterproofing the joints. The gutters are covered with 1¼-inch loose oak planks, cleated and jointed at stall posts. They are provided with heavy countersunk galvanized iron lifting rings, by which they are daily removed to permit the gutters to be swept and flushed. There are ventilation ducts in the side walls that have openings near the ceilings and above the roof. There is a large gong at the main entrance and speaking tubes and whistles to every story. Mr. Mortimer C. Merritt was the architect of this stable, and acknowledgment is made to him for data. The total cost of building and equipment was $43,556. The principal contracts were let to Mr. S. I. Acken for mason work; Mr. James Connity for plumbing; Morse, Williams & Company for engine and elevator, and to Mr. S. K. McGuire for carpenter work.

A SMALL NEW YORK LIBRARY.

Among the many libraries and reading rooms which are scattered all over the city of New York are the ten branches constituting the New York Free Circulating Library. This is an association formed for the maintenance of various reading centers by which a large proportion of the city's people may obtain good home reading at no cost and with minimum inconvenience occasioned by distance from such institutions. The libraries are supported by annual subscriptions of certain associate members, by voluntary contributions of books and money, and by an annual grant from the city depending in amount upon the number of books put in circulation.

One of the branches, known as the Bloomingdale Library, is situated on West One Hundredth street between Amsterdam avenue and the Boulevard. It occupies a new building, into which it moved in the early part of November of last year, having up to that time been confined in crowded quarters on Amsterdam avenue. The present building is three stories high and stands on a plot of ground measuring about 43 feet wide and 55 feet deep. It is flanked on either side by adjoining buildings, as is common practice in residence sections of New York City, and runs close to the building on the rear. It was therefore only possible to provide windows for light on front and rear. The building is of fire-proof construction and was built from the plans of Mr. James Brown Lord of New York by Mr. John J. Tucker of New York.

The facade of the library is the subject of the accompanying cut. The first story is of light-gray limestone, and the two above are of light-colored brick, with terra-cotta ornamentation. The main entrance is through a stone portico which extends nearly across the first story, while above it four Ionic engaged columns of terra-cotta rising to the roof form a conspicuous feature of the building.

The basement of the building includes, besides a cellar containing the heating apparatus, a working room for the librarians and a retiring and cloak room. The main floor is devoted to the circulating department of the library. The patron enters through the portico and finds a rectangular enclosure facing him. This is a counter, within which are stationed the assistants of the library, and at the left of it books are received and credited to the member. The walls of the rooms are lined with shelves, and the books are open to the public. This is a practice which, while probably of quite recent adoption, is said to prove most satisfactory for libraries of this type. It is deemed wise that the readers should have access to the shelves whereby the selection of a work desired may be reached by a personal inspection of the books, and not by a mere consultation of a card catalogue. It is acknowledged, of course, that such liberty is liable to increase the percentage of lost books, which every library suffers to a greater or less extent, but it is also probable that the inclination that some people have of taking the property belonging to large institutions is suppressed by the arrangement of the enclosure near the entrance. The borrower, then, having disposed of his old books and having selected a new one must pass out by the right end of the counter, where the book is charged.

The room, and those on the floors above, are finished in white plaster and trimmed with oak. It is well lighted by large windows in the front and by windows and an inclining skylight at the rear. The adjacent property fronting on the next street comes close to the rear of the building, and a shaft indents the rear of the library structure. The shaft drops to the ceiling of the first story to the skylight mentioned, which has been fitted with prisms made by the American Luxfer Prism Company of Chicago, throwing the light forward into the room. Two or three cast-iron columns along the center line of the building support the longitudinal beams for the floor above and book shelves extend in line with these and divide the rear of the room in two parts, one for children and one for adults. A double dumb-waiter or book-lift extends upward through the room at the rear of the enclosure communicating with the working room below and the floor above. The work room may be reached from the "pen," as the enclosure is technically known at the library, by a private stairway.

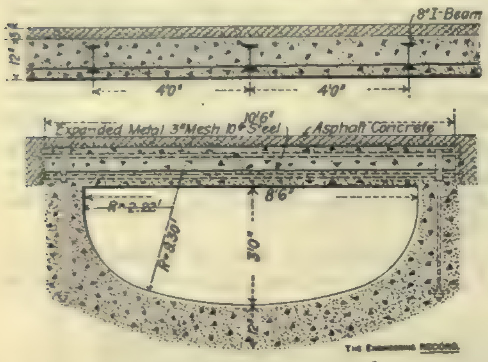
The second floor is used as a reading room, and is equipped with wall shelves and numerous tables. A reference library is placed on the shelves and the city newspapers and many magazines may be found. The tables seat six each and are smaller than those used in other branches of the library. Books taken from the shelves may be read either up-stairs or down-stairs without charging. This room is lighted by large windows in front and rear. The top floor is given up to the apartments of the janitor of the building and to a large room which may be used for storage. All floors, including basement, are accessible from a winding staircase of iron at a rear corner.

THE BLOOMINGDALE BRANCH LIBRARY, NEW YORK.

The building is heated by direct radiation by an Ideal steam boiler. At present the building is lighted by gas, using the De Lery incandescent system, which, as is well known, employs a pendant tassel. Provision has been made for electric light whenever mains are laid in the street. Rising mains in conduits extend through the building, with wall distributing boxes on each floor. Branch circuits with switch connection and combination gas and electric fixtures are already in place. Including the land, the building cost nearly $50,000, supplied entirely from the funds of the library association.

NOTES.

A Sewer of Unusual Cross-Section, forming part of the surface-water drainage system of Worcester, Mass., has been built for a distance of about 215 feet where the regular circular section, 84 inches in diameter, could not be used because of the thin covering between the arch and a much-used street above. Its general design is shown in the accompanying illustration, from sketches by Mr. F. A. McClure, city engineer. The street is depressed at this place



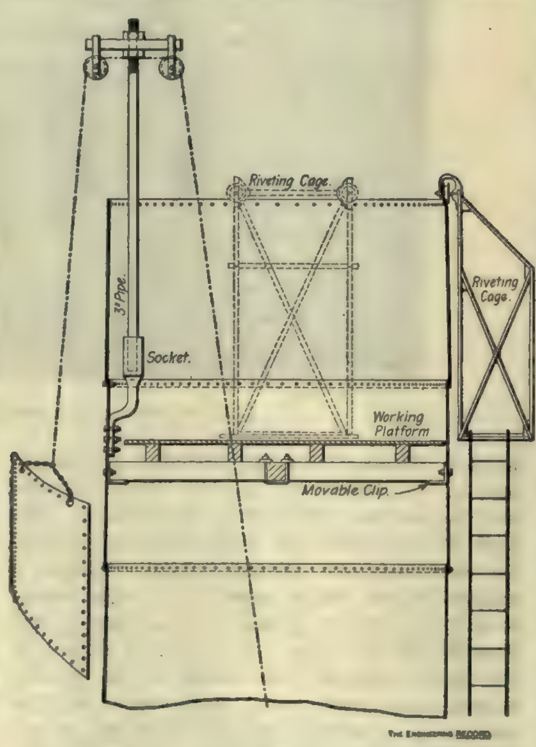
to pass under a railway track, and the cover is but 1⅓ to 4 feet thick. The sewer was constructed under the supervision of Mr. Harrison P. Eddy, superintendent of sewers, who gives the following note concerning it in his annual report for 1898: "This conduit was constructed of American Portland cement concrete, and in the roof there was a layer of expanded metal to strengthen the arch. The portion of the sewer which will at times work under considerable head was covered with I-beams at intervals of 4 feet. These beams were anchored to the concrete invert, so that there will be no possibility of the roof of the sewer being lifted by the pressure of the water."

Protection from Rock Blasts in the vicinity of buildings has been secured on Pennsylvania Avenue in Philadelphia by covering the blasts with strong nets heavily loaded, which have proved more satisfactory than the usual chained logs or timber platforms. The net shown in the illustration resembles a coarse mat measur-

ing 10 to 12 feet on a side. It is made of hemp rope 1 to 1½ inches in diameter, which is woven closely by hand. Partly worn rope is as good for the purpose as that which is new, and more easily woven. At each side, the rope is looped over a wood pole and the loops are tied in groups of three each. The net is lifted by the boom derrick for handling the drills, by means of a loop at the middle of each pole and at the center of the net itself. The blasts do not move the mat bodily nor cut the ropes very much. The work is under the general superintendence of Mr. G. S. Webster, chief of the Bureau of Surveys, with Mr. Samuel Tobias Wagner as first assistant engineer in charge.

Philadelphia has Awakened to the vital importance of the reports its Bureau of Water has been making for several years, but it has taken a rapid rise in the typhoid fever rate to bring it about. The present situation is stated as follows in the "Ledger" of March 15: "The fact that the recent rises of the waters of the Schuylkill, diminishing sedimentation, have been followed by an increase of typhoid fever cases, confirms the view of Chief Medical Inspector Taylor that the typhoid scourge is attributable to a polluted water supply. The new typhoid cases reported for the day ending at noon yesterday numbered 74; deaths, 12; cases since January 1, 3,817; deaths since January 1, 394. The 74 new cases is the highest number of such cases occurring in one day during the present typhoid epidemic. The typhoid visitation is a shame to the city, a serious check upon its business activities, an inexpressible outrage upon its people. Councils have trifled with the health and lives of Philadelphians, and the strangers within our gates, long enough, to say nothing of the bad reputation Councils are giving the city abroad. Some members of the Councilmanic bodies are impervious to any such considerations, and it is useless to appeal to them on humane grounds; but there ought to be enough virtue and humanity represented in the municipal legislature to furnish some alleviation."

A Steel Chimney 150 feet high and tapering from 9 to 8 feet in diameter, with a base about 15 feet in diameter and height, was recently erected at the Anheuser-Busch brewery in St. Louis in about three weeks without the use of falsework. Ten men were employed on the work, which was carried out by means of the light platform and derrick shown in the accompanying cut. Four small angles were bolted temporarily inside each course of plates, and on them was laid the cross of timbers 6 inches



square, which carried the working platform. A forging with a socket in the upper end was also bolted to the stack to hold the derrick. The inboard end of the hoisting line ran down inside the stack to a sheave at the bottom and thence to the hoist. Two light cages were hung outside the stack by double-flanged wheels, and were used to hold on the rivets from the outside. The permanent outside ladder was riveted in place as the work progressed, and, in connection with a short ladder attached to one of the cages, afforded access to the platform. The stack was designed by E. Jungenfeld & Company, and built by the Koken Iron Works, of St. Louis.

The Influence of Forests on Water Supply is becoming a subject of much importance to Colorado irrigators, and it is evident from the following extract from a report by Prof. L. G. Carpenter, of Fort Collins, that forestry legislation is particularly desirable in that State: "Since the early settlement the areas of forest have become much less from fires, and by denudation for mining and railroad purposes. The amount used for domestic purposes is of small importance, except as careless and irresponsible cutting gives conditions favoring the start and spread of the devastating forest fires. From the standpoint of the water supply on which our agriculture depends, the protection of the forest becomes of vital importance. The protecting influence of the forests on the snow cover is of the greatest importance. The letting in of the sun and wind melts and evaporates the snow without sensible formation of water, dries the springs and lessens the amount of water available for use. It is safe to say that with the former forest cover, even with the small snowfall and little rainfall of the past year, the low stage of the river would not have fallen to 34 feet as it did this year. It would have been several times more, for the innumerable small springs would have continued their supply. If the forest cover continues to be removed, autumns of low water like the present will cease to be exceptional, but become the rule, the river will be lower than it has been this year, and may become as dry as some of its tributaries."

Summer Courses of Instruction will be given at Lehigh University this year if there are a sufficient number of applicants to justify the formation of classes. The courses embrace chemistry, physics, surveying, mathematics, English, history, political economy, and ancient and modern languages. Among the non-resident lecturers for the second term of the present year are Capt. E. L. Zalinski, U. S. A.; Mr. F. H. Newell, U. S. Geological Survey, and John Sterling Deans, chief engineer of the Phœnix Bridge Works.

The Water Supply of Berlin during the year ending March 31, 1898, amounted to about 36,343,000 gallons a day, about 2 per cent. more than last year. The number of persons supplied was estimated at 1,763,000; of the total supply, 0.289 per cent. was used by the water department itself, 20.081 per cent. for public purposes, for which no payment was made, and 79.630 per cent. by private consumers. The amount of water taken by the last class has been gradually increasing from 5,518 gallons per consumer annually in 1892-93 to 5,950 gallons in 1897-98. The total daily supply per consumer is about 20.56 gallons. The greatest draft in any one day occurred in June, and was 147 per cent. of the average, while the least draft was in January, and was 70 per cent. of the average. During very warm days the greatest hourly draft was about half again as much as for the average of the 24 hours, and during the winter the ratio was still greater, nearly two to one in fact. The works paid a profit during the year of about $476,800.

A Bucket Water-Wheel working on a converse principle to the familiar bucket elevator has recently been installed at a Mannsville, N. Y., mill. The principle involved is the same as that of the old overshot wheel, except that the buckets are attached to an endless chain rather than arranged in a circle. The designer of the new wheel spent several years in experimenting with buckets of various forms, and has lately entered into an agreement with the W. J. Clark Company, of Salem, Ohio, by which it becomes his representative.

TRADE PUBLICATIONS.

Railroad asphalt plants built under the Hetherington patents by Messrs. Hetherington & Berner of Indianapolis are described in a well-illustrated pamphlet just issued by this firm. Portable plants have made it possible for small cities and towns to obtain asphalt pavements at a reasonable expense, and this pamphlet is of special value as showing a successful type of the apparatus which has brought about this desirable result. It describes the construction and operation of the machinery and gives information on these subjects which it will be difficult to obtain elsewhere.

The Michigan Pipe Company, Bay City, Mich., is distributing a little book in which the advantages of creosoted wood are explained, and its conduits, poles, railroad ties, paving blocks and water pipe are described.

Steel plate fans of many forms and sizes, driven by belt, steam engine or electric motor, are described and illustrated in a 132-page book issued by the B. F. Sturtevant Company. It is the second edition of the company's catalogue 96, and contains numerous tables relating to fans and the flow of air in pipes, as well as elaborate descriptions of many varieties of plate fans and fan installations.

The Joseph Dixon Crucible Company, Jersey City, N. J., has printed a brochure of 32 pages bearing the title of "Teachers' Note Book." It contains considerable information which will appeal to many people who are not engaged in training the young mind to work easily, and some of the mottoes it contains, evidently for copy-book purposes, deviate considerably from the usual sense, although preserving the familiar forms, such as "a thirsty man will catch at a straw" and "osculation is the thief of time." The little book is well worth writing for.

Dust-proof grain elevators of a type introduced in a number of places are described in a profusely illustrated pamphlet issued by the Steel Storage & Elevator Company, Buffalo, N. Y. Engineers who have not followed the rapid and important development of grain handling and storing apparatus in recent years will be surprised as well as interested by some of the facts which are here presented.

The Columbian Fireproofing Company, 156 Fifth Avenue, New York, has issued a new catalogue of its well-known system of fireproof construction. This contains the results of some interesting tests and good engravings of many buildings in which the company's system has been used.

The Detroit Graphite Manufacturing Company, Detroit, Mich., has published an attractive book of 106 pages describing in a general way the process of manufacturing its graphite paint, beginning with the crushing of the ore obtained from its mines in North Michigan and ending with its final sealing for shipment. The book also contains a general description of the properties of the paint, suggestions by Mr. C. T. Purdy for specifications for painting metal work, an account of some interesting tests of the company's product, and many fine engravings of boats, buildings and bridges on which it has been used. In a letter transmitting the book the company states that its business in 1898 was double that of 1897, and it is now building a large five-story addition to its factory.

Broken Stone Foundations for brick pavements will not be laid this year in Fort Wayne, Ind., according to City Engineer F. M. Randall. These foundations have served fairly well for eight years, but this season the Board of Public Works will use only concrete, the reason being that when a street is opened for gas, water or sewers, the broken stone cannot be replaced satisfactorily. The Board hopes to overcome this objectionable feature by the use of concrete.

PERSONAL AND OBITUARY NOTES.

Mr. Wm. M. Carter has been re-elected city surveyor of Woodbury, N. J.

Mr. George H. Hart has been elected water commissioner of Maynard, Mass.

Mr. William Reynolds has been elected water commissioner of Marblehead, Mass.

Mr. L. B. Stillwell has been retained by the Manhattan Railway Company, New York, as consulting electric engineer.

Mr. Walter A. McDonald has been elected borough surveyor of West Chester, Pa., and Mr. Evan Mercer, engineer and superintendent of water-works.

Mr. Emory Donaldson has been engaged as superintendent of construction, and Mr. George S. Lee as assistant superintendent by the Baltimore, Md., Electrical Subway Commission.

Mr. Charles L. Parmelee has resigned his position as assistant engineer to the Board of Trustees, Commisioners of Water-Works, Cincinnati, Ohio, to become chief engineer of the Continental Filter Company, New York.

Lieut.-Colonel George McC. Derby, Corps of Engineers, U. S. A., has been ordered to relieve Captain Henry Jervey at New Orleans, who will take over part of the river and harbor work in Florida, now in charge of Lieut.-Colonel W. H. H. Benyaurd.

Mr. H. M. Lofton has resigned the office of superintendent of the Savannah, Ga., water-works to become general manager of the street railway system in that city. His successor in the water department is Mr. I. U. Kinsey, who has been connected with the works for 16 years.

The Civil Engineers' Club of Cleveland elected the following officers at its annual meeting on March 14: President, Colonel Jared A. Smith, Corps of Engineers, U. S. A.; vice-president, Prof. John W. Langley; secretary, Arthur A. Skeels; treasurer, John N. Coffin; librarian, William E. Reed; directors, Joseph R. Oldham and William B. Hanlon.

Mr. William T. Manning has resigned the office of chief engineer of the Baltimore & Ohio Railroad, to look after his private interests, but will continue his relations with the company as its consulting engineer. The works executed under his supervision include some of the largest undertakings of the company, such as the belt line in Baltimore, and the terminal improvements at Pittsburg, Cumberland and at Staten Island. Major P. H. Irwin has been appointed acting chief engineer of the company.

In the death last week of Sir Douglas Galton, sanitary science loses one of its oldest and most distinguished experts. For many years no meeting of British sanitarians has been considered complete without his presence. He was born in Worcestershire in 1822, and his career at Rugby and afterwards at Woolwich was phenomenal, at the latter institution the first prize in every subject being awarded to him. His first commission in the Royal Engineers was dated 1849, and from that time until he retired in 1875 his Government work covered a wide variety of subjects from fortification and scientific reports to the management of a large portion of the affairs of the War Office as Under Assistant Secretary. From 1870 to 1895 he was general secretary of the British Association for the Advancement of Science, and from 1895 to 1896 was its president. During these years he devoted much attention to the construction of hospitals, ventilation, heating and other features of the hygienic arrangement of buildings. In these branches of engineering he was a prolific writer, and while some of his ideas are not considered good practice to-day, his work as a whole has been of the greatest value in bringing about a general appreciation of the importance of good sanitary conditions in cities and in buildings of all sorts.

CONTRACTING NEWS

OF SPECIAL INTEREST TO

CONTRACTORS, BUILDERS, ENGINEERS, AND MANUFACTURERS

OF ENGINEERING AND BUILDING SUPPLIES.

For Proposals see pages xi, xii and 368.

RIVER AND HARBOR APPROPRIATIONS.

The following river and harbor appropriations were made March 3, and are published in Public Document No. 189. The appropriations have been classified by States, and are for new work, continuing improvement, completion or maintenance, indicated by the letters *a*, *b*, *c*, or *d*, respectively. No items of less than $10,000 are given. (Figures in parentheses indicate maximum subsequent appropriations.)

Harbors.

Maine.—Moosabec Bar, *c* $11,000; breakwater, Mount Desert to Porcupine Island, *b* $20,000; Carvers Harbor, Vinalhaven, *b* $15,000; Cape Porpoise, *a* $70,000 ($55,000).

New Hampshire.—Little Harbor, *b* $12,000.

Vermont.—Burlington, *b* $15,000.

Massachusetts.—Boston, *b* $75,000 ($450,000); Nantucket, *b* $20,000; Newburyport, *b* $25,000; Plymouth, *d*, $10,000, *a* $75,000; Provincetown, *d* $10,000; Scituate, *d* $15,000; Sandy Bay, Cape Ann, *b* $250,000; Gloucester, *b* $40,000; Duxbury, *a* $12,000; New Bedford, *b* $10,000, *a* $34,000; Woods Hole Channel, *b* $20,000; Fall River, *a* $20,000.

Rhode Island.—Block Island, *b* $10,000; Newport, *b* $15,000; Great Salt Pond, B. I., *c* $50,000; Sakonnet Point, *c* $25,000.

Connecticut.—Bridgeport, *b* $50,000 ($250,000); New Haven, *a* $50,000 ($295,000).

New York.—Buffalo, *d* $75,000; Erie Basin and Black Rock Harbor, New York, *a* $50,000 ($198,113.80); Great Sodus Bay, *d* $14,000; Ogdensburg, *b* $15,000; Oswego, *b* $60,000; New York Harbor, *d* $100,000, *a* $1,000,000 ($3,000,000); Bay Ridge and Red Hook Channels, New York, *b* $100,000 ($2,400,000); North Tonawanda, *b* $75,000; Port Chester, *a* $25,000; Channel between Staten Island and Jersey shore, *c* $32,000; Gowanus Creek Channel, New York, *b* $25,000; Peekskill, *b* $10,000; Wallabout Channel, New York, *c* $40,000; Cape Vincent, *a* $25,000; Larchmont, *b* $50,000.

New Jersey.—Raritan Bay, *b* $65,000.

Pennsylvania.—Erie, *b* $125,000; Pittsburg, *c* $110,662.90.

Delaware.—Wilmington, *b* and *d* $45,000 ($205,780).

Virginia.—Cape Charles City, *b* $20,000; Milford Haven, *c* $12,500.

South Carolina.—Charleston, *a* ($175,000 also dredge for $150,000).

Georgia.—Brunswick, *d* $10,000; Savannah, *d* $50,000; Darien, *b* $10,000; Doboy Bar, *a* $70,000.

Florida.—Apalachicola Bay, *a* and *d* $20,000; Pensacola, *b* and *d* $70,000; Key West, *b* $25,000; Charlotte Harbor and Pease Creek, *c* $25,000; Carrabelle Bar and Harbor, *b* $10,000; Tampa, *a* $75,000 ($675,000); Hillsboro Bay, *a* $125,000.

Alabama.—Mobile, *b* $100,000 ($500,000).

Mississippi.—Ship Island Pass, *c* $40,000; Gulfport, *a* $150,000, *d* $10,000 annually, 5 years. See Louisiana.

Louisiana.—Calcasieu River, *b* $35,000; New Orleans, *b* $110,000; Natchez and Vidalia (La.) Harbor, *a* $50,000; rectification of Red and Atchafalaya Rivers, *b* $25,000; Pass a Loutre, *a* $200,000 ($300,000). See Texas.

Texas.—Galveston, *d* $50,000; Galveston Ship Channel, Buffalo Bayou, *a* $300,000 (provided by citizens of Houston); ibidem, *a* $250,000 ($2,000,000 in all); Brazos River, *a* $85,000; channel from Galveston to Texas City, *a* $250,000; Aransas Pass, *a* $60,000; Sabine Pass (La.), *a* $150,000.

Ohio.—Ashtabula, *b* $50,000 ($430,000); Black River (Lorain), *b* $50,000 ($600,000); Cleveland, *a* $75,000; Conneaut, *b* $100,000; Fairport, *b* $100,000; Huron, *b* $25,000; Sandusky, *b* $80,000; Toledo, *a* $150,000 ($800,000).

Indiana.—Michigan City, outer harbor, *c* money on hand ($195,000).

Illinois.—Chicago, *b* $100,000; Calumet, *b* $150,000 ($859,830).

Michigan.—Charlevoix, *b* $15,000; Frankfort, *b* $35,000; Grand Haven, *b* $10,000; Grand Marais, *b* $25,000; Manistee, $20,000; Holland (Black Lake), *a* $37,500; Muskegon, *b* $60,000; Pentwater, *b* $25,000; Portage Lake, *b* $75,000 ($85,000); Sand Beach, *a* $50,000 ($200,000); Saint Joseph, *a* $50,000 ($330,000); South Haven, *c* $45,000; White Lake, *b* and *d* $35,000; Marquette, *b* $25,000; Ludington, *a* $25,000; Petoskey, *b* $20,000; Presque Ile Point, Marquette Bay, *c* $30,000.

Wisconsin.—Ahnapee, b $13,000; Green Bay, b $28,600; Kenosha, c and d $50,000 ($141,000); Milwaukee, harbor of refuge, b $50,000 ($105,650); Milwaukee, d $14,000, a $12,000; Racine, a $50,000 ($67,650); Sheboygan, a $25,000 ($52,000); Ashland, b $35,000; Oconto, b $15,000; Sturgeon Bay Lake Michigan Ship Canal, b $30,000; La Crosse, b $12,000.

Minnesota.—Grand Marais, c $30,000; Agate Bay, c $71,708.

California.—Alviso Harbor, Santa Clara County, a $48,000; San Diego, b $65,000; San Luis Obispo, b $55,000; Humboldt, b $50,000; San Francisco, a $100,000 ($500,000).

Oregon.—Tillamook Bay and Bar, b $25,000; Siuslaw River, b $30,000; Coos Bay, b $150,000.

Washington.—Olympia Harbor, b $15,000; Everett Harbor, b $50,000 ($342,000).

Hawaii.—Pearl Harbor, c $100,000.

Rivers.

Maine.—Penobscot R., c $28,000; Lubec Channel, b $25,000; Georges R., b $10,000; Union R., b $15,000 ($115,000).

New Hampshire.—Cocheco R., b $20,000; Exeter R., c $12,000.

Massachusetts.—Powow R., b $12,000; Weymouth R., b $10,000; Essex R., c $10,000; Mystic R., a $50,000; Merrimac R., b $40,000.

Rhode Island.—Pawtucket R., b $30,000, Sakonnet R., c $20,000. See Connecticut.

Connecticut.—Connecticut R., below Hartford, b $20,000; Housatonic R., b $15,000; Thames R., b $20,000; Pawcatuck R. (R. I.), b $15,000.

New York.—Hudson R., b $100,000 ($500,000); Harlem R., b $100,000; East R. and Hell Gate, b $250,000; St. Lawrence R., b $20,000; Niagara R., Tonawanda to Port Day, b $15,000; Bronx R., b $20,000.

New Jersey.—Passaic R., b $15,000; Raritan R., b $20,000; Shrewsbury, R., d $10,000; Mantua Creek, a $25,000. See Pennsylvania.

Pennsylvania.—Allegheny R., b $15,000; Delaware R., Trenton to mouth (N. J.), b $300,000 ($500,000 in all); Monongahela R., a $50,000 ($135,556).

Maryland.—Patapsco R., b $200,000 ($1,000,000 in all); Potomac R., at Washington, D. C., a $100,000 ($150,000).

Virginia.—James R., b $150,000; Nomini Creek, b $10,000; Deep Creek, Turners Cut Level, Croatan Sound and Pasquotank R., (N. C.), a $25,000 ($232,450); Rappahannock R., b $15,000; York R., b $10,000.

North Carolina.—Cape Fear R., at Wilmington, b $150,000; Neuse R., d $10,000; Pamlico and Tar R., b and d $15,000. See Virginia.

South Carolina.—Santee R., b $20,000; Congaree R., a $50,000 ($200,000).

Georgia.—Chattahoochee R. (Ala.), b $50,000; Ocmulgee R., b $20,000 ($136,000); Oconee R., b $10,000; Savannah R., between Augusta and Savannah, b $20,000 ($250,000); Coosa R., a and d $20,000.

Florida.—Choctawhatchee R. (Ala.), b $16,000; Manatee R., b $10,000; St. Johns R., b $200,000; St. Johns R., Orange Mills Flats, a $40,000. Also $35,000 for dredge with snagging outfit; $36,000 for boat, etc., for removing water hyacinth.

Alabama.—Alabama R., b $50,000; Black Warrior R., b $50,000 ($140,500), from Tuscaloosa to Daniels Creek; Warrior and Tombigbee Rs., b $220,000 ($440,000); Tombigbee R., Demopolis to Columbus, Miss., b $10,000; Tombigbee R. mouth, to Demopolis, b $50,000. See Florida, Georgia and Tennessee.

Mississippi.—Pascagoula R., a $50,000 ($267,600); Yazoo R., b $20,000; Homochitto R., c $16,000; Pearl R., c $18,199.80. See Alabama.

Louisiana.—Red R. (Ark., Ind. Ter.), b $150,000; Bayou Teche, b $10,000; Bayou Courtableau, b $20,000; $36,000 for boat, etc., for removing hyacinth. See Arkansas.

Texas.—Brazos R., a $65,000; mouths of Sabine and Neches Rs., a $10,000.

Arkansas.—Arkansas R. (Ind. Ter.), b $100,000; ibidem, snag boats, a $20,000; White R., c $14,815; Upper White R., Lock and Dam No. 1, a $160,000 (Lock and Dam No. 2, a $150,000); Ouachita and Black Rs. (La.), b $110,000. See Louisiana.

Tennessee.—Cumberland R., above Nashville, a $100,000; ibidem, below Nashville, a $100,000; Tennessee R., below Riverton, Ala., a $100,000; ibidem, between Chattanooga and Riverton, a $35,000; ibidem, Colbert and Bee Tree Shoals, b $100,000; ibidem, above Chattanooga, b $30,000.

Kentucky.—Big Sandy R. (W. Va.), b $52,500 ($420,000); Green R., above Big Barren R., c $85,673.20.

Ohio River.—b $375,000; including harbor, Madison, Indiana, $20,000; Golconda, $10,000; Brooklyn, $10,000; Mound City, $25,000, all in Illinois; embankment, Lawrenceburg, Indiana, $15,000; Shawneetown, Illinois, $25,000; Dam No. 13, a $50,000 ($800,000); Dam No. 18, a $50,000 ($800,000).

Michigan.—Belle R., c $10,000; St. Marys R., Hay Lake Channel, b $100,000 ($394,115); Saginaw R., b $40,000; Detroit R., b $100,000 ($661,500); Kalamazoo R., b $10,000; Grand R., b $75,000; Sebewaing R., c $32,000. See Wisconsin.

Wisconsin.—Chippewa R., b $10,000; Fox R., b $27,500; Menominee R. (Mich.), a $18,920.

Minnesota.—Red R., of the North, b $25,000.

Indiana.—Wabash R. (Ill.), below Vincennes, b $15,000. See Ohio River.

Illinois.—Calumet R., b $60,000; Illinois R., b $100,000. See Ohio River.

Mississippi River.—Reservoirs at head waters, b $210,000; at St. Paul and Minneapolis, b $150,000 ($815,579.33).

Missouri.—Missouri R., mouth to Sioux City, a $100,000; Gasconade R., b $15,000; Osage R., a $25,000 ($146,000); Missouri R., above Sioux City, a $50,000; ibidem, b $170,000; Missouri R., Nebraska side, a $25,000.

California.—Sacramento R., mouth to Sacramento, b $30,000 ($250,000); San Joaquin R., b $20,000.

Oregon.—Columbia R., canal at cascades, b $75,000; Lower Willamette R., at Portland and below, and Columbia R., in Oregon and Washington, b $150,000; Coquille R., b $40,000; Clatskanie R., c $13,000; Columbia R., south channel at Astoria, c $71,000.

Idaho.—Clearwater R., c $10,000.

Washington.—Lewis R., mouth to Lacenter, a $10,000; Puget Sound, b $20,000; Pend Oreille R., a $10,000; Swinomish Slough, b $20,000; Okanagon R., b $15,000. See Oregon.

WATER.

Mankato, Kan.—Bids are wanted April 1 for a complete system of water-works. H. V. Hinckley, Engr. in charge, Topeka.

New York, N. Y.—Bids are wanted March 23 for furnishing hydrants, stop cocks, etc., to the Department of Water Supply, Boroughs of Manhattan and Bronx. Wm. Dalton, Commr. Water Supply.

Topeka, Kan.—H. V. Hinckley has been engaged by the city as consulting engineer on the proposed new water-works system.

St. Petersburg, Fla.—L. T. Jenners writes that the vote taken on March 7 was in favor of issuing bonds for water-works construction.

Phœnixville, Pa.—B. H. Williams, Supt. of the Water-Works, writes that the Borough has under consideration the construction of a 6,000,000 gal. reservoir, a new intake pipe to the middle of the river, and flood wall around pump house.

Pearl City, Ill.—J. J. Treas, Village Clk., writes that there is talk of improving the water-works system by drilling another artesian well and putting in a new pump and engine.

Jackson, O.—James Kinney, Jr., of Bellaire, O., and S. C. Boyer, Jr., of Scranton, Pa., having received a water-works franchise, will begin at once the work of drilling wells, and if supply of water is secured will construct complete plant, for which there will be required two 1,000,000 gal. duplex pumps, two 125 h. p. boilers, 8 miles of pipe, 72 hydrants and a stand pipe or tanks.

Seattle, Wash.—Bids are wanted April 12 for additions to the existing water-works, including a gravity water supply from Cedar River, reservoirs and portions of an auxiliary high service system, as advertised in "The Engineering Record."

Lockport, N. Y.—Chas. H. Carnes, City Engr., writes that bids will probably be received April 3 for 2,000 ft. of water pipe and 2,000 ft. of sewer construction.

Monessen, Pa.—H. Dallas McCabe, Engr. in Charge, writes that bids will be received about March 20 for 4 miles of piping and 180,000 gal. tank. Probable cost of work, $20,000.

Cullman, Ala.—Bids are wanted April 1 for water-works and an electric light plant, as advertised in "The Engineering Record."

Butte, Mont.—Bids are wanted April 8 for furnishing material and labor necessary for the construction of the following pipe line: Approximately 50,000 lin. ft. of 24-in. banded stave pipe, 16,000 lin. ft. of 26-in. riveted steel pipe with gate-valve special castings, etc., as advertised in "The Engineering Record."

Lakeview, Cal.—The Lakeview Domestic Water Co. has been organized to supply water to the town of Lakeview, and to establish and operate electric light and power plants, etc.; capital $35,000. The directors are G. H. Coffin, E. Stears, of Pasadena; F. E. Brown, of Chicago, and others.

Tyler, Minn.—The Council has been petitioned to submit the question of issuing bonds for constructing a water system to popular vote.

Mandan, N. D.—Press reports state that the city will endeavor to secure this season a system of water-works and electric lights.

Golden, Colo.—The vote taken recently was in favor of issuing $45,000 bonds to establish a gravity water system.

Rocky Mount, N. C.—J. C. Braswell, City Clk., writes that a vote will be taken in May on the proposition to issue $40,000 water-works bonds.

Enterprise, Kan.—The city, which has been furnished water by a private company, will extend its pipe system and build a municipal pumping station. H. V. Hinckley, of Topeka, is the engineer.

Perris, Cal.—Articles of incorporation have been filed of the Subterranean Water Co. The articles state that the company is organized to acquire water-bearing lands, to sink wells, purchase, operate or deal in pumps, pumping machinery, and electrical, steam or gas engines and appliances. The directors are John Peters, J. N. Hearn, H. A. Plimpton, and others. Capital stock, $25,000.

Wadsworth, O.—The proposition to construct water-works will be voted upon at the spring election.

Hempstead (L. I.), N. Y.—Press reports state that the Hempstead Water Co. will shortly spend about $15,000 for improvements to its plant.

Pomeroy, Ia.—The town will vote April 10 on the construction of a system of water-works.

Houston, Tex.—The Houston Water Co. has filed articles of incorporation. Capital stock, $240,000. Incorporators: T. H. Scanlan, T. W. House and J. A. Baker.

Sardis, Miss.—Water-works bonds to the amount of $12,000 have been issued.

Belding, Mich.—It is stated that bids will soon be asked for constructing the water and electric light plant, for which $20,000 bonds have been voted. M. A. Reed, Secy.

Ardsley, N. Y.—Articles of incorporation of the Ardsley Water Co. have been filed. The corporation is formed to supply water in the town of Greensburg. Capital stock, $50,000. The directors are: Newton Clark Lyon, of Montclair, N. J.; Samuel T. Davis, Jr., of Ardsley, and Lewis A. Beebe, of Dobbs Ferry. The certificate of incorporation of the Ardsley Electric Co. has also been filed. The directors are the same as those of the water company. The capital stock is $50,000.

Fort McPherson, Ga.—Bids are wanted April 8 for an artesian well. John Simpson, Dept. Q. M. Gen., U. S. A., Ch. Q. M. Atlanta, Ga.

Prescott, Ont.—Bids are wanted March 25 for water-works and sewerage. John Raney, Secy. Bd. Water Commrs.

Avondale, Ala.—At a recent election it was voted to issue $25,000 bonds to procure water-works and electric lights. J. R. Ellard, Mayor.

Colorado Springs, Colo.—The City Council has passed an ordinance providing for the issue of $50,000 bonds for the extension of the water-works. I. S. Harris, City Clk.

Norristown, Pa.—Press reports state that the Norristown Water Co. is negotiating for a lease of Barbadoes Island, in the Schuylkill River, on which it intends to erect a filtering plant to supply Norristown with pure water.

Burlington, Ia.—It is stated that bids are wanted March 20 for a pumping station in Crapo Park. Wm. Steyh, Secy. Bd. Park Commrs.

Montgomery, Ala.—Bids are wanted April 1? for furnishing 4 horizontal tubular boilers and removing the present battery of 6 boilers for city water-works. R. H. Sommerville, City Treas.

Laporte, Ind.—Bids are wanted March 27 for 27,000 ft. of 16, 18 or 20 in. cast-iron standard pipe, or 27,000 ft. of 18 or 20 in. steel riveted coated pipe. Chas. F. Lefmann, Chmn. Bd. Water Commrs.

Pittsburg, Pa.—Bids are wanted March 21 for furnishing cast-iron water pipe, special castings, valves, hydrants, etc., for one year, for the Bureau of Water Supply and Distribution. Edw. M. Bigelow, Dir. Dept. Pub. Wks.

Baltimore, Md.—The contract for auxiliary piping for the Mt. Royal pumping station has been awarded to Crook, Horner & Co. for $13,533.

Oregon, Wis.—Bonds have been voted to construct a $7,000 water system. John Nader, of Madison, Wis., is preparing plans.

Minneapolis, Minn.—It is stated that bids are wanted March 31 for furnishing 460 tons of 16-in. cast-iron pipe for laying pipe during the year; also for constructing 277 Buck wells around hydrants; also for 19,757 ft. of 66-in. brick to 12-in. pipe sewers. L. A. Lydiard, City Clk.

Golden, Colo.—It is stated that bids are wanted about April 15 for water-works. J. W. Rubey, Mayor.

Boston, Mass.—Bids are wanted April 4 for laying water pipe, excavating, surfacing with broken stone, etc., as advertised in "The Engineering Record."

Richland, Ga.—It is stated that a $5,000 water-works system is to be built.

Nevada, Mo.—The Missouri Water, Light & Traction Co. has been incorporated with a capital stock of $100,000. The stockholders are J. B. Quigley, S. A. Wight, H. M. Buck and others.

Washington, D. C.—The District appropriation act, passed by the last Congress, provides for an investigation of the feasibility of filtering the water supply of Washington and appropriates $3,000 for necessary expenses of said investigation.

Punxsutawney, Pa.—Press reports state that the Lindsey Water Co., of Lindsey, Pa., recently organized, has consolidated with the Punxsutawney Water Co., and a corporation to be known as the Clover Run Water Co., capitalized at $150,000, has been organized. The new concern will put in the gravity system, and a 16,000,000 gal. reservoir will be built, and the water will be conducted through an 18-in. main to the towns of Big Run, Punxsutawney, Lindsey and Walston. Dr. John L. Wentz, of Scranton, Pa., is said to be interested.

Baird, Tex.—It is stated that the City Council has issued bonds for a water-works system.

SEWERAGE AND SEWAGE DISPOSAL.

Jackson, Miss.—Press reports state that on March 7 the Board of Aldermen passed an ordinance authorizing the issue of $100,000 bonds for the construction of sanitary sewers and a surface drainage system.

Athens, Ga.—See "Paving and Road Making."

Lockport, N. Y.—See "Water."

East Liverpool, O.—Bids are wanted April 4 for sewers in Sewer District No. 2. F. H. Croxall, Secy. Bd. Sewer Commrs.

Livingston, Mont.—Bids are wanted March 25 for the construction of a sewerage system to cost about $5,500. S. H. Crookes, Engr. in Charge. C. S. Hefferlin is interested.

Wilkesbarre, Pa.—Frank Deitrick, City Clk., writes that the work contemplated with the $100,000 bond issue recently authorized is principally sewer construction, street improvements and the purchase of a fire engine.

Marshall, Mich.—Riggs & Sherman, of Toledo, O., have prepared plans for sanitary sewers, and a vote will be taken in April on the proposition to issue $25,000 bonds for the construction of same.

Paducah, Ky.—See "Business Buildings."

La Crosse, Wis.—D. E. Brice, Chmn. Bd. of Pub. Wks., writes that sewer work estimated to cost $35,000 is under consideration. Frank Powell, Engr. in Charge.

Carrollton, Mo.—Hiram Phillips, of St. Louis, has been employed to prepare plans and specifications for a sewer system and for street paving.

Oregon City, Ore.—The matter of constructing a sewer system for the hill district is under consideration.

Williamsport, Pa.—City Engineer Snyder estimates the cost of building a 10½-ft. sewer from High St. to the river at about $100,000.

Chicago, Ill.—The special assessment ordinance authorizing the construction of the main outfall sewer at Lawrence Ave. has been recommended for passage by the Council Committee on Streets and Alleys West. Probable cost $200,000.

McKeesport, Pa.—The contract for constructing Irwin St. sewer is stated to have been awarded to Keeling, Ridge & Co., of Pittsburg, for $30,492.

East Cleveland, O.—It is stated that bids are wanted March 31 for sewers in several streets.

Savannah, Ga.—W. H. Stair has been designated as the Government civil engineer to take charge of a sewer system to be established on the reservation at Tybee.

Lead, S. D.—The City Council has voted to construct a sewer system, estimated by Engineed Rosewater, of Omaha, to cost $26,000.

Prescott, Ont.—See "Water."

Buffalo, N. Y.—Bids are wanted March 22 for an 8 ft. 10 in. x7 ft. 6 in., 7 ft. 6 in. and 5ft. 3 in. brick sewer in Van Rensselaer St., and a 3 ft. brick sewer in Swan St. R. G. Parsons, Secy. Bd. Pub. Wks.

Minneapolis, Minn.—See "Water."

Scranton, Pa.—It is stated that bids are wanted March 23 for sewers in the Fifth District. M. T. Lavelle, City Clk.

Plainfield, N. J.—Bids are wanted April 3 for 1,125 lin. ft. 24-in. sewers, connections, etc. Jas. T. MacMurray, City Clk.

Bloomington, Ill.—See "Paving and Roadmaking."

Whiting, Ind.—It is stated that bids are wanted April 3 for 2½ miles of pipe and one mile of 3 to 2 ft. brick sewers. J. G. Erdlitz, Town Clk.

Syracuse, N. Y.—Bids are wanted March 20 for a 24-in. pipe sewer in Grape St. M. Z. Haven, City Clk.

Salem, O.—See "Paving and Roadmaking."

Pittsburg, Pa.—Bids are wanted March 24 for 9 to 30 in. pipe sewers in several streets; also for a 5-ft. brick sewer. Edw. M. Bigelow, Dir. Dept. Pub. Wks.

Dallas, Ore.—Press reports state that the City Council has decided to rebuild the sewer system.

Washington, D. C.—Bids are wanted March 25 for 50,000 vitrified sewer invert bricks. John B. Wight, Chmn. Commrs., D. C.

St. Paul, Minn.—Bids are wanted March 23 for a sewer on Atwater St. John Copeland, Pres. Bd. Pub. Wks.

Norfolk, Va.—The following bids were opened March 9 by W. T. Brooke, City Engr., for constructing sewers in Brambleton Ward, as advertised in "The Engineering Record": Guild & Co., Chattanooga, Tenn., $66,330; W. H. Fritchman & Co., New York City, $71,633.50; McElvain, Unkerfer Co., Pittsburg, Pa., $74,354.50; B. J. Coyle, Washington, D. C., $104,849; N. B. Abbott, Columbus, O., $115,524.

Plainfield, N. J.—Andrew J. Gavett, Engr. in Charge, writes that the following bids were opened March 13 by the Common Council for replacing vitrified pipe sewers with 2,290 ft. of iron pipe sewers: *a*, 12-in. sewer complete, 700 lbs. per length; *b*, 10-in. sewer complete, 600 lbs. per length; *c*, 4-in. cast iron house connections; *d*, 15-in. underdrain: C. M. Meeker, Plainfield, * *a*, $1.03; *b*, 96c.; *c*, 45c.; *d*, 53c. P. Christmas, Plainfield, *a*, $1.05; *b*, $1.10; *c*, 45c.; *d*, 47c. A. Costa, Orange, N. J., *a*, $1.20; *b*, $1; *c*, 45c.; *d*, 54c. A. P. Hamblin, East Orange, N. J., *a*, $1.30; *b*, $1.25; *c*, 45c.; *d*, 72c.

*Contract awarded.

BRIDGES.

Chicago, Ill.—Bids are wanted May 10 for a 4-track swing railroad bridge crossing the main channel of the Sanitary District. Wm. Boldenweck, Pres. Sanitary Dist.

Cleveland, O.—Bids are wanted April 7 for constructing the steel and iron superstructure of Center St. bridge over Cuyahoga River. Geo. R. Warden, Dir. Pub. Wks.

Mt. Holly, N. J.—See "Electric Railways."

North Milwaukee, Wis.—See "Electric railways."

Defiance, O.—A correspondent writes that the Wabash R. R. Co. intends to build 2 70-ft. bridges over the tracks on Ruiston Ave., and North Minton Sts.

Waukesha, Wis.—The City Council has been petitioned to construct a bridge over the Fox River, at Gordon St., at an estimated cost of $7,000.

Richmond, Ind.—The construction of a bridge over Heiney's Ford, in Jackson Township, is being considered.

Sheffield, Ala.—A bill passed the Senate authorizing the construction of a bridge over the Tennessee River.

Toledo, O.—The City Engineer has been instructed to receive plans for a bridge across Swan Creek, at Lafayette St.

Eureka, Mo.—Press reports state that the citizens of Pacific and Valley Park have organized an association to build a bridge across the Meramec River between Eureka and Crescent. Capital, $50,000.

Olympia, Wash.—The County Commissioners will readvertise for bids for a bridge over Nisqually River, at Bennett's Ferry.

Syracuse, N. Y.—The Governor has signed the bill authorizing the construction of a bridge over Onondaga Creek, at Rich St., to cost $10,000.

Chicago, Ill.—The Finance Committee of the Council appropriated $100,000 for bridge repairs.

St. Paul, Minn.—The City Engineer has been instructed to prepare plans and estimates of the cost of widening the south end of Wabasha St. bridge.

Albuquerque, N. Mex.—Edward A. Pearson, County Surveyor, writes that the present session of the New Mexico Legislature has passed a law by which the counties may levy special taxes to the amount of $15,000 for the construction of bridges. Bernalillo County proposes to construct at once an iron bridge over the Rio Grande at a point about 30 miles above Albuquerque.

Albany, N. Y.—Bids are wanted March 23 by the Superintendent of Public Works for a plate girder bridge over the Erie Canal at Erie St., Buffalo; also for vertical retaining walls on each side of the Oneida feeder to the Erie Canal, in Oneida, as advertised in "The Engineering Record."

Minneapolis, Minn.—It is stated that bids are wanted March 31 for the steel and iron work for widening the stone arch bridge over the East Channel. L. A. Lydiard, City Clk.

Cumberland, Md.—Bids are wanted March 21 for a brick arch bridge, with stone abutments, wings and parapets, over Braddock's Run, above the Narrows. D. P. Le Fevre, Co. Engr.

Kalama, Wash.—It is stated that bids are wanted April 3 for a bridge over Fallert Creek. J. H. Wood, Co. Clk.

Boston, Mass.—Bids are wanted March 24 for furnishing and placing the steel superstructure of the Charlesgate West bridge over Ipswich St., as advertised in "The Engineering Record."

Grand Forks, N. D.—Bids are wanted April 3 for furnishing bridge iron required for county bridges to be built during 1899. J. W. Scott, Co. Aud.

Raleigh, N. C.—Local press reports state that bids are wanted April 23 by Supervisor McMacin for a steel bridge over the river at the Falls of Neuse.

Sidney, O.—Bids are wanted April 4 for the superstructure of an iron bridge over Loramie Creek, in Cynthian township. J. S. Laughlin, Co. Aud.

New York, N. Y.—The Board of Estimate authorized the issue of $100,000 bonds to provide for an overhead crossing above the New York, New Haven & Hartford Railroad tracks, between Bronx and Pelham parkways.

Niles, Mich.—It is stated that the Michigan Central Railway Co. has decided to build a viaduct.

Rochester, N. Y.—Press reports state that the Board of Supervisors will invite plans and specifications for the steel bridge across Genesee River. Estimated cost, $200,000.

Ottumwa, Ia.—The Board of Supervisors has been petitioned to construct a wagon bridge across the Des Moines River, near Cliffland, at a cost of $20,000. The Street Committee has been authorized to advertise for bids for building approaches to Blackhawk St. bridge and a side approach to Vine St. bridge.

Newark, N. J.—The Park Board is stated to have accepted plans prepared by Carrere & Hastings, of New York City, for the construction of an ornamental iron and stone bridge over Morris Canal, where the stream enters Branch Brook Park.

Harrisburg, Pa.—Local press reports state that the Northern Central R. R. will build a bridge from a point on its Baltimore division, opposite Rivington, to connect with the Cumberland Valley bridge.

Peoria, Ill.—Local press reports state that the St. Louis, Peoria & Northern R. R. has under consideration the construction of a steel bridge across the Illinois River, to cost about $500,000.

Omaha, Neb.—It is stated that the Omaha & Council Bluffs Railway & Bridge Co. is having plans prepared for a steel bridge to replace the present structure over Indian Creek at Broadway and 13th St.

Syracuse, N. Y.—Plans have been prepared for a hoist bridge across the Erie Canal at Catharine and Almond Sts. Appropriation, $15,000.

Columbus, O.—Bids are wanted April 8 for a bridge over Big Walnut Creek, Blendon Township; for a bridge over Hell Branch, Pleasant Township, and for an arch culvert at St. Mary's Academy, Mifflin Township. Bids are also asked April 12 for a bridge over Columbus Feeder, Ohio Canal, West Main St.; for 2 bridges over run in Madison Township. W. H. Halliday, Co. Aud. and Clk. Bd. Co. Commrs.

New Kensington, Pa.—It is reported that the Schultz Bridge & Iron Co., McKee's Rocks, Pa., has received the contract for a bridge over Allegheny River, 2 spans 223 ft., 1 span 415 ft., 1 span 68 ft., and 113 ft. of viaduct. Herman Laub, Pittsburg, Engr.

PAVING AND ROADMAKING.

New York, N. Y.—Bids are wanted March 23 for a 12-ton steam road roller for Bronx Borougn parks. George C. Clausen, Chmn. Commrs. of Parks.

St. Paul, Minn.—Bids are wanted March 20 for asphalt pavement on Cedar and Washington Sts. John Copeland, Pres. Bd. Pub. Wks.

Bellefontaine, O.—Bids are wanted March 28 for 1,978 sq. yds. brick pavement and 888 lin. ft. of curbing on Court Ave., and Main. St. M. J. Nichols, City Clk.

Athens, Ga.—Bids are wanted April 1 for furnishing a quantity of stone curbing, Belgian blocks, vitrified brick, terra cotta piping, cement and sewer castings, as advertised in "The Engineering Record."

Paducah, Ky.—See "Business Buildings."

Easton, Pa.—H. R. Fehr, City Engr., writes that brick paving contracts have been awarded as follows: To T. M. Lesher & Son, Easton, for Northampton St., at $2.01 per sq. yd., and to M. Miles, Easton, for East and West Washington Sts., at $1.93 per sq. yd.

Shreveport, La.—N. B. Murff, City Comptroller, writes that street paving bonds to the amount of $40,000 have been sold.

Barre, Mass.—The matter of purchasing a rock crushing plant will be reported upon at the April meeting of the Selectmen. C. H. Fallansby, Chmn. of Selectmen.

Leavenworth, Kan.—A correspondent writes that extensive street improvements are contemplated by the City Council. Either brick or asphalt will be used.

Waterbury, Conn.—City Engineer Cairns estimates the cost of paving North Main St. with brick at $23,000.

Adrian, Mich.—John Mawdsley, City Clk., writes that about $16,500 will probably be expended upon brick paving this year, but no definite action has been taken by the Council.

Buffalo, N. Y.—Bids are wanted March 21 for paving, masonry and other work necessary for improving widened Smith St. Frank V. E. Bardol, Ch. Engr. Bureau of Engineering, Grade Crossing Com.

Carrollton, Mo.—See "Sewers and Sewage Disposal."

Warren, O.—Plans and specifications have been prepared for paving High St.; estimated cost, $27,608.

Celina, O.—Mayor J. S. Metzner writes that it was voted on March 6 to issue $75,000 bonds for street improvements.

Reading, Pa.—Bids are wanted March 30 for asphalt paving on North 6th St., as advertised in "The Engineering Record."

Union City, Pa.—Bids are wanted April 3 for paving with brick on Main St., as advertised in "The Engineering Record."

Lafayette, Ind.—Bids are wanted April 10 for asphalt paving on Sixth, Columbia and South Sts., as advertised in "The Engineering Record."

Greenville, Miss.—The City Council has ordered an election to be held April 4 for the purpose of voting on the proposition to issue $50,000 bonds for street paving purposes.

Monon, Ind.—It is stated that bids are wanted March 23 by the Town Board for about 2 miles of macadamizing.

Sioux City, Ia.—Bids are wanted March 21 for 7,500 sq. yds. asphalt and 18,000 sq. yds. brick pavement. J. M. Lewis, Acting City Engr.

Salem, O.—Bids are wanted April 12 for paving several streets with brick and asphalt; also for constructing a sewer in Ellsworth and East Fourth Sts. Bonds for this work to the amount of $144,493.20 will be sold April 10. George Holmes, City Clk.

Benton Harbor, Mich.—It is stated that bids are wanted March 20 for asphalt paving on Pipestone St. R. P. Chaddock, City Clk.

Montgomery, Ala.—The City Engineer has been instructed to prepare estimates of the cost of paving North Bainbridge St. with brick.

Bloomington, Ill.—Bids are wanted March 23 for brick paving on Center and Washington Sts., and for a brick sewer in Sugar Creek Valley. C. F. Koch, Pres. Bd. Local Improvements.

Louisville, Ky.—Local press reports state that the Board of Public Works will receive bids March 24 for brick paving in several alleys.

Pittsburg, Pa.—Bids are wanted March 23 for repairing asphalt streets for one year. Edw. M. Bigelow, Dir. Dept. Pub. Wks.

Nebraska City, Neb.—It is stated that bids are wanted March 27 for 500,000 vitrified paving bricks. A. M. Munn, City Engr.

Hartford, Conn.—Bids are wanted March 29 for sheet asphalt paving, as advertised in "The Engineering Record."

Buffalo, N. Y.—Bids are wanted March 28 for repairing asphalt pavements; also for surfacing the stone pavement in Court St. with Trinidad Lake asphalt. R. G. Parsons, Secy. Bd. Pub. Wks.

Fargo, N. D.—The City Council has ordered bids advertised for about one mile of paving.

Oneida, N. Y.—The Board of Village Trustees has under consideration the matter of purchasing a steam road roller.

Akron, O.—City Engineer Payne estimates the total cost of paving East Market St. with stone and brick at $14,589.79.

Boston, Mass.—The State Highway Commission in its annual report asks for an appropriation of $500,000 for the current year.

Atchison, Kan.—Fred. Giddings, City Engr., writes that the contract for grading, curbing and brick paving on Division St. has been let to Thos. Beattie, of Atchison, at the following prices: 2,700 cu. yds. grading at 17½c., 3,193 lin. ft. curbing at 35c., 6,140 sq. yds. paving at 74c., 2,700 pounds cast iron plates at 1½c., $40.50; 1 catch basin, $10; 2,060 sq. ft. brick sidewalk at 5c.; total, $6,301.55.

Brooklyn, N. Y.—The following bids were opened March 7 by James P. Keating, Commr. of Highway, New York City: *a*, For paving Avenue B, work includes 18,700 sq. yds. of macadam pavement, 8,863 cu. yds. of excavation, 3,702 sq. yds. of stone pavement and 8,313 lin. ft. of curb; *b*, for paving Ocean Ave., work includes 14,000 cu. yds. of excavation, 14,319 lin. ft. curb, 37,370 sq. yds. of macadam; *c*, for paving 84th St., work includes 21,043 cu. yds. excavation, 5,317 sq. yds. of macadam:

De W. C. Bouker, Jr., 434 3d St., Brooklyn, *a*, $25,966.50; *b*, $63,076.44; *c*, $7,539.29. Harris & Maguire, 125 St. Mark's Ave., Brooklyn, *a*, $29,709.30; *c*, $9,509.07. Thomas P. Murphy, 25th Ave., corner Cropsey Ave., Brooklyn, *a*, $26,112.39; *b*, $61,575.08; *c*, $8,011.48. Norton & Gorman, 910 Classon Ave., Brooklyn, *a*, $28,454.27; *b*, $66,714.76; *c*, $10,100.69. Newman & Co., 355 Adams St., Brooklyn, *a*, $25,302.25; *c*, $7,107.10. John F. Maillie, 1247 Prospect Pl., Brooklyn, *a*, $28,479.40; *b*, $64,678.86; *c*, $9,613.16. James P. Graham, 85th St., 22d Ave., Brooklyn, *a*, $26,370.94; *b*, $61,757.12; *c*, $6,437.42. Charles Hart, 4th Ave., Degraw St., Brooklyn, *a*, $30,529.55; *b*, $71,940.54; *c*, $10,526.05. Hann & Phillips, 189 Montague St., Brooklyn, *a*, *$23,891.11; *b*, *$55,251.62; *c*, $7,013.93. Borough Construction Co., 189 Montague St., Brooklyn, *a*, $27,591.82; *b*, $56,442.96; *c*, *$6,409.13. James H. Holmes & Co., 58 Manhattan Ave., Brooklyn, *a*, $28,829.95; *b*, $62,519.68. Frawley & Rooney, 1239 Simpson St., N. Y. City, *a*, $30,148; *b*, $71,393.50; *c*, $11,006.01. Sullivan Bros., Flushing, L. I., N. Y., *a*, $38,118.20; *c*, $10,461.47. Kelly & Byrnes, 419 Park Pl., Brooklyn, *a*, $26,805.20; *b*, $63,974.96; *c*, $7,599.29. Frank J. Gallagher, 574 Park Pl., Brooklyn, *a*, $28,184.22; *b*, $65,448.84. Bart Dunn, 321 E. 68th St., N. Y. City, *b*, $61,261.34. Peter Fruh, 44 Court St., Brooklyn, *c*, $7,669.20. Ligretto & Maninno, 173 Douglass St., Brooklyn, *c*, $8,033.64. John Madigan, 96 6th Ave., Brooklyn, *c*, $6,652.35.

*Contract awarded.

POWER PLANTS GAS AND ELECTRICITY.

Defiance, O.—Bids are wanted March 30 for lighting the streets with 75 arc lights or other lights for a period of 5 or 10 years. M. W. Steinberger, City Engr.

Harrisburg, Pa.—The Merchants' Light & Power Co. is stated to have received a franchise to construct an electric light plant here.

Mt. Vernon, N. Y.—The Westchester Gas & Coke Co. has been incorporated to manufacture gas for lighting purposes; capital, $200,000. Directors: Thos. R. Hodge and Theo. F. Nesbitt, of Mt. Vernon; Thos. L. Holmstrom, of Long Island City; Thos. S. White, of New York, and others.

Oxford, Miss.—Mayor W. B. Cowan writes that the town has under consideration the matter of granting a franchise to B. R. Williams & Co., of Memphis, Tenn., for the construction and operation of an electric light plant.

Mandan, N. D.—See "Water."

Fond du Lac, Wis.—It is stated that the Fond du Lac Light Co. will lay 10 miles of mains.

Hoboken, N. J.—The Directors of the North Hudson Light, Heat & Power Co., which furnishes electricity in Hoboken and the North Hudson towns, are stated to have decided to expend about $250,000 to improve and enlarge the plant in Hoboken. The company is also said to be considering the advisability of placing its wires underground.

Grand Island, Neb.—Arnold C. Koenig is preparing the plans for brick and frame buildings for an electric light and ice manufacturing plant, to be erected for Joehnk-Waldman Co.

Glencoe, Minn.—The Glencoe Electric Light Co. is stated to have been incorporated; capital, $8,000. Incorporators: B. F. Allen, E. E. McIntire, and others.

Cullman, Ala.—See "Water."

Muscatine, Ia.—It is stated that the plant of the Electric Light & Power Co. will be remodeled, new machinery purchased, etc. J. C. Hubinger, Pres.

Riceville, Ia.—The Riceville Electric Light & Power Co. is stated to have been incorporated with a capital of $10,000, and will shortly put in an electric light and power plant. B. W. Hendricks, Pres.; Robt. Templeton, Secy.

Manton, Mich.—There is talk of constructing an electric light plant here. A stock company will probably be organized.

Geneva, N. Y.—The following bids for paving were opened Feb. 20 by Edward Seybolt, Supt. Bd. of Pub. Wks., as advertised in "The Engineering Record":

Bidders.	Residence.	8,650 Cu. Yds. Excavation.	16,250 Sq. Yds. Brick Pavement.	16,200 Sq. Yds. Asphalt Pavement.	1,400 Sq. Yds. Medina Pavement.	4,800 Ft. 6 In. Curb.	2,050 Ft. 4 In. Curb.	Protective Curb.	6,850 Ft. 8 In. Drain Tile.	1,000 Ft. 12 In. Tile.	15 In. Tile.	18 In. Tile.	13 Catch Basins.	5 Years Guarantee, Per Year.	10 Years Guarantee, Per Year.	15 Years Guarantee, Per Year.	Total.
J. K. Van Campion	Olean, N. Y	.30	1.97	3.00	3.10	.60	.52	...	.10	.45	.51	.60	45.	20.	30.	50 00	$41,958 50
F. R. Spaulding	Bethlehem, Pa	.27	1.80	....	2.60	.65	.55	.65	.12	.42	.50	.59	25.	50.	250.	......	41,445.00
Whitmore, Rauber & Vicinus	Rochester, N. Y	.20	1.88	1.75	2.55	.68	.48	.58	.09	.50	.63	.76	35.	10.	10.	148.33	40,793.00 Brick. 35,938.50 Asphalt.
Sullivan & Graham	Columbus, O	.25	1.90	....	2.70	.70	.60	.50	.10	.35	.40	.45	35.	15.	500.	1,000 00	43,330.00
Barber Asphalt Co.	New York	.30	....	1.89	2.85	.70	.60	.70	.10	.47	.57	.67	50.	1.	245.	245.00	39,488.00
Rock Asphalt Co.	Rochester	.32	....	1.97	2.65	.67	.56	.38	.08	.58	.68	.78	36.	75.	175.	275.00	40,186.10

Butler, O.—Oscar Wise is said to be interested in the construction of an electric light plant.

Paxton, Ill.—It is stated that the citizens will vote on the question of purchasing an electric light plant.

Ripley, O.—The Ripley Gaslight & Coke Co. is stated to have received the contract to light the streets by electricity for 10 years. The company expects to have the plant in operation by July.

Evanston, Ill.—The Yaryan Hot Water Construction Co., of Toledo, O., is stated to have applied for a franchise to construct a heating and lighting plant in this city.

Garner, Ia.—The Garner Electric Light, Power & Telephone Co. has been incorporated; capital, $10,000. E. C. Abbey is one of the incorporators.

Albany, N. Y.—Bids are wanted March 24 for installing an electric lighting system, wiring and fixtures complete for the Second Separate Naval Division at Charlotte Harbor, N. Y. Brigadier-Gen. Avery D. Andrews, Adj.-Gen.

Ouray, Colo.—An ordinance is stated to have been passed granting the Ouray Electric Light & Power Co. a franchise for electrical and other purposes.

Easton, Pa.—It is stated that the Delaware Gas Co. will shortly apply to the State Department for a charter, and will construct a gas plant here.

Avondale, Ala.—See "Water."

Syracuse, N. Y.—The Syracuse Electric Light & Power Co. is reported to have decided to expend about $200,000 on improving its plant. It is stated that the company will probably put its wires underground this spring.

Parsons, Kan.—Walter W. Pratt, of New Haven, Conn., is stated to have purchased the electric light plant. It is stated that new machinery will be put in and the new owner will probably construct an electric railway in the near future.

Uniontown, Pa.—Henderson Johnson, Thos. W. Bulger and others, are stated to be interested in the construction of an electric light plant here.

Houston, Tex.—See "Sewers and Sewage Disposal."

Portland, Conn.—There is talk of establishing an electric light plant here or granting permission to the National Stamping & Enameling Co. to construct a plant for private use.

Jerseyville, Ill.—The City Council is stated to have granted the Jerseyville Electric Light & Power Co. a franchise to conduct a hot-air and steam-heating plant here.

Fairhaven, Mass.—Chas. F. Swift, Town Clk., writes that it was voted on March 11 to appoint a committee to investigate the matter of a municipal electric lighting and power plant. John H. Howland, Chmn. Com.

Belding, Mich.—See "Water."

Yonkers, N. Y.—The Consumers' Electric Co. has been incorporated; capital, $10,000. Directors: Leonard B. Lampman, of Coxsackie; F. A. Stratton and Geo. M. Curtis, Jr., of New York City.

Lakeview, Cal.—See "Water."

Van Wert, O.—J. B. and E. C. Bradley, and Wm. Morris, of Penn Yan, N. Y., have purchased the plant of the Van Wert Gas Light & Fuel Co. It is stated that the works will be enlarged and generators of 100,000 cu. ft. added.

East McKeesport, Pa.—The North Versailles Electric Light & Power Co., is stated to have received a franchise.

Ardsley, N. Y.—See "Water."

Buffalo, N. Y.—The Economical Gas Construction Co., of Toronto, Ont., is stated to have completed plans for the proposed municipal gas plant. The experts estimate that it will cost $875,000 to erect a plant having a capacity of 2,250,000 cu. ft. of carburetted water gas and 2,250,000 cu. ft. of coal gas daily, and supply the gas holders and other necessary equipment; also, $1,500,000 to put in gas mains and the district holders required to distribute the gas throughout the city.

Harbor Springs, Mich.—The Governor is stated to have signed the bill authorizing the Council to extend the electric light plant.

Nicholasville, Ky.—The Council is said to have under consideration the establishment of an electric light plant.

Lyons, N. Y.—A. B. Bishop, of Clyde, and Jacob Straus, of Lyons, are stated to have applied for a franchise for an electric light and power plant.

Picton, Ont.—It is stated that bids are wanted April 4 for furnishing the following machinery for a plant: Alternator, 120 k.w. capacity; transformers, 1,000 lights capacity; steam engine, low speed, 125 h.p. capacity; supplies, weatherproof wire, insulators, cross-arms, etc. R. A. Norman, Town Clk.

Nevada, Mo.—See "Water."

Cresco, Ia.—It is stated that the citizens will vote on granting an electric light franchise to Alfred Horne.

Herkimer, N. Y.—It is stated tnat bids are wanted March 22 by the Village Board for electric lighting or for a plant.

Orange, N. J.—The city is considering the question of constructing an electric light plant. For further information, see the advertising columns of "The Engineering Record."

Evansville, Ind.—F. B. Rae, of Chicago, is stated to have been engaged to prepare preliminary plans for the proposed municipal electric light plant.

Palo Alto, Cal.—It is stated that bids are wanted April 1 for an electric light plant. C. E. Moore, Engr., Santa Clara, Cal.

South Bethlehem, Pa.—Bids are wanted March 20 for lighting the streets with electricity for a period of 5 years. Charles G. Boyer, Chmn. Lamp Com.

ELECTRIC RAILWAYS.

North Milwaukee, Wis.—The Milwaukee Electric Ry. & Light Co. has secured a franchise for an extension of its Center St. line through this village. It is stated that in consideration of this extension the village will build a bridge over North Milwaukee Creek and a subway under the Milwaukee road tracks at 32d Street. Mr. Beggs, Gen. Mgr.

Coatesville, Pa.—There is talk of constructing a trolley road here.

Manchester, N. H.—The Manchester St. R. R. Co. has obtained an amendment to its charter allowing the construction of an 8-mile extension to Goffstown.

Huntsville, Ala.—T. W. Pratt, one of the owners of the Coons & Pratt Cotton Mill, is stated to have applied for a franchise.

Pueblo, Colo.—The Pueblo Traction & Electric Co. has been incorporated; capital, $500,000. Directors: John F. Vail, Chas. E. Gast, John O. Albert, and others.

Chesterfield, Va.—The Supervisors of Chesterfield County are stated to have voted in favor of granting a franchise to the Richmond & Petersburg Electric Ry. Co. for an electric railway from Richmond to Petersburg, through Chesterfield.

Xenia, O.—The Dayton & Eastern Traction Co., of Dayton, O., has received a franchise.

Richmond, Ind.—The Richmond Interurban Ry. Co. has been incorporated, to construct and operate street railroad lines in Richmond, Centerville, East Germantown, Cambridge City, Dublin and other towns in this State and Ohio; capital, $10,000. Incorporators: John H. Roling, W. K. Bradburg and others.

Mt. Holly, N. J.—The Freeholders are stated to have granted the Monmouth Traction Co. right of way through Burlington County, the company agreeing to pay half the cost of widening or rebuilding certain county bridges.

Providence, R. I.—The Providence & East Greenwich Electric Traction Co. is stated to have been incorporated to build an electric line. Incorporators: Louis K. Potter, John H. Collingwood and others.

Cincinnati, O.—The County Commissioners have granted the Cincinnati, Lawrenceburg & Aurora Electric Ry. Co. a franchise to construct and maintain a line between Anderson's Ferry and the State line, a distance of about 23 miles. J. C. Hoover, Pres.

Little Falls, N. Y.—The Highway Commissioners are stated to have granted a franchise to the Little Falls & Herkimer St. Ry. Co. on the north side of the river.

North Hoosick, N. Y.—The Bennington & Hoosick Valley Ry. Co. is stated to have filed with the Secretary of State a certificate of extension of its lines connecting North Hoosick, Johnsonville, Valley Falls, Schaghticoke, Melrose, Lansingburg and Stillwater, Rensselaer County.

Indianapolis, Ind.—The Indianapolis St. Ry. Co. has been incorporated; capital, $2,000,000. Incorporators: Hiram P. Wasson and Julius A. Lemcke, of Indianapolis; Randall Morgan, of Philadelphia, and others.

Sea Cliff (L. I.), N. Y.—The Nassau County Ry. Co. has been incorporated with a capital of $25,000 to construct and operate a surface railroad in Nassau County. Directors: Wm. F. Brown, Wm. L. C. Allan, of Brooklyn, and L. E. Freeman, of Summit, N. J., and others.

Northville, Mich.—The Detroit, Plymouth & Northville Electric Ry. Co. is stated to have received a franchise.

Parsons, Kan.—See "Power Plants, Gas and Electricity."

Kansas City, Mo.—The Metropolitan St. Ry. Co. is said to be considering the matter of changing the Independence Ave. and East 9th St. cable lines and a portion of the 8th St. line to electricity.

Linden, Mich.—The Michigan Electric Ry. Co. is stated to have received a franchise. This company proposes to construct a line 87 miles long. Estimated cost of construction and equipment, $950,000.

Williamsport, Pa.—The Leetonia R. R. Co. has been organized in this city to construct a road 20 miles long; capital, $150,000. C. B. Farr, Pres.; W. H. Newton, Secy.

Belleville, Ill.—The St. Louis, Belleville & Suburban Electric Ry. Co. is stated to have received a franchise.

Seattle, Wash.—The Seattle & Tacoma Electric R. R. Co. has been incorporated to construct a line between Seattle and Tacoma; capital, $1,000,000. Incorporators: John Collins, Chas. W. Slater, and others, of Seattle, and Henry Bucey and H. E. Knatvold, of Tacoma.

Norfolk, Va.—The Tennis Construction Co. of Philadelphia is stated to have received the contract for constructing an electric road from Norfolk to Sewell's Point, Va., a distance of 18 miles, and also for a road from Cincinnati, O., to Aurora and Rising Sun, Ind., 40 miles long.

Nazareth, Pa.—A charter has been granted to the Northampton Central St. Ry Co. to build and operate a trolley line between Nazareth and Farmersville; capital, $72,000. Directors: M. P. McGrath, Worcester, Mass.; Edward J. Fox, of Easton, and others.

Lebanon, Ind.—The County Commissioners are stated to have granted the Commercial Club of Lebanon right of way for an electric railway.

Akron, O.—The City Commissioners are stated to have granted a 25-year franchise to the Akron St. Ry. Co.

Bloomsburg, Pa.—It is stated that a company has been formed to construct an electric railway from this place to Berwick; capital, $250,000. Wm. Ridgeway, Pres., 725 Walnut St., Philadelphia.

Trenton, N. J.—The Board of Chosen Freeholders has passed an ordinance granting the Trenton St. Ry. Co. permission to extend its lines to Lawrenceville.

Muncie, Ind.—F. G. Brownell, of Muncie, is said to be interested in the construction of an electric line between Montpelier and Muncie.

Xenia, O.—The Xenia & Wilmington Traction Co. has been incorporated, with a capital of $10,000. Harry H. Armstrong, of Wilmington, is said to be one of the incorporators.

Dunkirk, N. Y.—Frederick H. Stevens, C. J. Carney and others are stated to have applied for a franchise.

Evansville, Ind.—It is stated that the Evansville & Southern Ry. Co. has been incorporated to build lines in New Harmony, Princeton and Cannelton. E. M. Henning, of Cannelton, Ind., is said to be one of the incorporators.

Ottawa, Ill.—The La Salle County R.R. Co. is stated to have received a franchise.

Herkimer, N. Y.—The Little Falls & Herkimer St. Ry. Co. is stated to have received a franchise.

Grand Rapids, Mich.—The Grand Rapids, Grand Haven & Muskegon Electric Ry. Co. has been incorporated, with a capital of $100,000. Thos. F. Carroll, Pres., Grand Rapids.

RAILROADS.

Buffalo, N. Y.—The Union Station Ry. Co. has been incorporated to build and operate an elevated steam standard gauge railroad 6 miles long; capital, $60,000. Directors: Lewis Stockton, Wm. C. Cornwell and others.

Columbus, Ind.—W. H. Rights is the engineer in charge of constructing a steam railway for which preliminary surveys are now being made by the Columbus, Bloomington and Terre Haute R. R. Co. Estimated cost, $1,000,000. Chas. W. Shaw, Gen. Supt., Bloomington, Ind.

Trenton, N. J.—Articles of incorporation were filed with the Secretary of State March 7 for the Alaska-Yukon Ry. & Navigation Co. The company is to construct a railroad from the mouth of the Unalaklik River on North Sound to a point at the mouth of the Kattag River, at its juncture with the Yukon River; capital, $125,000. Incorporators: Jas. Read Girling and Oliver P. Hubbard, St. Michaels, Alaska, and Joseph V. Clark, Jersey City.

Chicago Heights, Ill.—The Chicago Terminal Transfer R. R. Co. is stated to have received a franchise for a railway through a portion of this place.

Hot Springs, Ark.—The Kansas City, Hot Springs & New Orleans R.R. Co. has been incorporated, with a capital of $1,350,000, to construct a road from Hot Springs to Mansfield. Incorporators: P. C. Ledwidge, John D. Ware and others, of Hot Springs.

Norfolk, Va.—Bids are wanted by the Atlantic & Danville Ry. Co. for constructing a branch line in North Carolina. Chas. O. Haines, Gen. Mgr., Norfolk.

Grand Junction, Colo.—The Colorado State Line R.R. Co. has been incorporated to build a railroad from Crevasse, in Mesa County, to some point in Utah; capital, $50,000. Directors: Chas. O. Baxter, Sylvester P. Barron and others.

PUBLIC BUILDINGS.

(See also Schools and Government Work.)

Oshkosh, Wis.—The Supervisors have decided to erect a county jail, to cost about $25,000.

Calumet, Mich.—The plans of Charlton, Gilbert & Demar, of Marquette, are stated to have been accepted for a $20,000 edifice for the Ste. Anna French R. C. Church.

Hart, Mich.—Bids are wanted March 29 for a hospital on the County Farm. John Giddings, Chmn. Com.

Forest, Miss.—The plans of Bryan & Co., of Atlanta, are stated to have been accepted for a $15,000 court house.

Wayne, Neb.—The plans of Geo. A. Berlinghoff, of Omaha, are stated to have been accepted for a court house for Wayne County, to cost about $26,000.

Indianapolis, Ind.—It is stated that the First Baptist Society will erect an $85,000 church. S. M. Dyer, Chmn. Fin. Com.

Butte, Mont.—The Mountain View M. E. Church is stated to have decided to build a $20,000 edifice. C. H. Redpath, Chmn. Com.

Kingston, N. Y.—The plans of Myron Teller, Pier 46 (new), N. R., N. Y. City, are stated to have been accepted for a 3 story jail.

Louisville, Ky.—Bids are wanted April 1 for an addition to the court house, cost $40,000. Kenneth McDonald, Archt., Louisville.

Massena, N. Y.—It is stated that a $20,000 town hall will be erected here.

Whitehall, Wis.—The Supervisors are said to be considering the matter of erecting an insane asylum and county poor house and farm, at a probable cost of $50,000.

Woonsocket, R. I.—Plans prepared by Wm. M. Butterfield, of Manchester, N. H., are stated to have been accepted for a $25,000 church for the Globe Congregational Society.

Jersey City, N. J.—Bids are wanted April 3 for a public library. L. J. Gordon, Pres. Trus. Free Public Library.

Shepherdsville, Ky.—All bids received March 6 for the court house are stated to have been rejected. New bids will be received. W. B. Tilden, Co. Clk.

Evergreen, Ala.—Bids are wanted March 24 for repairs and additions to the present court house, also for building a new court house. F. J. Dean, Chmn. Commrs. Court. Com.

Akron, O.—The County Commissioners are stated to have passed a resolution to submit the question of issuing bonds for a $250,000 court house to a vote of the people.

Brownsville, Tenn.—Adolph Eberhart, of Memphis, is stated to have received the contract for erecting the Methodist Church at $20,000.

Dartford, Wis.—J. E. Mallory, of Oshkosh, is stated to have received the contract for a court house, jail and sheriffs' residence. His bid was said to be $21,619 for all but the steel work.

Niles, O.—It is stated that the M. E. Society will build a $15,000 church.

Houghton, Mich.—Bids are wanted April 1 for a church. Rev. A. J. Rezek, Pastor.

Detroit, Mich.—Bids are wanted March 23 (readvertisement) for the marble and scagliola work, iron, steel metal and mason work on the new Wayne County building. Walter H. Coots, Chmn. Com. on Site and Bldgs.

The Supervisors on March 8 confirmed the following contracts for the interior work on the new county building: For woodwork, painting and glazing, to Vinton & Co., Detroit, for $103,328; for plastering (subject to use of rock wall), to Lennox & Heideman, of Chicago, for $54,994; for marble flooring, to the Venetian Marble Co., of Detroit, for $46,408.

Montgomery, Ala.—Bids are wanted March 27 for an auditorium, additions to the city jail and for remodeling the market house. Lockwood & Smith, Archts., Moses Bldg.

BUSINESS BUILDINGS.

Manchester, N. H.—The Knights of Pythias will erect this spring a block, containing lodge rooms; cost, about $25,000. Gen. Franklin W. McKinley is interested.

Joliet, Ill.—It is stated that plans have been prepared for a depot to be erected here by the Chicago & Rock Island R. R. Co.

Wabash, Ind.—The Knights of Pythias are stated to have decided to erect a $20,000 opera house.

Leavenworth, Kan.—C. Johns has prepared plans for a $30,000 opera house.

Detroit, Mich.—Brown Bros. will build a cigar factory, to cost $60,000, on State st. and Park Place. Architect not selected.

Indianapolis, Ind.—The Indianapolis Cold Storage Co. is about to erect a $350,000 building on Penn. St. Samuel H. Brubaker & Co., Archts., Indianapolis.

Nashville, Tenn.—A $60,000 store and office building is to be built by Norman Kirkman on Summer and Union Sts. R. H. Hunt, Archt., Chattanooga.

Washington, D. C.—Geo. A. Fuller & Co., 160 5th Ave., N. Y. City, are stated to have received the contract for the building of the Evening Star Newspaper Co.; contract price said to be $377,341.

St. Louis, Mo.—W. Albert Swasey, 707 Olive St., is said to be preparing plans for a $300,000 masonic hall. Capt. Robert McCulloch, Pres.

Johnstown, Pa.—The Swank Hardware Co. is about to erect a $40,000 brick and stone building with elevators, etc., on Main and Bedford Sts. Wild & Reiche, Archts.

Fargo, N. D.—It is stated that a $30,000 Masonic temple will be erected here.

Des Moines, Ia.—Hallett & Rawson, of Des Moines, are stated to have been selected to prepare plans for the city auditorium, to cost about $35,000.

NEW YORK CITY.

Permits for the following buildings have been issued; o signifies owner; a, architect; b, builder, and c, contractor.

635 to 639 East 9th st, 2 br stores & flats, cost, $50,000 all; o, Jacob Sommer; a, Samuel Sass.

14-16 Jackson st, 386-388 Madison st, 2 br stores & flats, cost, $52,000 all; o, Geo Dellon; a, Horenburger & Straub.

147-149 East 22d st, 2 br & stone stores & flats, cost, $56,000 all; o, Julius Dreyfus; a, G F Pelham.

303-305 and 315-317 East 106th st, 4 br stores & flats, cost, $114,000 all; o, Celia Haft; a, G F Pelham.

59th st & Grand Circle, br hall & cafe, cost, $33,000; o, August H. Ruck; a, Henry Anderson.

Broadway & 113th st, br, stone & terra cotta stores & flat, cost, $175,000; o, Gunn & Grant; a, Henry Anderson.

St Nicholas ave & 113th st, br stores & flat, cost, $275,000; o, Emily L Felt; a, Neville & Bagge.

Lenox ave, 114th & 115th sts, 8 br stores & flats, cost, $196,000 all; o, Henry Rothchild; a, Geo F Pelham.

BROOKLYN, N. Y.

Walcott & Ferris sts, br machine shop & stores, cost, $60,000; o, Morris Building Co; a, W B Tubby.

DWELLINGS.

Indianapolis, Ind.—Louis Gibson and John Thurtle have prepared plans for an 8-story flat to be built on Penn and St. Clair Sts. Cost, $150,000.

Kansas City, Mo.—G. M. Myers is about to erect a $20,000 brick flat on 14th St. and Troost Ave. Geo. Mathews, Archt.

Lancaster, Pa.—C. Emlen Urban has prepared plans for a $17,000 brick and stone residence for J. J. Evans; also for a $10,000 brick and stone residence for Dr. Detweiler.

Cambridge, Mass.—A. W. Strauss is about to build a $75,000 brick and stone apartment house on Massachusetts Ave.; Arthur Vinal, Archt., Boston.

Allentown, Pa.—Jacoby & Weishampel have prepared plans for a $25,000 brick residence, to be erected by E. M. Young on Hamilton and 15th Sts.; also for an $18,000 brick residence, to be built by Jas. K. Mosser on Hamilton, near Penn St.

NEW YORK CITY.

Permits for the following buildings have been issued; o, signifies owner; a, architect; b, builder, and c, contractor.

133 to 139 Broome st, 2 br tenem'ts, cost, $50,000 all; o, J. & M. Weinstein; a, M. Bernstein.

2d ave & 3d st, br flat, cost, $35,000; o, Abram Silverson; a, Schneider & Herter.

335 5th ave, 4 br flats; cost, $80,000 all; o, Wm Rogers; a, H S Howell.

105th st & West End ave, 6 br dwell'gs, cost, $150,000 all; o, J C Umberfield; a, James & Leo.

Columbus ave & 107th st, 3 br flats, cost, $60,000 all; o, Hellman & Vollitsky; a, M Bernstein.

Columbus ave & 108th st, 4 br flats, cost, $80,000 all; o, Ableman & Rosenbaum; a, M Bernstein.

Lenox ave, 116th & 117th sts, 2 stone flats, cost, $46,000; o, Arlington C Hall; a, Neville & Bagge.

NEW INDUSTRIAL PLANTS.

Armour & Co., Chicago, Ill., are building a large power house, for which the foundations have just been started. J. E. Smith, of the motive power department, is in charge.

The Kentucky Oil & Pipe Line Co., Somerset, Ky., has completed a 35-mile line to its wells in Wayne County, now yielding 500 bbls. daily, and will erect a refinery if the pumping tests justify the expense.

E. N. Clemence, treasurer of the Eagle & Phoenix Mills, Columbus, Ga., will start a knitting or yarn mill in the buildings formerly occupied by the Georgia Mfg. Co.

The Opelousas (La.) Mercantile Co. contemplates erecting a mill at Eunice; Isaac Roos is president of the company.

The Proximity Mfg. Co., Greensboro, N. C., will erect a mill for 12,000 spindles and 360 looms, and will need a 400 H.-P. engine and boiler plant.

The Block-Pollak Iron Co., Cincinnati, O., will erect an additional 95x200 ft. steel hammer shop at its Steelton works. A 5-ton steam hammer and several of smaller size, two furnaces and two boilers will be installed.

Henry E. Pridmore, 111-113 W. Harrison St., Chicago, will erect a 60x100 ft. 2-story brick and steel machine shop and a 60x150 ft. foundry. A 30 H.-P. gas engine will be used for the machine shop and one of 10 H.-P. for the foundry. It is said this plant when completed will be the only one in existence devoted exclusively to sand moulding machines.

The Amory Mfg. Co., Manchester, N. H., is making some alterations in its power plant, changing a condensing engine to one of the vertical, cross-compound type, and two vertical water wheels to a pair of horizontal wheels.

The Acheson Graphite Co., Niagara Falls, N. Y., will put up a 50x100 ft. building on the Niagara Falls Power Co.'s land, and install an electric furnace of 500 H.-P., plans for which are now in the hands of electrical construction companies.

The Warren (Ohio) Brick & Tile Co. will put up a plant with a daily capacity of 40,000 brick, and will use a 60 H.-P. power plant.

The City Grain & Feed Co., Columbia, Tenn., contemplates building a 60,000 to 70,000 bush. elevator and erecting a 2-story building for manufacturing feed.

A large cement plant will be erected by the Illinois Steel Co., Chicago, from the plans of Mr. J. Whiting, manager of its cement and brick department, who states that the mill will be operated by a 1,200 H.-P. power plant. It is understood that the product of the new works will not only be a foundation cement, like that now made by the company, but also a grade for finer finishes as well.

The Dillon (S. C.) Cotton Seed Oil Mill will put up a 50x100 ft. building and install a 150 H.-P. engine and a 60-ton oil mill.

A 3-story cotton mill with 120,000 sq. ft. floor space and an 800 H.-P. steam plant will be built at Trion Factory, Ga. Further information may possibly be obtained from the Trion Mfg. Co., which operates large mills at that place.

The Norris Mfg. Co., Glens Falls, N. Y., is erecting a 2-story, 40 x 80-ft. factory and is in the market for a 20 H.-P. upright boiler and a 10 H.-P. engine.

Charles A. Johnson, Arkansas City, Kan., is putting up a 500-bbl. flour mill, and will need a 250 H.-P. power plant.

BUSINESS NOTES.

The Water Commissioners of Dunkirk, N. Y., have ordered from the Snow Steam Pump Works a 4,000,000 gal. crank-and-flywheel pumping engine.

The Pepsin-Seltzer Drug & Chemical Co., Baltimore, Md., will erect a large plant, but no details of its size or the amount of power required can be announced yet.

Pawling & Harnischfeger, Milwaukee, Wis., will put up a 114x125 ft. building, partly 2 stories and partly 4 stories high. Outside of an electric crane, no machinery will be installed at present.

Henry R. Worthington is constructing a new power house at the company's Elizabethport foundry, which is to contain two 100 H.-P. Babcock & Wilcox boilers and three 75 H.-P. Bigelow boilers. There will be five generators of 65 kilowatts each, belted to Ball & Wood compound condensing engines, and a Worthington compressor delivering 350 ft. of free air per minute at a pressure of 80 pounds. The works are equipped throughout with electric lights, and when the power house is completed all the machinery, including traveling cranes and hoists, will be driven by electricity.

Mangham Bros., bankers, Griffin, Ga., wish to correspond with parties of practical experience in cotton mill management desirous of engaging in cotton manufacturing in the South and willing to put in a part of the cost of a mill to be managed by them.

The Lombard Water-Wheel Governor Co. has received an order for three additional governors for the plant of the St. Anthony Falls Water Power Company, Minneapolis, one for each of the three new units of four Victor turbines each. The filling of this order will place 10 Lombard governors in this plant, regulating 40 water wheels.

PROPOSALS OPEN.

Bids Close. — See Eng Record.

WATER-WORKS.

Mar. 20. Monessen, Pa .... Mar. 18
Mar. 20. Pipe, etc., Pueblo, Colo. .... Mar. 18
Mar. 20. Burlington, Ia .... Mar. 18
Mar. 21. Pipe, etc., Pittsburg, Pa .... Mar. 18
Mar. 21. St. Louis, Mo .... Feb. 25
Mar. 23. Bloomington, Ind .... Mar. 4
Mar. 23. Brooklyn, N. Y .... Mar. 11
Mar. 23. Windsor, N. Y .... Mar. 11
Adv., Eng. Record, Mar. 11.
Mar. 23. Hydrants, etc., New York, N. Y .... Mar. 18
Mar. 25. Prescott, Ont .... Mar. 18
Mar. 27. Pipe, Laporte, Ind .... Mar. 18
Mar. 28. Darlington, Okla. .... Mar. 11
Mar. 29. Pump, South Bend, Ind .... Mar. 11
Mar. 31. Pipe, etc., Minneapolis, Minn .... Mar. 18
Apr. 1. Cullman, Ala. .... Mar. 11
Apr. 1. Fire hydrants, Washington, D. C. .... Mar. 11
Adv., Eng. Record, Mar. 11.
Apr. 1. Mankato, Kan .... Mar. 18
Apr. 3. Lockport, N. Y .... Mar. 18
Apr. 3. Engine, Winnepeg, Man. .... Feb. 4
Adv., Eng. Record Feb. 4 to 18.
Apr. 3. Supplies, Winnipeg, Man. .... Mar. 11
Adv. Eng. Record, Mar. 11, 18.
Apr. 4. Pipe, Boston, Mass .... Mar. 18
Adv., Eng. Record, Mar. 18.
Apr. 8. Fort McPherson, Ga .... Mar. 18
Apr. 8. Butte, Mont .... Mar. 18
Adv. Eng. Record, Mar. 4.
Apr. 10. Boilers, Montgomery, Ala .... Mar. 18
Apr. 10. Tank, Washington, D. C .... Mar. 11
Apr. 11. Philadelphia, Pa .... Mar. 11
Apr. 11. Lakeport, Cal .... Feb. 25
Apr. 12. Seattle, Wash .... Mar. 18
Adv., Eng. Record, Mar. 18.
Apr. 15. Golden, Colo .... Mar. 18
Apr. 15. Forestport, N. Y .... Mar. 4
—— Engine, Marion, Ind .... Mar. 4
—— Pumps, etc., Dubuque, Ia .... Mar. 4

SEWERAGE AND SEWAGE DISPOSAL.

Mar. 20. Pipe, Bradford, Ont .... Mar. 11
Mar. 20. Albany, N. Y. .... Mar. 11
Mar. 20. Syracuse, N. Y .... Mar. 18
Mar. 21. Mt. Vernon, N. Y .... Mar. 11
Mar. 21. Boston, Mass .... Mar 11
Adv., Eng. Record, Mar. 11.
Mar. 22. Buffalo, N. Y .... Mar. 18
Mar. 23. Scranton, Pa .... Mar. 18
Mar. 23. Bloomington, Ill .... Mar. 18
Mar. 23. St. Paul, Minn .... Mar. 18
Mar. 24. Pittsburg, Pa .... Mar. 18
Mar. 24. Pontiac, Mich .... Mar. 4
Mar. 25. Bricks, Washington, D. C .... Mar. 18
Mar. 25. Livingston, Mont. .... Mar. 11
Mar. 25. Prescott, Ont .... Mar. 18
Mar. 28. Kearney, N. J. .... Mar. 11
Mar. 31. East Cleveland, O .... Mar. 18
Mar. 31. Minneapolis, Minn .... Mar. 18
Apr. 1. Havana, Ill .... Mar. 11
Adv., Eng. Record, Mar. 11.
Apr. 1. Athens, Ga .... Mar. 18
Adv., Eng Record, Mar. 18.
Apr. 3. Lockport, N. Y .... Mar. 18
Apr. 3. Plainfield, N. J .... Mar. 18
Apr. 3. Whiting, Ind .... Mar. 18
Apr. 4. East Liverpool, O .... Mar. 18
Apr. 6. Submerged sewer, New London, Conn .... Mar. 11
Adv., Eng. Record, Mar. 11.
Apr. 6. Vitrified pipe, New London, Conn. .... Mar. 11
Adv., Eng. Record, Mar. 11.
Apr. 12. Salem, O .... Mar. 18
Apr. 15. Honolulu, H. I .... Feb. 25
Adv., Eng. Record, Feb. 25, Mar. 4.

BRIDGES.

Mar. 21. Superstructure, Bellefontaine, O .... Feb. 25
Mar. 21. Buffalo, N. Y. .... Mar. 11
Mar. 21. Cumberland, Md .... Mar. 18
Mar. 22. St Joseph, Mo .... Mar. 11
Mar. 23. Albany, N. Y. .... Mar. 18
Adv., Eng. Record, Mar. 18.
Mar. 24. Boston, Mass .... Mar. 18
Adv., Eng. Record, Mar. 18.
Mar. 25. North Adams, Mass. .... Mar. 11
Adv., Eng. Record, Mar. 11, 18.
Mar. 31. Minneapolis, Minn .... Mar. 18
Apr. 1. Substructure, St. Joseph, Mo .... Jan. 7
Apr. 1. New Whatcom, Wash .... Mar. 4
Apr. 1. Columbus, O .... Mar. 11
Apr. 3. Kalama, Wash .... Mar. 18
Apr. 3. Grand Forks, N. D .... Mar 18
Apr. 4. Superstructure, Sidney, O .... Mar. 18
Apr. 5. Columbus, O .... Mar. 11
Apr. 7. Superstructure, Cleveland, O .... Mar 18
Apr. 8. Columbus, O .... Mar. 18
Apr. 10. Chicago, Ill .... Feb. 18
Adv., Eng. Record, Feb. 18.
Apr. 12. Columbus, O .... Mar. 18
Apr. 23. Raleigh, N. C .... Mar. 18
—— Quincy, Ill .... Feb. 25
Adv., Eng. Record, Feb. 25.
May 10. Chicago, Ill .... Mar. 18

PAVING AND ROADMAKING.

Mar. 20. Benton Harbor, Mich, Mich .... Mar. 18
Mar. 20. Albany, N. Y .... Mar. 11
Mar. 20. Joliet, Ill. .... Mar. 11
Mar. 20. Paterson, N. J .... Mar. 11
Adv., Eng. Record, Mar. 11.
Mar. 20. St. Paul, Minn .... Mar. 18
Mar. 21. Sioux City, Ia .... Mar. 18
Mar. 21. Buffalo, N. Y .... Mar. 18
Mar. 22. Machinery for plant, Winnipeg, Man .... Mar. 11
Adv. Eng. Record, Mar. 11, 18.
Mar. 23. Roadroller, New York, N. Y .... Mar. 18
Mar. 23. Monon, Ind .... Mar. 18
Mar. 23. Pittsburg, Pa .... Mar. 18
Mar. 23. Bloomington, Ill .... Mar. 18
Mar. 24. Louisville, Ky .... Mar. 18
Mar. 27. Nebraska City, Neb .... Mar. 18
Mar 27. Toledo, O .... Mar. 4
Mar. 28. Buffalo, N. Y .... Mar. 18
Mar. 29. Hartford, Conn .... Mar. 18
Adv., Eng. Record, Mar. 18.
Mar. 30. Reading, Pa .... Mar. 18
Adv., Eng. Record, Mar. 18.
Mar. 31. Bellefontaine, O .... Mar. 11
Apr. 1. Athens, Ga .... Mar. 18
Adv., Eng. Record, Mar. 18.
Apr. 3. Union City, Pa .... Mar. 18
Adv., Eng. Record, Mar. 18.
Apr. 5. Asphalt, Winnipeg, Man. .... Mar. 11
Adv., Eng. Record, Mar. 11, 18
Apr. 10. Lafayette, Ind .... Mar. 18
Adv., Eng. Record, Mar. 18.
Apr. 11. Huntington, Ind .... Mar. 11
Apr. 12. Salem, O .... Mar. 18
Apr. 28. Bellfontaine, O .... Mar. 18

POWER, GAS AND ELECTRICITY.

Mar. 20. San Diego, Cal .... Mar. 4
Mar. 20. South Bethelehem, Pa .... Mar. 18
Mar. 22. Herkimer, N. Y .... Mar. 18
Mar. 24. Albany, N. Y .... Mar. 18
Mar. 30. Defiance, O .... Mar. 18
Mar. 31. Telephone, Shanghai, China .... Nov. 19
Mar. 31. Springhill, N. S .... Mar. 11
Mar. — Fonda, Ia .... Mar. 4
Apr. 1. Cullman, Ala .... Mar. 11
Apr. 1. Palo Alto, Cal .... Mar. 18
Apr. 4. Picton, Ont .... Mar. 18
Apr. 4. New York, N. Y .... Mar. 11
Apr. 4. Transmission line, Benica, Cal .... Mar. 11
Apr 8. Norfolk, Va .... Mar. 11
Apr. 10. Dayton, O .... Mar. 4
Adv., Eng. Record, Mar. 4, 11.
—— Pleasantville, O .... Dec. 24

GOVERNMENT WORK.

Mar. 27. Santa Fe, N. M. .... Mar. 11
Mar. 28. Water, Darlington, Okla. .... Mar. 11
Mar. 28. Chicago, Ill .... Mar. 4
Adv., Eng. Record, Mar. 4. to 18
Mar. 30. Ice plant, Manila, Philippine Islands .... Mar. 18
Apr. 1. Tompkinsville, N. Y .... Mar. 18
Apr. 1. Rock Island, Ill .... Mar. 11
Adv., Eng. Record, Mar. 11, 18
Apr. 5. Vicksburg, Miss .... Mar. 4
Adv., Eng. Record, Mar. 4 to 18.
Apr. 6. New Orleans, La .... Feb. 11
Adv., Eng. Record, Feb. 11 to 25.
Apr. 6. Wilmington, Del .... Mar. 11
Adv., Eng. Record, Mar. 11, 18
Apr. 8. Norfolk, Va. .... Mar. 11
Apr. 10. Tank, Washington, D. C. .... Mar. 11
Apr. 10. Kansas City, Mo .... Mar. 11
Adv., Eng. Record, Mar. 11.
Apr. 13. St. Paul, Minn .... Mar. 18
Adv., Eng. Record, Mar. 18.
Apr. 14. Louisville, Ky. .... Mar. 11
Apr. 17. San Francisco, Cal .... Mar. 11
Adv., Eng. Record, Mar. 11.
Apr. 18. Chicago, Ill .... Mar. 18
Adv., Eng. Record, Mar. 18.

BUILDINGS.

Mar. 20. Iowa City, Ia. .... Feb. 18
Mar. 20. Vent. and htg. school, Lima, O. .... Mar. 4
Mar. 20. Bloomington, Wis .... Mar. 4
Mar. 20. Appleton, Miss .... Mar. 4
Mar. 20. School, New York, N. Y. .... Mar. 11
Mar. 20. Schools, Mattoon, Ill. .... Mar. 11
Mar. 20. School, Hampton, Va .... Mar. 18
Mar. 21. Schools, Mt. Vernon, N. Y .... Mar. 18
Mar. 21. Pittsburg, Pa .... Mar. 18
Mar. 21. School, Annapolis, Md. .... Mar. 11
Mar. 21. School, New York, N. Y. .... Mar. 11
Mar. 22. Dallas, Ore .... Mar. 4
Mar. 23. School, Monticello, Ind .... Mar. 18
Mar. 23. Vault, Montgomery, Tex .... Mar. 4
Mar. 23. Steam plant, New York .... Mar. [illegible]
Mar. 23. School, New York, N. Y .... Mar. 18
Mar. 23. Detroit, Mich .... Mar. 18
Mar. 24. Evergreen, Ala .... Mar. 18
Mar. 25. School, Cleveland, O .... Mar. 4
Mar. 25. School, York, N. D .... Mar. 4
Mar. 27. Montgomery, Ala .... Mar. 18
Mar. 27. Schools, New York, N. Y .... Mar. 18
Mar. 28. Mansfield, O .... Mar. 4
Mar. 29. Hart, Mich .... Mar. 18
Mar. 30. Uvalde, Tex .... Mar. 11
Mar. — Portland, Ind .... Mar. 4
Apr. 1. School, Hannaford, N. D .... Mar. 4
Apr. 1. School, Cleveland, O .... Mar. 11
Apr. 1. Houghton, Mich .... Mar. 18
Apr. 1. Louisville, Ky .... Mar. 18
Apr. 2. School, Omemee, N. D .... Mar. 18
Apr. 3. Htg School, Clifton Heights, Pa .... Mar. 18
Apr. 3. Library, Jersey City, N. J .... Mar. 18
Apr. 3. Many, La .... Jan. 21
Apr. 3. School, Wells, Minn .... Mar. 11
Apr. 3. School, Lakota, N. D .... Mar. 18
Apr. 4. School, Columbus, O .... Mar. 18
Apr. 4. Plumbing, etc., New York, N. Y. .... Mar. 11
Apr. 6. Jail, Keyser, W. Va .... Mar. 11
Apr. 14. Plans, Bradford, England .... Jan. 21
Apr. 15. Plans, etc., Birmingham, Ala .... Mar. 4

MISCELLANEOUS.

Mar. 20. Street cleaning, Albany, N. Y .... Mar. 11
Mar. 21. Dredging, Buffalo, N. Y. .... Mar. 11
Mar. 23 Albany, N. Y .... Mar. 18
Adv., Eng. Record, Mar. 18.
Mar. 23. New York, N. Y .... Mar. 11
Mar. 30. Garbage disposal, Providence, R. I. Mar. 11
Mar. 31. Garbage disposal, Rochester, N. Y. Mar. 4
Apr. 3. Dredging, Philadelphia, Pa .... Mar. 11
Apr. 10. Ditch, etc., Fremont, Neb .... Mar. 4
Apr. 12. Dam, Cincinnati, O .... Mar. 18
Apr. 17. Levee work, West Memphis, Ark. Mar. 18
Apr. 17. Garbage disposal, Louisville, Ky .... Mar. 18
June 30. El. Ry., Shanghai, China .... Mar. 4
Oct. 1. Railroad, Moscow, Russia .... Feb. 25

SCHOOLS.

Concordia, Kan.—Wm. P. Feth, of Leavenworth, has prepared plans for a $50,000 building for the Nazareth Academy.

Omemee, N. D.—Bids are wanted April 2 for a school. August Springer, Pres. Bd. Dirs. of Willow Vale School Dist.

Warren, O.—At the April election the question of issuing $30,000 school bonds will probably be voted upon.

Philadelphia, Pa.—Saml. Gourley is stated to have received the contract for an addition to the James Alcorn School for $29,865.

Hampton, Va.—Bids are wanted March 20 for a school. W. T. Daugherty, Clk. Pub. Instruction. Jas. W. Lee, Archt.

Kenton, O.—The citizens are stated to have voted to erect a $10,000 school.

Shell Rock, Ia.—C. E. Patterson, of Waterloo, is stated to have received the contract for a school at $11,000.

Louisville, Ky.—D. X. Murphy & Bro., of Louisville, have prepared plans for the St. Franciscan R. C. Seminary, to be built at Jackson and Green Sts.

Depere, Wis.—Architects have submitted plans for a $15,000 school. Contracts have not yet been let.

Mt. Vernon, N. Y.—Bids are wanted March 21 for 2 schools, including ventilating, heating, plumbing, electric work, etc. Joseph S. Wood, Pres. Bd. of Educ.

Baltimore, Md.—Morrow Bros., 212 Clay St., are stated to have received the contract to erect the Friends' Elementary High School; contract price said to be about $25,000.

North Washington, Pa.—It is stated that an election will be held April 15 to vote on issuing $25,000 school bonds.

Williston, N. D.—W. T. Tower, of St. Paul, is said to have prepared plans for a $16,000 school.

Jersey City, N. J.—The House is stated to have passed a bill authorizing the issue of $150,000 bonds to rebuild School No. 20, in Greenville, and erecting a primary school in the same vicinity.

Lakota, N. D.—It is stated that bids are wanted April 3 for a school for Kane School Dist. J. W. Ross, Archt., Grand Forks, N. D.

Columbus, O.—Bids are wanted April 4 for completing the South High School. C. E. Morris, Chmn. Com. on Bldgs., Bd. of Educ.

Monticello, Ind.—It is stated that bids are wanted March 23 for a school. C. S. Kingsbury, Township Trustee.

Clifton Heights, Pa.—Bids are wanted April 3 for hot water heating in the Clifton Heights Borough school. J. H. Wise, Secy. School Bd.

Lancaster, Pa.—G. S. Flick, of Lancaster, is stated to have received the contract for an 8-room school, at $23,943.

Fostoria, O.—At the election April 3 the citizens will vote on erecting a $25,000 high school.

North Attleboro, Mass.—The citizens are stated to have voted to erect an $18,000 school.

Homestead, Pa.—F. J. Osterling has been engaged to prepare plans for a $30,000 school.

Duquesne, Pa.—It is proposed to issue $25,000 bonds to build a school.

New York City.—Bids are wanted March 23 for an addition to School No. 46. Richard H. Adams, Chmn. Com. on Bldgs.

The New York Post-Graduate Hospital is to have a new training school for nurses, to cost $100,000.

Luke A. Burke, 401 W. 59th St., has received the contract for School No. 174 at $139,000.

Permits for the following schools have been issued:

To Col. Oliver H. Payne for a medical college for Cornell University, to be built at 27th St. and 1st Ave., to cost $500,000. McKim, Mead & White, Archts., 160 5th Ave.

Brick and stone school for the city to be built at 101st St. and Amsterdam Ave., to cost $260,000. C. B. J. Snyder, Archt., 585 Broadway.

Brick and stone school for the city to be built at 156th St. and Amsterdam Ave., to cost $70,000. B. J. Snyder, Archt.

Bids are wanted March 27 for a school on 101st and 102d Sts., between Columbus and Amsterdam Aves.; also for alterations in and additions to school 70, Brooklyn Borough. Richard H. Adams, Chmn. Com. on Bldgs.

The following bids were opened March 16 for the erection of schools; *a*, 175, and *b*, 171: Harry McNally, 287 4th Ave., *a*, $233,500. Luke A. Burke, 401 W. 59th St., *a*, $224,750. Mahoney Bros., 52 New Bowery, *a*, $276,592; *b*, $328,900. P. J. Walsh, 503 5th Ave., *a*, $262,000; *b*, $312,000. H. Probst, 1180 B'way, *a*, $239,450. P. Gallagher, 150 5th Ave., *a*, $254,246; *b*, $303,743. Mapes Reeve Con. Co., 150 Nassau St., *a*, $244,678; *b*, $310,000. Murphy Bros., 407 E. 101st St., *a*, $252,000; *b*, $315,974. Thos. Cockerill & Son, 550 W. 51st St., *a*, $254,000; *b*, $311,787. Wm. S. Long, 1125 B'way, *b*, $311,800. Jas. J. Loonie, 287 4th Ave., *b*, $299,975.

STREET CLEANING AND GARBAGE DISPOSAL.

Brooklyn, N. Y.—The following bids were opened March 10 for the disposal of garbage, street sweepings, etc., for the Boroughs of Queens and Richmond: Dixon Garbage Crematory Co., Toledo, O., 97 cts. per ton; Zepheniah F. Magill, of 2001 5th Ave., Troy, N. Y., at 45 cts. per ton. James Cameron, of 15 Bennett St., Port Richmond, S. I., bid only for the Richmond wards, as follows: 1st and 3d Wards, 68 cts. per ton; 2d and 4th Wards, 72 cts. per ton, and 5th Ward, $1 per ton.

Bridgeport, Conn.—Local press reports state that the Board of Health has decided to enter into a contract with the Dixon Crematory Co. for the construction of a crematory at a cost of $12,000, average cost of operation guaranteed not to exceed 35c. a ton.

Atlanta, Ga.—The following bids were opened March 3 by Chas. F. Benson, Secy. Bd. of Health, for the destruction of garbage, general refuse, etc.; prices given are per ton, *a*, garbage and general refuse; *b*, night soil; *c*, garbage, general refuse and night soil: Venable Bros., Atlanta; *a*, 39c.; *b*, 38c. Dennis Crematory Co., Atlanta, *c*, 35c. Dixon Garbage Crematory Co., Toledo, O., *a*, 50c.; *b*, 70c. John W. Welch, New York City, by the "Thackeray" process of San Francisco, Cal., *a*, 48c.; *b*, 55c. According to local press report all bids have been rejected by the Board of Health, and the Dennis-Lester Crematory Co. will be allowed to make another test of its crematory.

Louisville, Ky.—Local press reports state that the Board of Public Works will receive bids April 17 for garbage incinerators having a capacity of 250 tons per day.

GOVERNMENT WORK.

New York, N. Y.—The following bids were opened March 10 by the Superv. Archt., Treas. Dept., Washington, D. C., for labor and material required for the ornamental iron work of the main buildings at the U. S. Immigrant Station, Ellis Island, N. Y. Harbor, as advertised in "The Engineering Record": Brown Ketcham Iron Wks., Indianapolis, Ind., $30,328; Shannon Mfg. Co., Philadelphia, Pa., $38,960; Keeler Iron Wks., Brooklyn, N. Y., $35,900; Bradley & Hubbard Mfg. Co., Meriden, Conn., $56,870.47; Delaplaine & West, Philadelphia, Pa., $40,950; R. H. Hood, New York City, $39,370; Snead & Co. Iron Wks., Louisville, Ky., $41,242.

Portsmouth, N. H.—Press reports state that the Bureau of Yards and Docks has decided to advertise in a few weeks for the construction of a stone dry dock.

Tompkinsville, N. Y.—Bids are wanted April 1 for the completion and delivery of metal work for the Romer Shoal lighthouse. Lieut.-Col. D. P. Heap, Corps. Engrs. U. S. A.

Manila, Philippine Islands.—Bids are wanted March 30 for furnishing and erecting a complete refrigerating and ice-making plant at Manila. Col. J. G. C. Lee. Ch. Q. M., 415 Pullman Bldg., Chicago, Ill.

Camden, N. J.—The following bids were opened March 7 by the Superv. Archt., Treas. Dept., Washington, D. C., for ventilating and heating apparatus for the U. S. Post Office and Court House, as advertised in "The Engineering Record": W. J. Robinson, Phila., Pa., $4,820; E. Rutzler, New York, N. Y., $6,537; Harry F. Murphy & Co., Phila., Pa., $5,513; L. O. Howell, Jr., Phila., Pa., $4,913; Anderson & Adams, Phila., Pa., $4,412; J. W. Cuff, Phila., Pa., $5,266; Chas. F. West, Phila., Pa., $5,598; Baker, Smith & Co., Phila., Pa., $4,998; Gaylord & Eitapenc, Binghamton, N. Y., $5,893; Hugh McKeal & Son, New Brunswick, N. J., $5,500; S. Faith & Co., Phila., Pa., $6,262; Blake & Williams, New York, N. Y., $5,445; Boryers Bros. & Co., Columbus, O., $5,657; Pittsburg Heating Supply Co., Pittsburg, Pa., $4,490; D. R. Burns, Phila., Pa., $4,995; W. N. Tobin, Syracuse, N. Y., $6,675; Edward Joy, Syracuse, N. Y., $4,914.

MISCELLANEOUS.

Trenton, N. J.—A bill has passed the Senate authorizing the Mercer Freeholders to construct a tunnel under the canal and railroad at the entrance to Cadwalader Park.

Albion, Ind.—Fred B. Moore, Co. Engr., writes that bids will be asked in April or May for the construction of a ditch, estimated to cost $50,000. There will be required 19¾ miles of tile and considerable dredging.

Washington, D. C.—The following bids for furnishing 20,000 bbls. of Portland cement were opened March 11 by the Commissioners, D. C., as advertised in "The Engineering Record": Price given per bbl.: Chas. M. Hall, New York City, $2, steel brand; J. G. Waters & Sons, Washington, D. C., $2.14, star brand; Walter F. Bradley & Co., Philadelphia, Pa., $2.17, Royal brand; Cranford Paving Co., Washington, $2.27, Vulcanite brand; Atlas Cement Co., New York City, $2.32, Atlas brand.

Albany, N. Y.—See "Bridges."

West Memphis, Ark.—Bids are wanted April 17 for 11 miles of levee work, containing approximately 1,248,000 cu. yds. John B. Driver, Pres. St. Francis Levee Bd.

Boston, Mass.—See "Water."

Brooklyn, N. Y.—The following bids were opened March 10 by the Commissioners of Docks, N. Y. City, for two wooden piers at Wallabout Basin: William H. Jenks, 130 Pearl St., N. Y. City, $118,493; Farrell & Hopper, 355 W. 145th St., N. Y. City, $117,270; R. P. & J. H. Staats, 29 B'way, N. Y. City, $109,850; Gildersleeve & Rolf, 39 Cortlandt St., *$91,633; Henry L. Spearin, 64 E. 3d St., Bayonne, N. J., $99,988.

*Contract awarded.

Washington, D. C.—The Commissioners have awarded the contract for quarrying and crushing stone at Dickerson's Station, Md., for the use of the District, to the Standard Lime and Stone Co. of Baltimore at 70 cts. per cu. yd. for both 2-in. and the finer size on the cars and the same rate on the ground; for loading on the cars 5 cts. per cu. yd.

PROPOSALS.

COMMONWEALTH OF MASSACHUSETTS.

METROPOLITAN WATER BOARD.

SEWERAGE SYSTEM.

Sealed proposals will be received at the office of the Metropolitan Water Board 3 Mt. Vernon street, Boston, Mass., until 2.30 o'clock p. m. of Tuesday, March 21, 1899, for continuing and completing Section 2 of the Clinton Sewerage System. The work to be done includes about 3,600 feet of intercepting sewer, 20, 24 and 30 inches in diameter, the completion of a masonry reservoir having a capacity of 600,000 gallons, and the foundations for a pumping station.

EXCAVATING SOIL.

Sealed proposals will also be received at the office of the Board until 2.30 o'clock p. m. of Tuesday, April 4, 1899, for excavating soil from Section 4 of the Wachusett Reservoir, and excavating and refilling at the Easterly Portion of the North Dike at Clinton, Mass. The work to be done includes the clearing and grubbing of 245 acres, and the excavation of 315,000 cubic yards of material.

Pamphlets containing further information for bidders and form of proposal will be mailed to contractors who apply to the Chief Engineer, or may be obtained at his office, 3 Mt. Vernon street, and at the office of the Metropolitan Water Board, Clinton, Mass. Plans and specifications may be seen at both these offices. The printed form must be used in making proposals. The Board reserves the right to reject any or all bids and to accept the proposal deemed best for the Commonwealth.

The following contracts will be let on April 4, or soon afterward:

1. Two contracts providing for the surfacing of about 3 miles of road along the margin of the Wachusett Reservoir with broken stone.

2. Laying 9,100 lin. ft. of 20-inch and 3,200 lin. ft. of 24-inch cast-iron water pipes to supply water to the town of Arlington.

3. Excavating 20,000 cu. yds. of earth at the Wachusett Reservoir for completing the grading of a railway.

These contracts will be advertised in subsequent issues of this paper.

Pamphlets containing further information for bidders, forms of proposal, contract and specifications will be mailed, as soon as ready, to contractors who apply to the Chief Engineer.

HENRY H. SPRAGUE,
Chairman.
WILMOT R. EVANS,
HENRY P. WALCOTT,
Metropolitan Water Board.
FREDERIC P. STEARNS,
Chief Engineer.
WILLIAM N. DAVENPORT,
Secretary.
Boston, March 14, 1899.

Memphis, Tenn.—The State Legislature has passed the bill authorizing the Board of Directors of the St. Francis Levee District to issue $750,000 bonds for the completion of the St. Francis levee to the mouth of the St. Francis River.

New York, N. Y.—The following bids were opened March 10 for dredging on the North River, between Battery and West 34th St. Engineers estimate 200,000 cu. yds. mud dredging: International Contracting Co., Syracuse, N. Y., 19 cts. per cu. yd.; R. G. Packard, Morristown, N. J., 18½ cts. per cu. yd.; Morris & Cummings Dredging Co., 22 State, N. Y. City, 18¼ cts. per cu. yd.; P. Sanford Ross, Incor., 277 Washington St., Jersey City, *18 cts. per cu. yd.

*Awarded contract.

Cincinnati, O.—Bids are wanted April 12 for building at Dam No. 6, Ohio River, 168 ft. of Chanoine dam, and 3 spans of weirs composed of 2 spans of Bear Trap and one of a Frame Dam. Maj. W. H. Bixby, Corps. Engrs., U. S. A.

Tacoma, Wash.—C. W. Griggs and Leonard Howarth, of Tacoma, and Edmund Seymour, of Pelham Manor, N. Y. have incorporated the Puget Sound Dry Dock & Machine Co., with a capital of $110,000.

PROPOSALS.

Proposals for Sheet Asphalt Paving

BOARD OF STREET COMMISSIONERS.
HARTFORD, Ct., March 17th, 1899.

Sealed proposals, endorsed proposals for sheet asphalt paving, will be received at this office until Wednesday, March 29th, 1899, at 5 o'clock p. m., for furnishing and laying the concrete base and the wearing surface of Trinidad Pitch Lake sheet asphalt, as follows:

For about 6,066 square yards on Allyn street, between Trumbull street and Union place; about 16,145 square yards on Farmington avenue, from its junction with Asylum street to Woodland street; for about 1,453 square yards on Gold street, from Main to Wells street; for about 6,543 square yards on High street, from Asylum to Main street; for about 1,845 square yards on Market street, from Temple to Morgan street; for about 1,290 square yards on Village street, from Pleasant street southerly to City Park, and for about 10,633 square yards on Windsor avenue, from Main street to Capen street.

All bidders will be required to furnish specimens of asphalt to be used at least five days previous to the closing of the bids, at the office of the City Engineer, where specifications may be seen and blank proposals obtained.

The right is reserved to reject any and all bids not deemed for the interest of the City.

The contract will be let subject to the approval of the Court of Common Council.

CHARLES H. NORTHAM,
President.

Electric Light Plant.

ORANGE, N. J.

The City of Orange, N. J., is considering the question of installing its own plant for lighting the city with four hundred electrical arc lamps of two thousand candle power each, and invites suggestions and propositions from engineers and manufacturers as to the approximate cost of the installation and yearly maintenance.

The second proposition is to install such lighting machinery in the same plant with the machinery for pumping the city's water supply, such plant to be located about five miles outside of the city limits. Upon the second proposition it invites suggestions for lighting and pumping plant, both operated by electricity; the pump to be capable of delivering not less than three million gallons daily through a sixteen-inch main under a pressure of 125 pounds as registered on the engine-room gage.

Address communications to

JOHN L. DAVIS, Chairman,
Orange, N. J.

TREASURY DEPARTMENT, OFFICE Supervising Architect, Washington, D. C. March 16, 1899.—Sealed proposals will be received at this office until 2 o'clock p. m. on the 13th day of April, 1899, and then opened for the low pressure and exhaust steam heating mechanical ventilating apparatus, etc., for the U. S. Post Office, Court House and Custom House building at St. Paul, Minnesota, in accordance with drawings and specification, copies of which may be had at this office or the office of the Superintendent at St. Paul, Minn. JAMES KNOX TAYLOR, Supervising Architect.

Proposals continued on pages xi and xii.

THE ENGINEERING RECORD.

Volume XXXIX. Number 17

TABLE OF LEADING ARTICLES.

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THE HOTEL FIRE IN NEW YORK.

The horrible loss of life that occurred in the burning of the Windsor Hotel in New York on the afternoon of March 17 calls attention to the woful lack of means of escape possible in buildings where the requirements of the present law are nevertheless complied with. The Windsor Hotel was a very old structure, built of brick walls, wooden beams, and plaster and lath partitions. It contained two enclosed courts and two courts on the rear of the building. Fire escapes had been erected, but none were built on the front of the hotel, all being on the courts, at the rear and on the sides of the building. Ropes were placed in the rooms and water buckets and a fire-protection system were provided some years ago, in accordance, it is said, with the instructions of the Building Department.

The fire occurred at a time when the front windows of the hotel were crowded with people viewing a passing procession. Yet it was able to get a start and spread with so great rapidity that the stairways were cut off almost immediately. It seems to have been so sudden, indeed, that it has since been difficult to learn exactly where it started. Most of the people who were fortunate enough to get out of the hotel were rescued by the heroic efforts of the fire and police departments. A few men, however, who kept their wits about them saved themselves by means of the ropes. Several women also are said to have escaped in this manner but most of them who made the attempt slid down the rope for a short distance and dropped the remainder, only to meet serious injury or death on the pavement below.

It is presumed that the coroner will hold an inquest, and that in due time the jury will report that the unfortunate victims came to their death as a result of the said fire, but that the law had been complied with and that no one was to blame. The law that permits such a structure and the many other hotels in New York and other cities to accept money for furnishing that kind of shelter to the traveling public is defective and ought to be changed.

The present law denominates as "fire escapes" the light iron balconies connected by steep iron ladders, the whole exposed at dizzy heights. Such means of escape may do for men and for a very few cool-headed women; but most of the latter sex, panic stricken by the fire and hampered as they are with long skirts, have very little chance with the modern authorized fire escape. Too often, moreover, they are not to be found on the walls of the building facing the street, where it is natural for anyone to go for assistance from the firemen. Frequently, on the other hand, they lead to the bottom of interior courts, from which the street may only be reached through devious and unfamiliar and generally dark passageways. The rope fire escape may prove a salvation to some men, but it is folly to expect that women will be able to lower themselves in this way, especially when under the stress of excitement.

What seems to be an efficient type of fire escape is one that is used to some extent in Philadelphia. It is a brick or fireproof shaft containing a fireproof spiral stairway connecting a landing in the shaft at each floor line with the sidewalk. The shaft is entered through doorways, and it would seem that if the doors were sheathed with iron and swung on spring hinges they would, by closing after every passage, prevent fire and smoke from entering the stairway. This is a type of escape that a woman could be expected to use with some degree of safety, and it would be a wise law that would compel such a construction for many hotels throughout the State, a great number of which might prove greater fire traps than the ill-fated Windsor. Some such legislation cannot be urged too strongly, and it should be wide enough to cover all structures where the massing of humanity is unusually large. This is certainly true of some of the department stores in New York city, where there is as great a need of proper means of escape as in some of the hotels.

NEW UNITS IN THE DESIGN OF SEWERS.

Among the many important engineering subjects referred to in the report of the Massachusetts Metropolitan Sewerage Commissioners on the great high-level sewer described briefly in these columns last week, there is none which will attract more attention than the estimated volume of sewage to be handled. When the main drainage works of Boston were designed a quarter of a century ago they were planned to carry away the sewage of a population of 600,000, and a rainfall of a quarter of an inch in 24 hours on an area of 15 square miles. It was assumed that the amount of sewage, exclusive of rain water, would not exceed 75 gallons per capita, or 5 gallons less than the water supply in Boston at that time. When these estimates were made it was believed that the supply of water in Boston could be reduced, by taking precautions to diminish the waste, to not more than 70 gallons per capita daily. This belief was based on the experience of European cities, but in this as in some other engineering subjects foreign experience has been found an unreliable guide to American conditions.

An intercepting sewer of the character proposed by the Massachusetts commission is required to handle the sewage from communities supplied with water by both private and public works, and also some storm and ground water. It is assumed that these sources are distributed over the area to be drained in somewhat the same proportion as the population, and it is accordingly customary to estimate the amount of sewage on a per capita basis. Hence the first estimate is naturally that of the population to be served by the works for a number of years to come; in this case until 1940. An estimate of this sort was made with great care by the State Board of Health in 1895; the figures have been revised in accordance with later census returns and extended by the engineers of the Sewerage Commission under the direction of Mr. William M. Brown, Jr., M. Am. Soc. C. E., chief engineer. It is difficult to determine the law of increase which was adopted, so the estimates are given without comment:

Year............	1900	1905	1910	1915	1920
Population ...	603,900	682,800	774,300	873,300	984,900
Year	1925	1930	1935	1940	
Population.....	1,111,600	1,248,800	1,395,000	1,550,000	

In estimating the quantity of sewage from this population, two methods are available, based on studies of the flow of sewage and of the consumption of water, respectively.

Measurements on one of the existing sewers under the control of the Commissioners were made on thirteen days, on four of which they were continued for a period of 24 hours and for 10 hours on the remaining dates. The average of the measurements was 142 gallons per capita daily. The records of the sewage pumping stations are more complete, but probably of less accuracy, because they are influenced by the slip of the pumps, which is usually quite large in the case of machinery handling sewage. These records are equivalent to a flow of 113 gallons in 1889 and 134 in 1897. An extension of these rates gives 144 gallons per capita as the probable average flow in 1900 and 175 gallons in 1940.

The fluctuations in the average flow for the year are very important factors in considering this problem, however, and in the case of the works under consideration the engineers have been fortunate to obtain important data from the records of the pumping plant. These records show that the average daily flow of each month exceeded the annual daily average during six consecutive months, and that the greatest amount pumped during any one day was about 50 per cent. more than the annual daily average. The average daily flow during a wet week in each of seven different months was greater than the daily average of the year. Hence it is evident that if no provision is made to carry more than the average daily flow for the year, the overflows along the route of the sewer will discharge large quantities of sewage into the neighboring streams. In order to prevent such an excessive amount of sewage finding its way into the streams it has accordingly been decided to add 12 per cent. to the average annual daily flow; this increases the average amount in 1897 from 134 to a maximum of 150 gallons, and in 1900 from 144 to 160 gallons. The maximum in 1940 will be about 200 gallons.

The effect of storm water on the flow of the Boston sewers can also be studied from pumping records. In the station of the Boston main drainage works the reports show that the pumping during the wettest month of the year ranges from 5 to 45 per cent. more than the average of the year, while the pumping records on some of the sewers under the control of the Metropolitan Commissioners show that the average of the flows of the maximum day in each month was respectively 42, 44, 53 and 57 per cent. greater than the average flow of the year at the several stations. The flows of the maximum days during several of the wettest months were found to be in excess of the average of the year by from 48 to 114 per cent. at different places. The mean value of the wet-weather excess seems to be about 70 per cent. of the annual average flow. This is equivalent to an increase of the daily flow in 1900 from 144 to 244 gallons per day, and when applied to the estimated yearly average flow for 1940, 175 gallons, gives about 300 gallons per day for the maximum storm flow of that year. This latter flow is 100 gallons more than the estimated maximum dry-weather flow of sewage in 1940, and is nearly identical with the allowance made by Mr. Joseph P. Davis when he designed the Boston main drainage works.

The estimation of the amount of sewage to be handled can also be made on the basis of the probable water consumption in the district in the following manner: From the studies made by the Massachusetts State Board of Health, extended and amplified under Mr. Brown's direction, it is estimated that the average supply of water in 1900 will be about 100 gallons per capita and in 1940 about 140 gallons. The records of the Cochituate works show that the largest daily consumption during a

warm month was 11 per cent. more than the daily average for the year. This is so nearly the figure, 12 per cent., of the excess dry-weather sewage, as shown by the Boston pumping records, that the latter figure is used in determining the maximum dry-weather consumption of water. It is equivalent to an increase of the supply in 1940 from 140 to 157 gallons per capita. This amount, however, will not all reach the consumers on account of leakage in the distribution and service pipes; assuming the leakage is 10 gallons, the consumption is reduced to 147 gallons in 1940. To provide for the fluctuations in the flow during different hours of the day, this figure is increased 20 per cent. in accordance with the results of gaugings on the North Metropolitan intercepting sewer. The leakage of subsoil water into the sewers is difficult to estimate, and the figure allowed in the report under consideration, 24 gallons, is acknowledged to be under the usual assumption. The reason for making it so low is that the sewer will be situated on high land and free from the influence of tide water. These allowances bring the estimate of the maximum dry-weather flow of sewage to 200 gallons, as before.

JUNIORS IN THE AM. SOC. C. E.

In an article in last week's issue, a brief statement was made of the benefits which the proposed junior meetings of the national engineering societies would confer on their younger members. The more these innovations are considered the more desirable they seem, for they add to the advantages already offered to the class of membership which most desires opportunities for increasing its professional knowledge. No one acquainted with what the societies already give their juniors will be inclined to question that the present returns are amply worth the small annual sum charged for dues. The projects mentioned last week simply increase the number of these advantages, and afford opportunities to the young members of discussing among themselves subjects of much interest to them, but hardly of a nature to be presented at the regular meetings. This is brought out clearly in the following note from Mr. Charles Warren Hunt, Secretary of the American Society of Civil Engineers, which is printed all the more gladly, as it indicates an idea might possibly be gained from the previous article in these columns that the society he represents has not treated its younger members well, an idea which there was no intention of conveying.

"The editorial in your issue of March 18, 1899, on 'Junior Meetings of Engineering Societies' is timely, and to all of its well-considered conclusions I am sure every one interested in the proposed junior meetings will give cordial assent. It appears, however, that a casual reading would be likely to leave the impression, which I feel sure it was not intended to convey, that the juniors of the American Society of Civil Engineers have not been well treated by the society, and do not receive much benefit from their connection with it.

"The answers to an interrogatory circular recently sent to all juniors acknowledge emphatically the benefit derived from attendance at the regular semi-monthly meetings, and the only opposition to the proposed junior meetings originated in a fear that in some way it was intended to substitute the latter for the former, thus depriving the young man of the privileges which he now enjoys. If that were to be the effect the almost unanimous opinion of the juniors is that they prefer their present privileges.

"I am heartily in favor of the proposed meetings, and believe that, if undertaken primarily for the mutual improvement of the juniors, they will result in bringing out discussions which may be subsequently published with profit to the society and to older members. Whether they will be successful or not appears to me to be dependent on an attendance of juniors sufficient to warrant their continuance, and this can only be answered by the juniors themselves."

NOTES.

Electrically-Driven Deep-Well Pumps are to be used during the coming season in Kern and Tulare counties, California. In the latter county the Mt. Whitney Power Company, of Visalia, will install a plant on the Kaweah River, where three Westinghouse generators of 600 horse-power each will produce current for use at wells near five towns some distance apart, as well as for lighting and power purposes. Steam plants have been used successfully at irrigating wells for a number of years, and it was this fact which prompted the company to install small motors for the purpose.

A Fire Testing Station has recently been built by the British Fire Prevention Committee near Regent's Park, in London. The purpose of the tests to be made at the establishment is to obtain reliable data as to the exact fire-resistance of various building materials and systems of construction. The committee states that the experiments will be of an entirely independent character, conducted on scientific lines, but with full consideration of the practical purpose in view. Most of the records will be taken automatically or by photography, and will be under the general direction of a commission consisting of Messrs. Edwin O. Sachs, Max Clarke, Charles E. Goad, Ellis Marsland, Robert Mond, J. B. Mulholland, Ernest Runtz, E. D. Woodthorpe and C. H. Wordingham. The principal building contains office rooms and a laboratory, while the garden of the station will be utilized for making full size tests, which will be generally carried on in brick chambers specially erected for the purpose. The fuel will generally be gas.

The Management of Heating Plants in large buildings is occasionally intrusted to men who are incompetent for such duties, and the results are disastrous. It is rarely, however, that public officials refer to errors of this sort as frankly as the Board of Public Works of Oshkosh, Wis., which says in its last annual report: "Several of the schools are heated by steam, and two of these are supplied with engines and fans, and these plants require the services of competent men to run them properly and keep them in good order. A recent change at the Dale school has proved to be extremely expensive to the city. A competent man, familiar with the work required, was exchanged for one who, though faithful and painstaking, was wholly unfamiliar with the running of plants of the kind in use in that school. The natural results follow, heavy bills for repairs, increased consumption of fuel and unsatisfactory heating. The proper remedy would seem to be the employment of a janitor for one of these schools who is a good steam engineer and give him general supervision of all the heating apparatus in the various buildings."

Automatic Electric Drainage Pumps are employed on the Boston Subway to raise water into the sewers, and in the last annual report of Mr. Howard A. Carson, M. Am. Soc. C. E., chief engineer of the Boston Transit Commission, there is an interesting account of the apparatus. In addition to the rain water falling in the open inclines, there is about 81 gallons per minute of leakage into the whole subway. It is handled by four sets of pumps, which lift it from 12 to 18 feet. An illustration of a typical pumping station shows a number of drains in the bottom of the subway, leading to a brick manhole in the concrete invert. This manhole serves as a collecting basin, from which a 15-inch drain pipe discharges into a sump 7¼ x 11 1/3 feet, with its bottom about 25 feet below the street. On the bottom of the sump are two submerged centrifugal pumps, made of composition metal, and operated through vertical shafts by separate electric motors set on a floor a little higher than the invert of the subway. The water collects in the sump and raises a float connected by a chain with a rheostat which starts one motor and its pump. When the water has fallen to a certain height, the float descends and stops the motor. If it should happen that the first motor did not start, the water on rising a little higher would start the reserve motor, and if that should not work and the water continue to rise, an alarm bell at the center of distribution will ring and give warning that something is wrong. This alarm consists of an independent float, connected with a rod which, when it reaches a certain height, completes a circuit and causes a drop to fall at the center of distribution, and close a local circuit, which rings a bell until it is stopped. Each pump has a capacity of about 300 gallons per minute, and is direct-connected to a five horse-power motor. Most of the motors are wired so as to be run either from the circuits of the Boston Elevated Railway Company or the Boston Electric Lighting Company.

The New England Water-Works Association held an interesting meeting on March 8, at which several papers relating to the examination of water and the organisms in it were presented. Through the courtesy of President F. F. Forbes, a summary of the facts established by Mr. George C. Whipple's important paper on Asterionella is here printed: 1. That the common form of Asterionella is that known as A. formosa var. gracillima, but that great variations exist in size, shape and arrangement of the cells. 2. That Asterionella is widely distributed in nature and that it is found chiefly in lakes, ponds and reservoirs, where comparatively clear water is stored. 3. That its growth in surface waters occurs chiefly in the spring and fall and is intimately connected with the phenomena of stagnation. 4. That it develops most vigorously in open reservoirs where ground water is stored, and that its growth in these reservoirs follows the same laws as in surface waters. 5. That its odor varies in character from geranium to fishy and that under favorable conditions 3,000 Asterionella per cubic centimeter may impart to water an odor that will be easily recognized by the consumers. 6. That it forms spores during periods of rest, and that sporulation takes place at the bottom of reservoirs during periods of stagnation. 7. That its sudden developments after such stagnation periods are due to the germination of these spores. 8. That its food supply is a definite quantity and that the organism will not grow in a water where any one of its constituents cannot be obtained in sufficient quantity and in a form capable of assimilation. 9. That the food elements most likely to be deficient in water are silica, manganese, iron and nitrates. 10. That if reservoirs are not kept clean stagnation tends to increase the amount of food material in the water, and that the increased amount of food material after the stagnation periods helps to explain its periodic seasonal occurrence. 11. That, while it is desirable ground water should be stored in the dark, it is possible to alleviate the troubles due to the growth of Asterionella in open reservoirs by keeping such reservoirs free from deposits at the bottom, thus preventing them from becoming seeded with spores and also preventing a material increase in food supply. 12. That where open reservoirs must be used for the storage of ground water they should be so designed that they may be cleaned whenever necessary, and that they may be isolated from the system whenever growths of organisms make the water unsuited for use.

BRIDGE 69, NEW YORK DIVISION, PENNSYLVANIA RAILROAD.

Bridge 69 of the New York Division of the Pennsylvania Railroad is a double-track deck structure of 235 feet 7 inches span across the Schuylkill River about 90 feet above the surface of the water near Girard Avenue, Philadelphia. It is built under the Pennsylvania specifications for heaviest engine and train loads, and to endure frequent express service at comparatively high speeds, and its details conform to recent advanced practice. The structure is a simple one, but very heavy and rigid, and consists of two pin-connected Pratt trusses, 25 feet 9 inches deep and 19 feet apart, with floor-beams 5 feet deep between the top chords and two lines of stringers 33 inches deep, crossing the top chords of the floor-beams, as shown by Figure 1.

The top lateral system consists of a double triangular system of pairs of 5 x 3½-inch angles and single angles in the common plane of the top of the floor beams and the bottom of the stringers. These angles are riveted at the ends to horizontal connection plates engaging the truss and floor-beam top-chord flanges. They are riveted to the bottom-chord flanges of the stringers, and where they intersect each other one pair is continuous and secured by four rivets to the horizontal plate crossing over its horizontal flanges, splicing the other pair of angles, which have a section cut out to clear the continuous ones in the same plane. The stringers are braced together with the usua. vertical cross frames and horizontal diagonals of riveted 3 x 3½-inch angles. The lower lateral struts are riveted to the main-truss vertical posts just above the bottom-chord pins and have horizontal pin plates attached to their lower sides and to the posts. These plates receive the clevis connections for the lower lateral diagonals, which are single rods from 1¼ to 1½ inches square with 2 3/16-inch and 2 5/16-inch pins. The lower lateral struts have I-shaped cross-sections made up of four 3 x 3½-inch angles each, and at each end the vertical web plate is extended on the upper side so as to form a kind of knee brace, which is secured to the vertical post and receives a pair of 3 x 3½-inch diagonal angles, riveted on in the vertical transverse plane to form sway bracing. The upper ends of these angles are riveted to similar plates which form shelf braces under the ends of the floor-beams. The sway-brace diagonals are spliced by a web plate in their common center plane, which fits between the backs of both pairs and permits one of them to be cut away to leave clearance for the other to run through continuously. The connections for the lateral and sway brace systems are shown in Figure 2, which is a general elevation of the end panels and is characteristic of the whole span.

The top chord and inclined end posts are of uniform construction, with a height of 32 inches and width of 39 inches, and are made throughout with one cover plate, four 5 x 3½-inch and four 5 x 5-inch angles, four webs and four 5 x ¾-inch reinforcement plates for the lower flanges of the bottom angles. In the end posts and end panels of the top chord, the webs are single plates, but in the intermediate sections of top chord the webs are reinforced by a plate on the back of the outer web and one on each side of the inner web, both riveted on with two extra rows of rivets. The chords are spliced at every panel point 30 inches from the pin, on the side away from the center of the

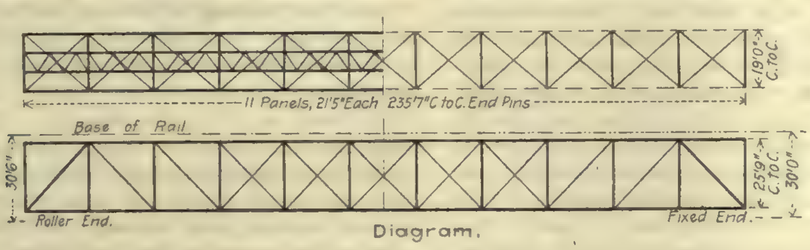


FIGURE 1.

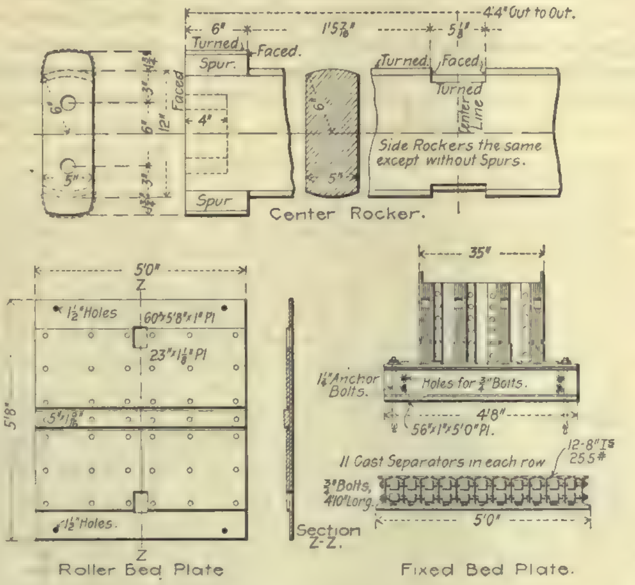


FIGURE 5.

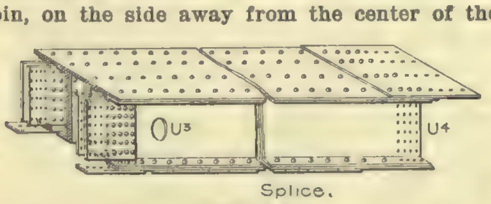


FIGURE 3.

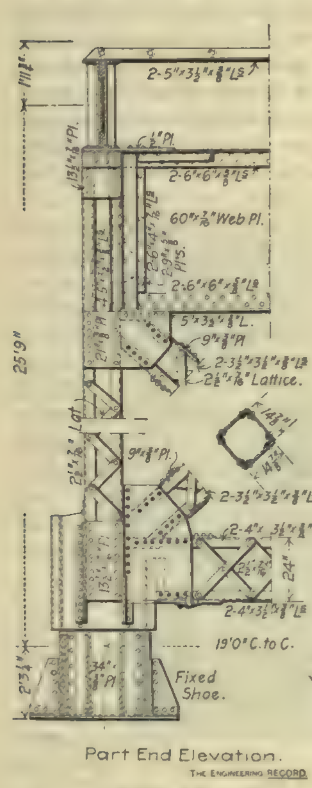


FIGURE 4.

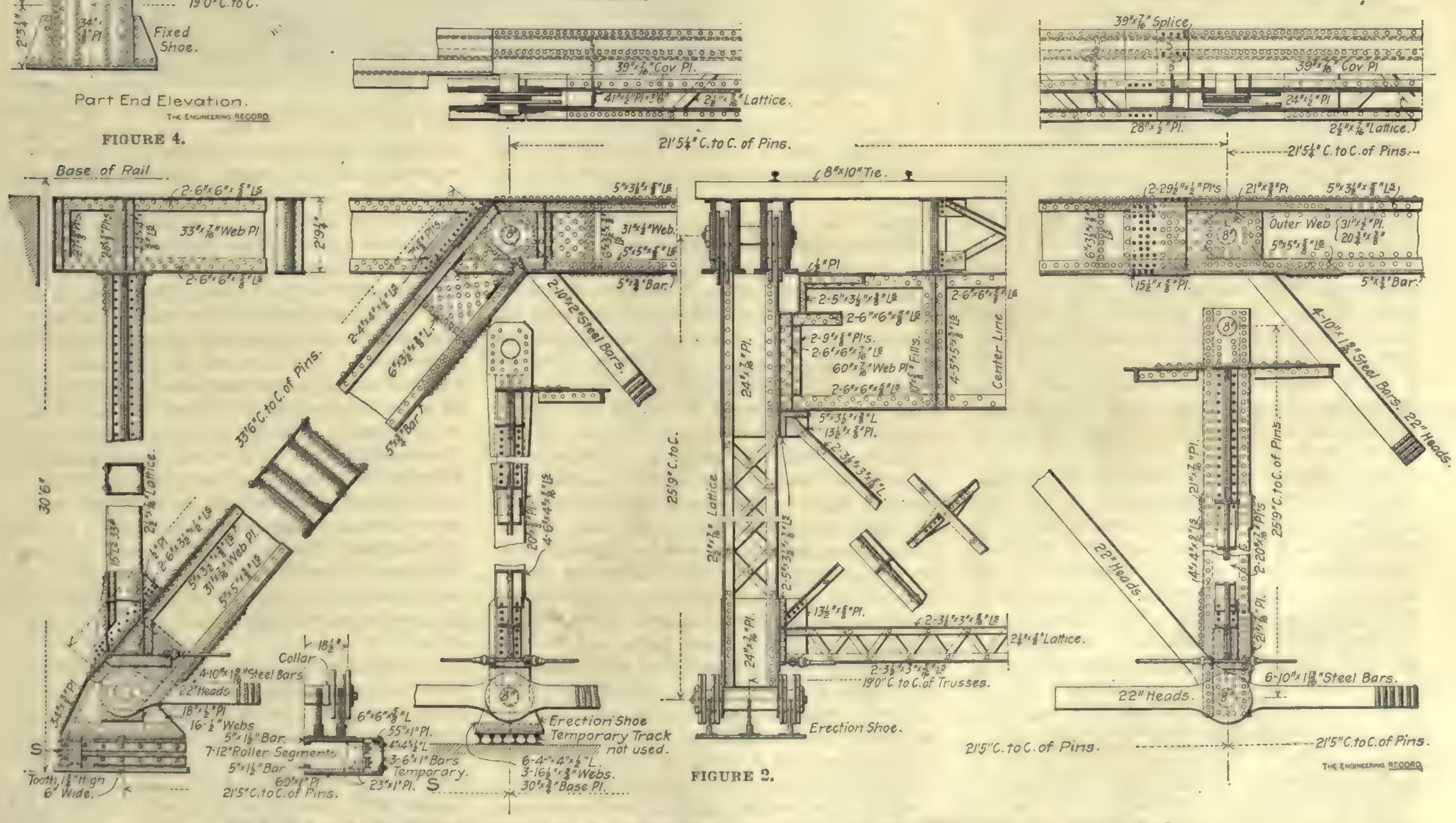


FIGURE 2.

DETAILS OF TRUSSES, BRIDGE 69, NEW YORK DIVISION, PENNSYLVANIA RAILROAD.

W. H. BROWN, CHIEF ENGINEER; W. A. PRATT, ENGINEER OF BRIDGES; EDGE MOOR BRIDGE COMPANY, CONTRACTORS.

span. Double cover splice plates are shop-riveted to the outer webs and single ones to the lower flanges of the pin end of the chord section, and a single top cover splice plate is shop-riveted to the other end, as shown in Figure 3, so that all splice plates are shipped fixed in position and easily entered and riveted without fitting in the field. At the hip joint one reinforcement plate on each side of the two outside webs of the end post and top chord is extended to take a full pin-hole and tie the two members together, at other pin bearings there are half holes and clearance is left between the milled ends of the adjacent sections. On each side of every splice the chord is stiffened by a continuous transverse diaphragm made by riveting vertical angles to the webs and connecting their outstanding flanges by a plate in the center and by direct riveting back to back where they overlap in the same plane on the sides, as shown at T in the horizontal section, Figure 2. The top chord has a gross sectional area of 227 square inches at the center, and is proportioned for a maximum compression, including the allowance for impact and vibration of 2,679,000 pounds. The net permissible compressive unit stress is 11,900 pounds.

The vertical posts have square cross sections made up by two webs and four angles; in the heaviest posts the webs are double and 20 inches wide with 4 x 4-inch angles; in the others, single, 17 and 18 inches wide and with 3½ x 3½-inch angles, all double latticed.

The maximum vertical post strain is 889,000 pounds, and the corresponding sectional area is 67 square inches. The maximum strain in main ties is 1,181,000 pounds, and the corresponding sectional area is 79 square inches. The maximum lower chord strain is 1,915,000 pounds, which is provided for by ten 10 x 1 13/16-inch bars with a combined nominal sectional area of 178.6 square inches.

All the chord pins have a uniform diameter of 8 inches, and each has an 1¼-inch hole bored through its axis. Through this hole a 1-inch bolt is passed, which has a nut on each end and clamps in position two hollow pressed steel disks resembling pin nuts, that cap each end of the pin. The middle lower chord pins have grips of about 52 inches.

The shoes are made with four webs to correspond with the end posts, and both sets of webs are cut at the same angle and abut on the pin in the same planes, with a slight clearance, each side of the pin, precisely as in a hip joint, thus avoiding shearing strains and securing direct bearing. Each expansion shoe rests on a nest of segmental rockers 12 inches in diameter and 52 inches long. These rockers are grooved top and bottom in the middle to engage ribs on the top and bottom plates, and resist lateral displacement, and the center rocker has top and bottom spurs 1¾ inches high and 6 inches wide at the ends, which engage slots in the bed plate and in the sole plate of the shoe, and altogether prevent longitudinal displacement, while permitting perfect freedom of motion under temperature changes. Each rocker is bolted top and bottom to a pair of side pieces, which retain the rockers in correct relative position at all times.

The vertical tension member in the end panels is of I-beam cross-section, and is built of four 6 x 4-inch angles, double latticed. At the upper end it is made with a 23-inch web plate and has a 20 x ⅝-inch sheared plate 8½ feet long on each side. These plates receive the floor-beam connection and act as suspenders for it, being bored to receive the top-chord pin at the hip. Similar but smaller plates are riveted at the lower end to receive the bottom chord pin and lateral strut, and in order to receive a maximum compressive strain of 363,000 pounds during erection, a temporary shoe, shown in position in Figure 2, was made to engage the lower side of the bottom-chord pin and afford bearing for hydraulic jacks by which the bridge was lifted after erection, and to be afterwards removed by simply lowering and displacing it.

Between the hips and the abutments the tracks are carried on four plate girders, two of which are extensions of the regular track stringers, and two of them are in the planes of the centers of the top chords and continue their upper surface to receive the ends of the ties. The shore ends of each set of these girders are carried by an end floor beam parallel with, and close to the surface of, the back wall and supported by a pair of vertical columns riveted to the lower ends of the inclined end posts, as shown in Figure 4. The stringers are 21 feet 5 inches long over all, and are made with a 33 x 7/16-inch web and four 6 x 6 x ⅝-inch flange angles. The floor-beams are made with 60 x 7/16-inch webs, four 6 x 6 x ⅝-inch flange angles and 5 x 5-inch and 4 x 6-inch vertical web stiffener angles. The total weight of the bridge including track and wooden deck is 660 tons. The cross-ties are 8 x 10-inch white oak, 23 feet long and 16 inches apart, dapped ½ inch over the top chords and stringers. This bridge was built for the Pennsylvania Railroad Company, Mr. W. H. Brown, M. Am. Soc. C. E., chief engineer. The designs were made and executed under the supervision of Mr. W. A. Pratt, M. Am. Soc. C. E., engineer of bridges, and the structure was manufactured and erected by the Edge Moor Bridge Company, Mr. Wm. H. Connell, president; Mr. C. W. Bryan, chief engineer; and Mr. S. P. Mitchell, manager.

THE MAINTENANCE OF CATCH-BASINS AND SEWERS IN PROVIDENCE.

An interesting account of the methods of maintaining catch-basins and sewers in Providence, R. I., has been sent to "The Engineering Record" by Mr. Allen Aldrich, who has been engaged in this work for about a quarter of a century, and therefore speaks from long experience. The maintenance of the basins is especially important in keeping a sewerage system in condition for the reason that the deposits collected in them are much more easily removed than after they have been washed through the traps into the sewers. When this material once enters the sewers the cost of getting it out is greatly increased, and the efficiency of the system is also decreased in a marked degree. Mr. Aldrich keeps a record in his office of each basin. An inspector makes an examination of each of them once a month, and, if necessary, after heavy rainfalls. The depth of the deposit, the condition of the trap, and the general desirability of repairs are all noted, and in this way the work of maintenance can be directed from the main office to the best advantage.

Each gang for catch-basin work consists of two laborers and a couple of carts with drivers. The outfit consists of a ladder, two shovels, a hand rope, two hoisting buckets, a bailing bucket, a pair of hip rubber boots, a small box of cement, a trowel and a can of disinfectant. The foreman of the gang receives an order for the day's work made out on a special form, and a duplicate of this order is kept at the office so that any man in the force can be located at once if he is wanted. The start in the morning is made by one cart going to the wash stand to be cleaned, and the second cart with the men and tools going to the first basin on the list.

When this basin is reached one man enters it by means of a ladder and bails the liquid through the trap into the sewer until nothing but the heavy sediment remains. This is hoisted into the carts by hand ropes and buckets. By the time the cart is loaded and starts for the dump, the second cart has arrived from the wash stand and is ready for its load. By the time the first cart has returned from the dump the second is ready to start. The next morning the second cart is the first to leave the yard, and the first is sent to the wash stand. This method keeps the men at work and also gives an opportunity to wash each cart thoroughly every second morning. When the deposit is removed from the basin and the sidewalk has been cleaned, the foreman notes on his list the amount of sediment which has been taken out and proceeds to the next basin on the list. When the day's work is done, the list is returned to the office to be compared with the measurements on file there in order to determine if the work has been performed correctly. In this method of cleaning, everything in the basin is removed, but only the solid material has to be carted away. Single-horse carts are used, which hold a cubic yard when loaded to within six inches of the top of the body. It is not considered advisable to load them any deeper because their contents will then slop on the streets. An average day's work for a gang is 20 cubic yards. The cement carried in the outfit is used to repair any defects which may be found about the trap or brickwork. Plenty of disinfectant is used when necessary. The city owns but four of the horses used for this work, which is all that are necessary for the Winter cleaning; when others are required, they are hired by the day, with harness and driver.

Some hints given by Mr. Aldrich deserve special attention. One is a plan to lessen the trouble liable to occur at low places in streets where there is no opportunity for surface relief. By employing a branch pipe in the basin connection and using two traps instead of one, he has yet to learn of a single instance where both traps have become entirely clogged during the same storm, although these duplicate connections are in use in several places which formerly caused frequent annoyance. A style of basin which he favors is what is locally known as a spider. It is placed near the center of the street, with chutes leading to as many inlets as may be desired, six chutes leading into a single basin in several instances. This plan is found to result in a considerable saving in construction and maintenance, and also keeps the men and carts away from the sidewalk when they are engaged in removing the deposits. Two traps should be placed in such basins to allow for the extra work to be performed by the outlet into the sewer.

During the winter months most of the trouble comes from ice. The warm air from the sewers is generally sufficient to keep the water in the traps from freezing, but there are places which are exposed in such a fashion that the trap will become filled solidly with ice. In one basin the ice has been found 18 inches thick, but such occurrences are rare. The chutes to the basins are easily frozen and require special attention. The apparatus used in remedying troubles of this kind is a light boiler mounted on a pair of wheels, so it can be moved readily by a single horse. These boilers furnish steam to a ¾-inch hose, which can be directed to any point, and is very effective. The inlets to basins need attention after each heavy snowstorm. This work is not attended to during the first 24 hours after a storm, except in some places of special importance, as this is the period allowed by law for the public to remove the snow from the sidewalks. Any space in the gutters or inlets cleared by the maintenance gangs would be filled by the snow from the sidewalk. After the 24 hours have elapsed an open cut about 10 feet wide is made from the inlet to the centre of the street. The public are inclined to keep this open as a street crossing or to reach cars, and it serves the purpose of the sewer maintenance gangs until the gutters can be cleared of snow.

In 1898 there were 4,026 basins in Providence. These were examined 18 times, and cleaned about 3½ times on an average. The total amount of deposit removed during the year was 10,600 cubic yards.

The first thing to do in the maintenance of sewers is to keep them under a system of constant inspection. In Providence a general in-

spection is made of every manhole at least once a year and a record of its condition filed away. Every sewer large enough for a man to pass through it from manhole to manhole is entered and its condition and the deposits in it noted for reference in the future. If a sewer is too small for a man to go through it, it is examined by the use of reflectors or by candles on a float pulled through the sewer by rods or lines. The best results are obtained by the use of candles, for the glazing of the pipes forms a sufficient reflector to reveal each crack and imperfect joint. The location of any defect can be found by counting the number of joints to the manhole or by measuring the rods connected with the float. Experience shows that some of the sewers require more attention than others, and they are consequently examined more frequently; for instance, one sewer which receives the wastes from a soap factory has to be attended to promptly in case of trouble, or a stoppage is certain.

Among the places in sewers which require special attention from the mantenance force are flat grades, curves, changes of grade and the inlets of side sewers. At these places backwater may be produced, which will result in the formation of dams of sediment. In sewers with flat grades, particularly those of a small diameter, the use of pans under the manhole covers has been found beneficial in Providence, as they catch the material which drops through the ventilation holes of the covers and prevent it from forming dams.

flushing the main sewers a 2½-inch fire hose with a 1½-inch nozzle is used. This gives a large body of water, which is very effective in the washing, and avoids the danger which a smaller stream with a greater velocity would have. Although Mr. Aldrich has washed sewers in this way for years, no injury to the brickwork or cement joints has yet been detected.

When possible, the cleaning begins at the dead ends of all branch sewers and ends at the main, which is cleaned last of all. It has been found that sand catchers in main sewers having flat grades are useful in collecting dirt at given points, and lessen the work of cleaning greatly.

The roots of trees cause considerable annoyance in Providence. They penetrate the sewers where least expected, and unless their presence is detected very soon they will cause much annoyance. A special piece of apparatus is required to remove them. It consists of three steel brushes linked together and drawn through the sewer by a horse or derrick. Each brush consists of two flat brushes placed at right angles to each other, their axis of intersection being in the line of the links connecting the different pairs. This apparatus cuts the roots and brings them to the manhole. Mr. Aldrich states that the cause of this plague is imperfect construction, and he has found less trouble with sewers having bell joints than those with sleeves. It requires less skill and attention to make perfect joints with bell pipe, and the results are therefore better.

Trouble with grease is also experienced in

RAFT WITH SCRAPER FOR CLEANING LARGE SEWERS.

Obstructions sometimes occur in the small sewers which it is difficult to guard against. They are generally caused by some article which catches against the joints of the pipes. Much trouble has been experienced in the vicinity of sawmills and carpenter shops which is caused by children poking small sticks through the ventilation holes in the manhole covers. So much annoyance was traced to this source that it was necessary to have the holes made as small as possible. In one instance a man removed a manhole cover and dropped a carcass of a 40-pound dog into a 12-inch sewer, thinking there would be no trouble with it. But there was.

Flushing has been found an important part of maintenance in Providence, as well as elsewhere. Special attention is paid to dead ends. At these places a line of hose is attached to a fire hydrant, a pail is placed against the outlet, the manhole is filled with water to the depth desired, and the pail is then pulled away from the outlet by means of a rope attachel to its bails. Sometimes a wooden ball attached to a line is allowed to float through the sewer, forced by the volume of water behind it. The water passing between the sewer and the ball cuts the sediment which has collected in the pipe. This method is said to be excellent, for it does the work without any of the injury to the joints of the pipe which is liable to occur when heavy streams of water are forced into the sewer. In Providence, as in other cities. It escapes through the drain pipes from houses and restaurants and flows along readily until it reaches a cold spot, where it congeals. In this way layer upon layer accumulates until the pipe is sometimes completely clogged. The best way to remove such an obstruction is to use a stream of water, according to Mr. Aldrich, and the best way to prevent it is to cause persons using the sewers for such purposes to provide large grease traps. The use of lye or potash, recommended by some as a remedy, is discouraged.

"One of the most successful ways of removing obstructions from pipe sewers," according to Mr. Aldrich, "is to force a line of hose into the sewer until the obstruction is reached, then pull it back about 2 feet; then by turning the water on suddenly the obstruction is removed without injury to the pipes. It is bad policy to try to force obstructions from the upper side, as any additional pressure is liable to strain the joints or break the pipes. When necessity compels me to work from the upper side, I do not allow the blocking of the pipe to obtain pressure, but leave an open pipe and depend upon the force of the hydrant steam directed upon the object to do the work."

Steam at a high pressure should not be allowed to escape directly into sewers from buildings. Vitrified pipe expands when heated, and a dash of cold water upon it in this condition seldom fails to crack the material. In places where tide water enters the sewer 6-inch cast-iron pipe has been injured in the same way. If the steam enters the sewers it is also liable to escape through the ventilation holes in the manhole covers and frighten horses, and it also makes a satisfactory examination of the interior of the sewers impracticable.

The accompanying illustration shows an apparatus used to remove the sand which settles to the bottom of large sewers. It consists of a raft formed so that it can be put into a manhole, and has a gate built to fit the circle of the sewer and controlled by two hand levers, as shown in the picture. Six large candles are set on the top of the gate, and give all the light required. The right-hand end of the raft in the picture is placed down stream. A man stands ready with a fork to remove any heavy obstructions in front of the scraper. By lowering the gate to rest on the bottom of the sewer the sewage is dammed up behind the raft and forces it along. The water escaping around the sides and the bottoms cuts and starts the deposit, which is forced ahead of the raft until the next manhole is reached, where the material is removed. A circular sewer 102 inches in diameter was cleaned for a distance of 6,400 feet with this apparatus at a cost of about $25. About 60 cubic yards of deposit were removed. The depth of sewage varied from 18 to 24 inches and the deposit was from 3 to 12 inches deep in places. The raft was used for four days. At times dirt would accumulate ahead of the scraper to a depth of 18 inches, but there was no failure of the apparatus to move it along.

THE MASSACHUSETTS STATE HIGHWAY REPORT FOR 1898.

The annual report of the Massachusetts Highway Commission for 1898, which has just been printed, contains many interesting statements concerning the cost and methods of road-work carried out under its direction. The commission's general methods were discussed at some length in these columns about a year ago so it is unnecessary to consider them at length at this time. The report shows that while the policy of awarding contracts for building State roads to municipal authorities is to be commended on the whole, nevertheless defects still continue to arise under it. It may be recalled by readers of the previous article on this subject that the contract prices agreed to by both parties are fixed by the commission after its chief engineer has made a careful study of the local conditions as to material, cost of transportation, wages, and other features. The estimates are considered to be generally liberal to the municipal authorities, and the commission is of the opinion that in a great majority of cases it is possible to execute the contract without loss to the town or city. When there is a considerable deficit an appeal is usually made to the commission to make good at least a part of the loss thus sustained. Experience in these cases shows that the loss is generally due to careless business methods on the part of the local authorities; wages are often considerably higher than the normal rates of the locality, and the labor is inefficient and incapable. The commonwealth suffers in no small degree through the delays which necessarily accompany this state of affairs, especially as it compels the maintenance of engineers on the work during a relatively longer period. Whenever losses have resulted from errors or omissions on the part of its engineers, the commonwealth will deal liberally with the contracting authorities, but the commission holds it should not undertake to make good those losses for which it is in no way responsible, which ordinary prudence and business ability would have avoided.

One feature of the present laws, also relating to the taking of contracts for road work by local authorities, which has caused delay and vexation, is that requiring the commission to

allow the town or city officials 30 days to consider whether they will accept the contract and prices fixed by the commission. In many cases the matter is held under consideration up to the very limit allowed by the statute, which causes a delay sometimes amounting to several weeks in starting the work. A recommendation is made that the law should be changed reducing this time from 30 to 10 days. On a large number of contracts this would make 20 days available in the best part of the season.

A section of the report which is particularly interesting at this time, gives the conclusions of one of the commissioners, Mr. William E. McClintock, M. Am. Soc. C. E., drawn from a personal investigation of the State roads built in New Jersey under the supervision of Mr. Henry I. Budd. He found that most of these roads traverse a fairly level country, which reduced the cost of grading to a low figure compared with the expense necessary in Massachusetts. Moreover, a large part of the little grading which is necessary was done in material removed cheaply and hauled but short distances. In cases where much work of this sort was necessary the cost was found to average about the same as on Massachusetts roads.

Most of the roads visited had a nominal depth of stone of 8 inches. It was stated that 9 inches of broken stone rolled to 8 inches. On this basis a mile of road 15 feet wide requires about 2,933 tons of broken stone, estimating a cubic yard to weigh 1 1/3 tons. At a cost of $1.60 per ton, the expense for stone is found to be $4,693. The only contractor who was found on the roads during the visit stated that on the particular work on which he was engaged, about 3,000 tons of stone per mile of 15-foot roads was used. These figures agree with those obtained in the Massachusetts work on a road 6 inches thick after rolling.

The difference between the thickness in the two States may be attributed to the different methods of working. In New Jersey the stone is spread to a depth of 9 inches, which is assumed to give a depth of 8 inches after rolling. In Massachusetts the stone is laid to arbitrary grades and an absolute depth of 6 inches is maintained. In New Jersey, the contracts are let at a stipulated price per square yard, while in Massachusetts all the broken stone is weighed and the contractor is paid for each ton placed on the road. Under the New Jersey method it is a simple matter to estimate the amount of stone required on any road. On the other hand the Massachusetts system of maintaining the top surface of the stone at an arbitrary grade results in much loss when the stone is pressed down into the subgrade. This results in considerably increasing the average number of tons of stone per mile of 15-foot roads. Another point of difference in the items entering the cost of roads in the two States relates to labor. The prices paid in Massachusetts are 20 per cent. higher on labor than in New Jersey, one-third higher on teams, and 11 per cent. higher on the length of the working day. A mile of 15-foot road in New Jersey costs about $4,700, and a similar road in Massachusetts costs about $5,700.

In the matter of the amount of stone used per mile of Massachusetts roads as compared with the New Jersey practice, it should be added, that the figures for Massachusetts are being gradually reduced, and the average for the roads built last year is not much greater than it is in New Jersey. It should also be added that in New Jersey all bridges, culverts and fences are built by the county, while in Massachusetts this expense is figured in with the cost of the State roads.

The Massachusetts commission speaks favorably of the New Jersey practice of building roads only 10 to 12 feet wide. The report states that wherever these narrow roads have been built they have given general satisfaction, and there is no reason to suppose that they would not be equally satisfactory in Massachusetts on all except heavily traveled roads.

In the report of Mr. Charles Mills, chief engineer of the commission, are some valuable statements concerning his experience in maintaining some of the State roads. Formerly when horse tracks formed on a road it was necessary to fill them with broken stone, cover it with screenings and then roll the place. The result was that the horses would continue to travel in the old track, kick out the stone in dry weather, and make more repairs necessary. It has been found that if the horse track is filled with broken stone without screenings the horses avoid it and travel on the side, so that the wheels gradually compact the stone. It is then not so easily kicked out as when compacted by the roller, and the horse track does not reappear. When screenings have been blown or washed off the roads, and a binder is needed to prevent the stone from unraveling, screenings, blue gravel, clayey sand, and coarse sharp sand have all been used in order to determine the relative value of the different materials. So far the best results have been obtained by using coarse sharp sand.

Several sections of road have been surfaced with selected gravel. Where they are continuations of roads surfaced with broken stone, so that they are subjected to travel of the same amount and character as the broken-stone sections, the relative wearing properties of the types are easily ascertained. It is seen that the gravel surface does not stand the travel so well as the macadam; although very good in dry weather it becomes rutted in wet periods and the expense of maintenance is very much larger than for a stone road. In building roads where the soil is clayey and good sandy gravel can be obtained, the latter has been used in place of telford with good results. In one place where gravel would have to be hauled for some distance, while a poor quality of stone was abundant and would cost no more than the gravel, 6 inches of broken stone as it came from the crusher was used for a foundation. Whether this mode of construction was advisable can only be determined by further use of the road.

Owing to the comparatively short sections of State roads built during the first three years' work of the commission, no systematic and economical method was devised for their maintenance. During 1898, however, connection was made between several of the shorter sections, which resulted in fairly long and continuous roads, and a system of continuous repairs has been inaugurated on them, which, it is hoped, will give good results at a minimum cost. One man with a horse is employed to look after as long a piece of road as can be properly cared for. This care included picking off loose stone, filling any incipient ruts or hollows, spreading binding material when the old material had been displaced, cutting the weeds alongside the roadway, filling any small washouts on the shoulders, and in general keeping the whole road in good repair. Broken stone of two sizes, half-inch screenings and that which passes a 2½-inch mesh and stops on a ½-inch mesh, has been stacked in small piles at convenient distances along the side of the road in the same manner followed with much success for many years in Europe.

The report of the geologist of the commission, Prof. Logan Waller Page, of Harvard University, contains a description of the apparatus recently constructed for making abrasion and cementation tests, which have thus far proved the most useful methods of determining the utility of different road metals.

The abrasion test is almost identical with the Deval test used by the National School of Roads and Bridges of France, the difference between the two being the omission of certain processes, not strictly necessary, for the purpose of saving time. A new machine was constructed during the year. It consists of four cylinders, each 7.9 inches in diameter and 13.4 inches deep, fastened to a shaft so that the axis of each makes an angle of 30 degrees with the axis of rotation. Each cylinder is closed at one end and has a tightly-fitting cover at the other. At one end of the shaft is a pulley by which the cylinders are revolved, and at the other end is a revolution counter. Four tests can be carried on at the same time with this machine.

The stones used are between 1¼ and 2½ inches in diameter, about the size used in making macadam roads. In a test 11 pounds of perfectly clean stone are placed in a cylinder, the cover is bolted on and the cylinder is rotated at the rate of 2,000 revolutions per hour for five hours. At each revolution of the shaft the fragments of stone are thrown twice from one end of the cylinder to the other, grinding them against each other and against the walls. At the end of the test the contents of the cylinder are placed on a sieve having 1/16-inch meshes. The material passing the sieve is put aside for the cementation test. The sieve and the stone remaining on it are held under running water until all the adhering dust is washed off. The stone is then thoroughly dried and carefully weighed, the decrease giving the weight of the detritus worn off by the test. The percentage of the detritus may be taken as a coefficient of water, or the coefficient adopted by the National School of Roads and Bridges of France may be used. The latter has been adopted by the commission, and is expressed by the formula, coefficient of wear $= 400 \div w$, where w is the weight in grams of detritus under 1/16 inch, obtained per kilogram of stone used.

The purpose of the cementation test is to obtain the relative binding power of the various stones used in road making. Experiments have been carried on for the past five years in the laboratory of the commission to determine some way of testing this important property. The test finally adopted is made by subjecting stone-dust briquettes to impact in a special apparatus. The briquettes are made of dust, which has passed through a screen with 100 meshes per inch. The dust is obtained either from the detritus of the abrasion test or by specially reducing the stone. The briquettes are of circular section 0.98 inch in diameter and of the same height, made by placing the dust in a metal die and mixing with it enough distilled water (about 0.24 cubic inch) to moisten it. A closely fitting plug is then inserted on top of the wet dust and subjected to a pressure of 1,422 pounds per square inch. The weight of dust varies with the density and compressibility of the stone, but generally about 0.9 ounce is required to make a briquette of the above dimensions. Two weeks should be allowed for the briquette to dry at the ordinary temperature of a room.

The machine used for testing these briquettes consists of a hammer, weighing 2.2 pounds, arranged like the hammer of a pile driver on two vertical guides. It is raised by a screw and dropped automatically from any desired height, falling on a plunger which rests on the briquette. The plunger is bolted to a cross-head which is guided by two vertical rods. A small lever, carrying a pencil at its free end, is connected to the side of the cross-head by a link motion, arranged so that it gives a vertical movement to the pencil six times as great as the movement of the cross-head. The pencil is pressed against a drum and its movement is recorded on a slip of paper fastened on this drum, which is moved automatically through a small angle at each stroke of the hammer, and in this way a record is obtained of the movement of the hammer after each blow. The standard fall of the hammer for a test is 0.39 inch, and the blow is repeated until the bond of cementation of the material is destroyed. The final blow is easily ascertained, for when the hammer falls on the plunger, if the material

beneath it can withstand the blow, the plunger rebounds; if not, the plunger stays at the point to which it is driven. The number of blows needed to break the bond is taken as representing the binding power of each stone, and is so used in comparing this property in road materials.

An automatic screen is used in preparing the stone dust for the cementation test. It is about 39.37 inches long by 4 inches in diameter, and consists of a cylinder of brass wire netting of five different meshes; 100 meshes per inch at one end and decreasing by 20 meshes each time to 20 meshes per inch at the other end, the smallest size being at the end where the dust enters. The cylinder is mounted on bearings at a slight angle to the horizontal. The unscreened dust is automatically fed into the upper end from a hopper, while the cylinder is rotating and in its passage is sifted into the various sizes. The upper end of the cylinder rests on wheel bearings, and on the bearing surfaces are several ridges which lift the cylinder as they pass over the wheels. This shaking device is necessary to prevent clogging of the finer meshes of the screen. This screen works very rapidly, and as it is entirely covered, no dust can escape into the air.

THE WATER-WORKS OF YORK, PA.

A good example of the results of poor engineering work is found in the experience of the York Water Company, of York, Pa., where a force main, from the pumping station to the reservoir, was carried over a hill 40 feet higher than the surface of the water in the reservoir, and reservoirs were built which were incapable of holding water. These reservoirs were afterwards repaired so as to be serviceable, but the pipe line has not been changed. The following information concerning this remarkable plant has been taken from a paper by Mr. John Birkinbine, read before the Engineers' Club of Philadelphia, and recently published in its "Proceedings."

The City of York has had a system of water supply since 1816, when water was taken from a spring and conveyed by gravity to a reservoir located in what is now the residential portion of the city. Later the gravity supply was increased by pumping, and the reservoir capacity was increased. In 1896 the York Water Company had two pumping stations, two reservoirs with an aggregate capacity of 10,000,000 gallons and 40 miles of distribution pipes. These reservoirs were too low for new portions of the city and being located on a limestone foundation gave considerable trouble from a number of serious and expensive leaks. An increase of population and manufacturing industries on the water shed threatened the character of the water from the old stations, and realizing that a practical reconstruction of the works was necessary, the company began in 1897 the construction of an entirely new system.

A new pumping station was built on a creek about two miles above the city, in which were installed two triple-expansion duplex Worthington pumps, each having a daily capacity of 5,000,000 gallons. Steam is supplied by two Zell water-tube boilers of 125 horse-power each. A 24-inch force main, 10,900 feet long, was laid from the pumping station to a pair of reservoirs, which were intended to have a combined capacity of 40,000,000 gallons. In building this force main, irregularities in elevation were preferred to changes in horizontal direction, with the result that air traps were formed and an avoidable summit, 40 feet higher than the reservoir surface, places a constant duty upon the pumping machinery in excess of what is actually required. The elevation of the full water-line of the reservoirs is 245 feet above the source of supply, but owing to the intermediate summit the pumping machinery works against a static head of 285 feet plus the friction in the force main.

"The locality selected for the reservoirs," says Mr. Birkinbine, "was one demanding special care in construction, for the hill upon which it was placed is one of a range formed of hydromica schists which define the limestone valley in which York is situated; in fact, limestone is found half-way up the slope of the reservoir hill. The schistose foundation is in multitudinous layers, from the thickness of a sheet of paper to, in a few cases, 2 feet. These layers generally have a steep dip into the hill, but there are folds in which the stratification changes its direction or is vertical, or nearly horizontal, and in these folds the harder strata, generally quartzites, were often fractured transversely. Over this treacherous, seamy and uncertain foundation was the surface earth, averaging about 10 feet in thickness, evidently largely the result of decomposition and weathering of material similar to that described. The variation of the schist in color was almost as great as in thickness or hardness of the strata. This certainly will not be recognized as especially desirable material in which to excavate the basin of a reservoir, and its adaptability was not improved by harsh treatment resulting from heavy charges of high-power explosives.

"The design and construction of the reservoir were evidently based upon the assumption that all that was necessary was the excavation of a cavity in the sloping hillside, depending primarily upon the assumed impermeability of the material *in situ* to hold water, and providing a rubble masonry core wall laid in cement in the center of the embankments. Although the specifications covered puddle and concrete 'if deemed necessary,' the amount and character of these in place and the wording of the specifications indicate that the above assumption covers the theory upon which the reservoir was planned; it certainly represents the practice followed in construction up to the time we took charge of the work.

"The west compartment of the reservoir which the contractor had attempted to put into service had clayey earth and muck placed upon the bottom as puddle, but none on the side slopes. A portion of the bottom and portions of the sides were covered with so-called concrete, the sides being riprapped with irregular stone, much too small and too loosely laid to be of any real service in a climate subject to the formation of ice in winter. There were numerous interstices between stones which would have formed ample accommodation for muskrats to enter holes which they could rapidly excavate.

"The material upon the bottom was not such as could be accepted as good puddling, much of it being muck, and what was rated as concrete had so little adhesion that it was impossible to obtain a sample block the stones separating like road metaling when attacked by bar or pick. The too liberal use of high explosives had broken up and seriously disturbed the laminated slippery rock in which the excavation was made, and some of the filling and embankment showed evidence of imperfect compacting. The core wall, as constructed, was not impervious, and at one corner the puddled bottom of the reservoir was practically at the natural surface level.

"An attempt had been made to store 20,000,000 gallons in the excavation made in the seamy rock above described with only selected earth (not puddle) covering the rock at the sides, and with a bottom formed of inferior clay, from which top-soil, roots and vegetable matter had not been removed, the thickness of the clay lining ranging from 9 to 20 inches. Where the rock had appeared specially treacherous, a cover of concrete (so called), 6 to 13 inches in thickness, had been placed upon 25 per cent. of the bottom and 15 per cent. of the side slopes, but this concrete was in disconnected patches, protected only by inferior riprap. The reservoir, as described, was expected to hold water to a depth of 30 feet. It failed when less than one-third full."

In the latter part of September, 1897, Mr. Birkinbine was retained to decide how the reservoirs could be made to hold water. Subsequently the work was placed in his hands as chief engineer, and Mr. Henry Birkinbine was employed as resident engineer. The approach of winter and the uncertainty of the old reservoir remaining in service, owing to a severe leak which developed at that time, demanded immediate action to secure some storage capacity. As no satisfactory co-operation could be obtained from the contractor who had done the work, it was undertaken on the company's account and carried out by day labor under the supervision of the resident engineer. Owing to lack of time to repair the whole of one of the new reservoirs before cold weather, it was decided to divide the west reservoir by an embankment and carry the work forward in the northern part of this as long as the weather would permit.

In plowing up the condemned puddle, on the bottom of the new reservoir, to secure a base for the transverse embankment, a team of mules floundered into a large hole loosely filled with quarry refuse. Similar defects were subsequently discovered in other portions of the bottom, which had been considered as finished. An inspection of the outlet pipes showed that they had been laid without baffle walls, and that all of the joints were defective. By working night and day the division embankment was constructed and the bottom and sides of the reservoir were puddled with satisfactory clay, so as to hold water to a depth of 12 feet, before cold weather stopped operations. Late in December, 1897, water was admitted to this temporary section of the reservoir upon the bare puddle, without covering of any kind, and the city was supplied from this for 10 months.

An examination of the puddle after the water had been withdrawn from this temporary reservoir, showed that the surface for a depth of 1½ to 2 inches was soft, but considerable force was necessary to press a sharp round-end shovel its depth into the clay, and the material at the shovel's point appeared as dry as when first put in place. Beyond some slushing on the sides, due to the action of the wind, frost and ice, the puddling stood remarkably well; repeated examinations and tests checked by pumping records, failing to indicate any leakage whatever. While this temporary reservoir was in use repairs were made on the rest of the western and on the eastern reservoir. Owing to the previous shattering of the schistose rocks, it was necessary to lengthen the remaining portion of the western reservoir and the eastern reservoir was shortened and widened to utilize the excavation and embankments already made. The best portion of the rock removed was laid as a support to the core wall in the division embankment, and against the unfinished core wall of the eastern reservoir. This was laid dry and grouted with clay. Open seams in the rock in the excavation were cleaned out and grouted with cement, and the disturbed strata were faced with stone laid in cement and stepped back to correspond with the inner slopes. The dry stone walls in the east compartment were protected with selected earth well compacted and covered with puddle. In making the earth banks and laying the puddle the materials were spread thinly with shovels and constantly rolled with light grooved rollers.

After the puddle was dressed to its proper slope or level it was covered with a 3-inch layer of coarse sand, made by crushing some of the harder rock excavated, on which red brick were laid dry. No cement was used in laying the brick, except in forming the inlet aprons, the effluent supports, the skewback at the bottom of the slopes, in finishing the top coping and in dressing up inequalities. The bricks in the bot-

tom were lightly grouted with cement, not to produce impermeability to water, but to fill voids which would make the burrowing of crayfish difficult. The bricks were laid on edge on the side slopes, and flat on the bottom. The clay lining is 2 feet thick on the bottom, decreasing on the slopes from 2 to 1½ feet, and is depended on to make the reservoirs impervious.

The effluent pipes in the western reservoir were recalked from the inside, baffle walls were built and puddle was liberally used about the pipes. To withdraw the water from the eastern reservoir an effluent main was laid against the inner slope. This consists of a series of 42 pipes, fitted with three sliding gates so as to draw the water at 4, 12 or 20 feet above the bottom. Removable screens were placed within the pipes. A mushroom fountain was erected at the reservoirs to utilize the head due to the summit in the force main and to improve the water by aeration.

When the water from the new reservoir was turned into the distribution pipes many breaks occurred, owing to the increased head, although the change of pressure was made gradually by districts. Some pipes were split, pieces were blown from others, and a number of imperfectly-secured fire hydrants, defective valves and poor joints were discovered. The water company supplied regulating valves to be placed on the service pipes at the expense of the consumers, and thus reduced the damage to private connections.

THE NEW HIGH-SERVICE SYSTEM, LAWRENCE, MASS.

A high-service water system has been put in service in Lawrence, Mass., to supply two residential sections of the city, portions of which were too high to receive adequate fire protection from the old reservoir, while a part of one hill, which is now coming into the market for house lots, was 40 feet above the water in the old reservoir. On the highest part of the land in the section supplied by the high-service system a short distance from the reservoir and near the westerly boundary of the city a stand-pipe was built 30 feet in diameter and 102½ feet high. It is connected with the old pumping station about a mile away on the river bank at the foot of the hill on which the stand-pipe was built by a 16-inch force main which runs through one of the high-service districts, and with which is connected at various cross streets the pipe system of that district. A 12-inch pipe, also branching from this 16-inch force-main, runs about two miles across the valley in which the principal part of the city stands, and is connected with the pipe system of another hill which forms the easterly boundary of the city. The stand-pipe is of steel, and is surrounded by an octagonal tower of masonry. It has a capacity of about 530,000 gallons.

By the requirements of the specifications for the stand-pipe the material is soft open hearth steel, containing not more than 0.06 per cent. phosphorus, has an ultimate tensile strength of not less than 54,000 nor more than 62,000 pounds per square inch, an elastic limit of not less than one-half of the ultimate strength, an elongation of not less than 26 per cent. in 8 inches, and a reduction of area of not less than 50 per cent. at fracture, which was silky in character. The steel, in test specimens, was required to bend flat upon itself without sign of fracture. The section of the specifications covering the construction was carefully drawn as to the punching of the rivet holes, the location, size and pitch of the rivets, which are of the best grade of soft charcoal iron, and the calking, which was done with a round-nosed calking tool. The courses are arranged in telescope fashion, the bottom of each course being inside the course below. The horizontal joints are single riveted. All the vertical joints are butt joints, with varying thicknesses of covering plates, and all but those in the five upper courses are double riveted. The side plates are connected with those forming the bottom by a 6-inch angle iron ring, and the top course is stiffened by a 3-inch angle iron ring riveted on the inside at the top. This top angle iron is placed with the edge up so as not to interfere with the hooking on of a tackle attached to a swinging stage which may hereafter be required in painting.

A plate ⅝-inch thick and one ½-inch thick reinforce the openings around the force-main and the manhole, respectively, securely riveted to the inside of the shell. The manhole is 18x24 inches in size, and is located on the lowest course, opposite the door in the masonry tower. There are no ladders or pipes located inside the stand-pipe to be injured or broken by the rising or falling of ice. A 10-inch overflow pipe leads from a point 100 feet above the bottom, passes down the outside of the stand-pipe and discharges into the reservoir, which is located about 450 feet away.

The force-main passes through a special bell casting near the middle of the stand-pipe, and projects 3 feet above the bottom, so that mud which may have accumulated on the bottom of the stand-pipe cannot be drawn back into the pipe lines. A 4-inch drainage pipe allows the mud to be drawn off into a drain pipe, which discharges on the surface of the ground some

WATER-TOWER AT LAWRENCE, MASS.

distance from the tower, and by another connection with the overflow pipe, this 4-inch pipe can be employed if occasion requires to discharge the entire contents of the stand-pipe into the reservoir. The courses build practically 5 feet each, except the two at the top. There are 21 round-about courses varying in thickness from ⅞-inch at the bottom, and decreasing by 1/16-inch at each change of thickness to ¼-inch for the five courses at the top. All the metal received three coats of "Durable Metal Coating" and the inside of the bottom four coats.

The bottom of the stand-pipe and the first round-about course were riveted together on a platform of barrels resting on top of the masonry foundation, and, by means of jack-screws placed under eight wrought-iron brackets bolted to the vertical joints through rivet holes left unfilled for this purpose, were then lowered and bedded in dry cement and sand mixed in equal parts. Seventeen barrels of Egypt Portland cement were used. The ingredients were used in a dry state, because of the difficulty of covering a circle 30 feet in diameter with mortar without part becoming set before the bottom could be lowered and properly leveled and bedded. It was also considered impossible to grout the joint between the metal and masonry, and be sure of the grout reaching to every cavity. After the bottom was lowered pins were driven into the top rivet hole of each of the eight vertical joints, and the tops of these pins were brought to a level with each other by the jack-screws to secure a plumb structure. After the leveling was completed the cement and sand were solidly rammed under the stand-pipe with long sticks and the jack-screws were removed.

The masonry foundation extends 9 feet below the bottom of the tank; under it to about the center runs a gallery 6 feet high and 6 feet wide, in which are located the various pipes and valves connecting with the stand-pipe. Access to this gallery is through a manhole covered with an ordinary sewer manhole cover. The floor of this gallery is cement concrete, 1 foot thick, which extends under the whole of the masonry foundation, and this rests on the natural hard pan soil. The stand-pipe is not bolted to the foundation, as this was considered unnecessary, owing to the outside tower.

To prevent collapse from wind pressure during the winter of 1896-97 before the masonry tower was built, angle irons were placed across the top of the stand-pipe, radiating from the center to eight points in the circumference. These consisted of two 6-inch angle irons crossing each other at right angles, and between them at their junction was placed a circular wrought iron plate about 2 feet in diameter and ½-inch thick. From this plate run 3-inch angle irons dividing the right angles made by the 6-inch angle irons. These angle irons are all bolted securely to the circular plate at the center and to the angle iron originally placed around the top of the tank.

The masonry tower around the stand-pipe is of brick and stone, the first 27 feet above the ground being of broken granite ashlar and the remainder of brick with granite trimmings. Above the stand-pipe is a balcony, the sides of which have brick arches supported by granite columns. A circular tower, 6 feet inside diameter, projects from one side of the octagon and encloses a spiral iron stairway. The walls are 2 feet thick at the bottom and 16 inches thick just below the floor of the balcony, battering on the outside and being plumb on the inside. Above the balcony they are 12 inches thick. The doorway giving entrance to the tower is an ornamental granite archway. Narrow windows with irregular granite quoins, double sashed to keep out the cold, admit light to the interior. Between the ground and the balcony level there are five landings in the stairway, at each of which is a doorway, closed with an iron lattice, opening into the tank room. The balcony floor is supported on 20-inch iron beams and covered with asphalt, a scuttle in one corner giving access to the stand-pipe and the space around it. The floor of the balcony is about 107 feet above the ground, the top of the roof about 138 feet, and the top of the finial about 157 feet. To secure the main roof from being lifted by the wind 1¼-inch iron bolts just inside the walls run from the eight corner rafters to an iron plate set in the walls just above the balcony floor and projecting from the walls only enough to receive the bolts. This plate is fastened by eight bolts running about 1½ feet down into the brick walls. The roofs of the towers and the space, about 4 feet wide, immediately below the balcony windows are covered with copper.

The thicknesses of the force mains and supply pipes are the same as those adopted by the Metropolitan Water Board of Massachusetts and vary from 0.65 to 0.81 inch for the 16-inch pipe and from 0.61 to 0.69 inch for the 12-inch pipe. The pipes were coated with coal pitch varnish according to Dr. Angus Smith's process. The length of the 16-inch force main from the face of the front wall of the pumping station to the top of the pipe outlet in the stand-pipe is 5,365 feet. The length of the 12-inch main from the force main to the old system of pipes is 10,-872 feet. A Venturi meter was placed on the force main near the pumping station.

The pump used in supplying the stand-pipe was built by the Barr Pumping Engine Company of Philadelphia. The general design is of the vertical cross-compound type with differential plungers. The steam end consists of two separate vertical engines of the Corliss type with a single shaft and fly wheel between. The steam and exhaust valves are of the rotary Corliss type. The suction inlet and delivery outlet are each 16 inches in diameter. The high pressure cylinder is 18 inches and the low pressure 36 inches in diameter. The water plungers are 9¼ and 13 inches in diameter, and the length of stroke is 24 inches. The capacity in 24 hours at a piston speed of 160 feet per minute is 1,500,000 gallons. The stand-pipe and pipe lines were designed by and the whole work constructed under the supervision of Mr. Arthur D. Marble, the city engineer. Mr. Albert F. Noyes was consulting engineer up to the time of his death. Mr. George G. Adams, of Lawrence, was the architect of the tower. This information has been obtained from the reports of Mr. Marble in the reports of the Lawrence Water Board for the years 1896 and 1897. Mr. A. H. Salisbury is superintendent of the water-works.

THE CLARIFICATION OF RIVER WATERS.

The removal of material in suspension, in addition to bacteria, in river waters used as sources of water supply is a subject which is interesting the officials in charge of the water supplies of many cities and towns. Mr. Allen Hazen, Assoc. M. Am. Soc. C. E., recently discussed it in a paper presented to the Franklin Institute, from which the following information has been taken:

Public water supplies from rivers contain two classes of substances which injure their appearance; peaty coloring matters and mud. Muddy waters are often spoken of as colored waters, and, in a sense, this is correct where the mud consists of clays or other materials having distinct colors; but it is more convenient to classify impurities of this kind as turbidities only, and to limit the term colored waters to those containing dissolved vegetable matters which color them. Colored waters are usually drawn from water sheds, where the underlying rock is hard and does not rapidly disintegrate and where the soils are firm and sandy, and especially from swamps. The water here comes in contact with peat or muck, which colors it, but is so firm as not to be washed by flood-flows and so does not cause turbidity. Large parts of the United States have for rock foundations shales or other soft materials, which readily disintegrate when exposed, and form clayey soils readily washed by hard rains. Waters from such watersheds are generally turbid and very rarely colored. In fact, a water carrying much clay in suspension is usually found colorless when the clay is removed, even if it were originally colored. It thus happens that waters which are colored and turbid at the same time rarely exist in nature. The removal of either color or turbidity may be called clarification. Color-producing and turbidity-producing materials are different in their natures, and the methods which must be adopted to remove them are different. The removal of turbidity only was discussed by Mr. Hazen in his paper.

Turbidity is caused by the washing of a heavy fall of rain after the surface-soil has become saturated. The impact of the rain-drops upon the soil loosens its particles and the water flowing off carries some of them in suspension. The particles carried off in this way are extremely small. Mr. George W. Fuller, in his report on water purification at Louisville, estimates that many of them are not more than 0.00001 inch in diameter. They may be present in water to such an extent as to form more than 0.001 of its weight. The degree of turbidity of a stream is measured in a very simple manner. A piece of platinum wire is forced into a stick and then pushed down into the water under examination until it disappears from view. The reciprocal of the depth in inches at which the wire disappears is the degree of turbidity. The stick is graduated to read the degree of turbidity directly. For the greatest accuracy it is necessary that the observations should be taken in the open air and preferably in the middle of the day, when the light is strongest. In case the sun is shining the wire must be kept in shadow and not in the direct sunlight.

The conditions which control the turbidity of any brook are numerous and complicated. Generally speaking, the turbidity of a river depends directly upon the turbidities of its feeders, and is not affected materially either by erosion of its bed or by sedimentation in it. There are, of course, some streams which cut their banks in times of great floods, and all streams pick up and move about from place to place more or less of the sand and other coarse materials on their bottoms. The materials thus moved, however, have but little influence on the turbidity. These conditions are well illustrated by a few data upon the turbidity of three Pennsylvania streams recently collected.

One of the streams is a small brook having a drainage area of less than 3 square miles. The observations extend over a period of 47 days. During this time there were five floods, or an average of one in ten days. The duration of floods was less than 24 hours in each case. Selecting the days when the turbidity was highest, to the number of one-tenth the whole number of days, the sum of the turbidities for these days was 67 per cent. of the aggregate turbidities for the whole period. That is to say, 67 per cent. of the whole amount of mud was in the water of only one-tenth of the time, the other days containing only 33 per cent. The average turbidity for the flood days was eighteen times as great as the average turbidity for the remainder. The next stream is a considerable creek, having a drainage area of 350 square miles. The observations extended over 117 days, during which time there were seven floods, or an average of one in 19 days. The floods lasted in each case one or two days, and the sum of the turbidities for the tenth of the whole number of days when the water was muddiest was 55 per cent. of the aggregate of all the turbidities for the period. The last set of observations was for a large river with a drainage area of over 11,000 square miles, and extended over a full year. In this period there were 16 floods, each lasting from one to six days, and the sum of the turbidities for the tenth of the whole number of days when the water was muddiest was 45 per cent. of the aggregate turbidities for the year. The floods occurred on an average of once in 22 days, and the average duration was 2½ days.

The results show that a very large proportion of the mud is carried by the water in flood-flows of comparatively short duration. They also show that in small streams the proportion of mud in the flood-flows is greater and the average duration of floods is shorter than in larger streams. In other words, the differences between flood and low water flows are greatest in small streams and gradually become less as the size of the stream increases.

When a stream is used for water-works purposes in the usual way, a certain quantity of water is taken from the stream each day, which quantity is nearly constant, and is not dependent upon the condition of the stream or the volume of its flow. The proportions of the total flows taken at high and low-water stages are very different, and it thus happens that the average quality of the water taken for water-works purposes is different from the average quality of all the water flowing in the stream. Assume, for example, a stream having a water-shed of such a size that in time of moderate floods water from the most distant points reaches the water-works intake in 24 hours. Assume further that rain-falls of sufficient intensity to cause floods and muddy water occur, on an average, once in ten days, and that the turbidity of the water at these times reaches 1.00, and that for the rest of the time the turbidity averages 0.10. Assume further that at times of storms the average flow of the stream is 100 units of volume, and for the nine days between storms the average flow is 10 units of volume. In a 10-day period there will be for one day 100 volumes of water with a turbidity of 1.00, and nine days with 10 volumes each, or a total of 90 volumes of water, with a turbidity of 0.10. The total discharge of the stream will then be 190 volumes, and the average turbidity 0.57. The turbidity of 0.57 represents the average turbidity of all the water flowing in the stream, or in other words, the turbidity which would be found in a lake if all the water for ten days should flow into it and become thoroughly mixed without other change. In computing the average turbidity of the water taken from the stream for water-works purposes, assume the plant requires one volume each day. Then for the first day, water with a turbidity of 1.0, and for nine days water with a turbidity of 0.10 will be obtained. The average turbidity of the water taken by the works for the period is thus only 0.19 in place of 0.57, the average turbidity of the whole run-off.

By doubling the length of the water-shed and assuming and working out an example in a similar manner, the length of time during which the water is turbid is doubled and the average turbidity of the water taken for water-works purposes is increased from 0.19 to 0.26, although the average turbidity of all the water running off remains exactly the same. If a water-shed is assumed so long that three days are required for the water from the most remote points to reach the intake, with computations as before, water taken for water-works purposes will have an average turbidity of 0.32; and with still longer water-sheds this amount will increase, until with a water-shed so long that 10 days are required for the water from the upper section to reach the intake, the average turbidity of the water taken for water-works purposes will reach the average turbidity of the run-off, namely, 0.57. In these computations the numbers taken are round ones, and would not represent actual conditions. They serve, however, to illustrate clearly the principle that the larger the water-shed, other things being equal, the more muddy will be the water obtained from it for water-works purposes, and the longer will be the periods of muddy water, and the shorter the periods of clear water between them.

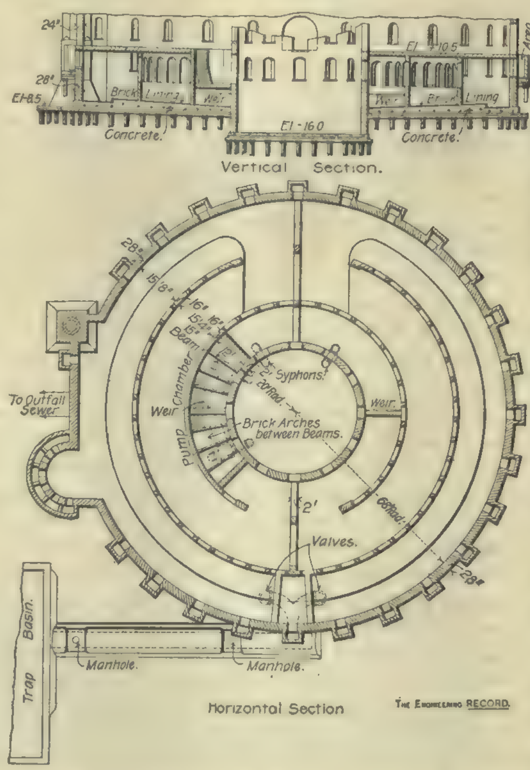
Reservoirs serve two purposes in connection with water drawn from streams; they allow sedimentation and they afford storage. If a water having a turbidity of 1.00 is allowed to remain in a sedimentation basin for 24 hours, the turbidity may be reduced by as much as 40 per cent. If it is held a second day the additional reduction is much less. If samples are taken of the water in the reservoir before and after settling and sent to a chemist for analysis, he will probably report that from 70 to 80 per cent. of the suspended matters have been removed by the process. These are removed in much larger ratio than the turbidity, because there is a certain proportion of comparatively coarse material in the water, as it is taken from the river, which increases the weight of the suspended matters without increasing the turbidity in a corresponding degree. In 24 hours the coarser materials are removed completely and at the end of that time only the clayey or finer particles remain in suspension. It is these clayey particles, however, that constitute the turbidity which is most objectionable in appearance, and which is most difficult of removal by filtration or otherwise. Sedimentation thus removes the

heavier matters from the water, but it does not remove the finer matters, which principally affect the appearance of the water and are otherwise more troublesome. The economical limit of sedimentation is about 24 hours, and the clayey material remaining at the end of that time can hardly be removed by further sedimentation.

Next consider the effect of a sedimentation basin or reservoir holding a 24 hours' supply of water, into which water is constantly pumped at one end, and constantly withdrawn from the other, upon the water of a stream of such size that the time of passage from the feeders to the intake is less than 24 hours. During the period between storms the water is comparatively clear and passes through the sedimentation basin without change. When a storm comes the water in the stream promptly becomes muddy and muddy water is supplied to the reservoir; but owing to the time required in the passage through it, the outflowing water remains clear for some hours. There is a gradual mixing, however, and long before the expiration of 24 hours, somewhat muddy water appears at the outlet. The turbid water period rarely lasts in streams of this size more than 24 hours, and at the expiration of that time the water in the sedimentation basin is as muddy or muddier than the water flowing in the stream. After the height of the flood the stream clears itself by the flowing away of the turbid water much more rapidly than the water clears itself by sedimentation in the reservoir. Generally the improvement in the stream is several times as rapid as in the sedimentation basin. The latter thus for eight days of clear water has done nothing. For the day of the flood very much clearer water has been obtained from it than was flowing in the stream. For the day following the flood the water in the basin has been muddier than the water in the stream. The only time when the basin has been of use is during the first part of the flood and then its use has been principally because of its storage capacity. It is thus seen that under these conditions storage is much more important than sedimentation. In this case if the reservoir is used for storage instead of sedimentation the average quality of the water can be greatly improved. It should be kept full during clear-water periods, and pumping to it should be stopped whenever the turbidity exceeds a certain limit and the reservoir drawn from for the supply until the turbidity again falls to the normal. As the stream becomes larger and the turbid periods longer the size of the storage reservoir necessary, becomes larger.

But neither storage nor sedimentation is capable of adequately removing mud from water. The process can only be finished by either sand or mechanical filtration. With either of these methods the difficulty in treatment increases nearly in direct proportion to the turbidity, and it is highly important to secure a water for filtration with as little turbidity as possible, and to develop to their economical limits the preliminary processes of storage and sedimentation.

One of the agencies in filtration which lead to the removal of turbidity is the straining action, which consists in stopping particles too large to go through the passages in the filter. This is an important element, but it is never adequate in itself. If the passages of a filter are so small as to stop even tolerably well the finest particles of sediment they are so small as to make it impracticable to get adequate quantities of water through them. Any filter which acts as a strainer can remove only the larger particles and not the smaller ones, which so largely constitute the turbidity. The next agency of importance in the work is adhesion. When the particles of suspended matters are carried into contact with the filtering material, many of them get close enough to adhere to it and remain fixed, while the water flows on without them. Closely connected with adhesion, but differing from it, is sedimentation taking place in the pores of the filter. In the removal of suspended matters from water by sedimentation, it may be assumed that owing to its weight and the viscosity of the water, each particle will make a certain rate of progress downward through the water. With the smaller particles this rate of progress is extremely slow and with a sedimentation basin several feet deep many days may be required for a particle to reach the bottom. If a basin is filled with coarse gravel or other loose material through which the water flows very slowly, particles have to settle only to the first stone or other obstruction with which they come in contact. It thus happens that by putting water through material so coarse that no straining whatever can be conceived as taking place, the improvement in its appearance may nevertheless be quite marked. In a filter the conditions for sedimentation are still further improved. The spaces between the sand grains are extremely small, and the course of a particle from any point in the interstices to the



SEWAGE TREATMENT WORKS, BROOKLYN.

sand grains next below is very short. When a particle strikes bottom it is perhaps assisted in remaining there by adhesion, especially where the grains of filter sand have accumulated organic growths more or less sticky in their nature. Sedimentation in the filter beds thus becomes an important factor in clarification. It is essential for these processes that the rate of filtration shall not be so great as to sweep the particles forward when they come in contact with the filtering material instead of allowing them to remain upon it.

These agencies constitute the clarifying power in sand filtration without coagulant. In mechanical filtration the rate is greatly increased, and all of these agencies, especially the last two, are very much limited in their action. But a fourth agency, coagulation, is introduced. The most common and successful coagulant is sulphate of alumina. Waters to be treated with it generally contain lime in solution as calcium carbonate. This reacts with the sulphate of alumina, forming calcium sulphate, which remains in solution, and aluminum hydrate, which forms a flocculent precipitate. This surrounds and gathers together the finest particles in the water and forms them into aggregates, which are removed by straining much more readily than the separate particles can be removed. One of the essential conditions of success in the use of a coagulant is that the raw water shall contain more than enough lime to decompose the sulphate of alumina applied. The flood-flows require much larger quantities of coagulant for their clarification than do the waters at other times, and they usually contain much less lime than the normal flows. It thus becomes an important question whether the flood-flows of a given stream carry enough lime to decompose the sulphate of alumina necessary for their clarification, and it may happen that serious difficulties will be encountered at these times, even with waters which ordinarily present no difficulties in this respect.

Regarding these two systems of filtration, it can be said that, within certain limits, each is capable of removing mud satisfactorily. In filtration without coagulant the rate of filtration must not be too great, especially with very turbid waters. It is more difficult oftentimes to remove the finest clay particles than to remove the bacteria; and to secure clarification, rates of filtration must be employed lower than would be necessary for bacterial purification.

CHEMICAL SEWAGE TREATMENT, BROOKLYN, N. Y.

A plant to dispose of the sewage of a portion of the Borough of Brooklyn was completed in May, 1898, and has been in operation since that time. The system used is that of chemical precipitation and purification, as patented by Mr. James J. Powers. The portion of Brooklyn contributing sewage to this plant lies between Jamaica Bay and the ridge known as the "backbone of Long Island," which crosses the city. From the ridge to the bay is about two miles, and this tract is quite flat, except on the ridge. The improved portion of this district is near the ridge, and some distance from the point of disposal, necessitating a considerable length of sewers through unsettled streets. Owing to the fish and oyster industries, the raw sewage could not be turned into the bay, and so chemical treatment was adopted.

The plant is situated near the shore of the bay, and is housed in a circular brick building about 140 feet in diameter. The sewage is brought to it in a twin sewer, each half of which is equivalent to a circle 132 inches in diameter. This discharges into a rectangular basin, measuring 60 x 80 feet, and located outside the building. Directly opposite the inlet of this basin is the storm-water overflow and outlet. In times of ordinary flow the sewage is turned into a channel at the side of the basin leading to the building. The accompanying illustration is a plan and section of the building, and also shows a portion of the trap basin. In the center of the basement of the building is a pump well 40 feet in diameter, and the remainder of the basin is divided into two settling tanks. At the entrance to the building the sewage may be turned into either tank by means of valves. As shown in the figure, each tank is divided by brick walls into three semicircular channels, through which the sewage runs to the pump well. The sewage flows through the tank at the rate of about 8 or 9 feet per minute, and passes under two dip boards, through two screens and over a weir. It remains in the treating works about 40 minutes.

The chemicals used are lime, per-chloride of iron, and chlorine. The lime is mixed with water and added to the sewage in the form of milk of lime. The most of it is added to the sewage in the channel leading from the trap-basin to the building, but tanks are arranged inside the building so that lime may be added there if necessary. One barrel of lime is used to each 200,000 gallons of sewage pumped. The perchloride of iron is mixed with water and added inside the building at the rate of about one pound to each 3,500 gallons of sewage. The chlorine is made in generators situated on a platform over the pump-well, and is conveyed

to the sewage through pipes laid on the bottom of the channels in the settling tanks. These tanks are about 3 feet deep, and the chlorine is delivered to them under a pressure of about one foot, so that the whole of the gas is taken up by the sewage and does not escape to the air. In making the chlorine, 216 pounds, by weight, of sulphuric acid, an equal amount of water, 96 pounds of oxide of manganese and 128 pounds of salt are used to each 4,000,000 gallons of sewage.

The sewage passes from the settling tank to the pump well through syphons. To lift the sewage from the pump well to the outfall sewer there are two Worthington triple-expansion engines, each with a capacity of 10,000,000 gallons in 24 hours. To furnish the steam for these engines there are three Peck horizontal, tubular, internally fired boilers of 150 horse-power each. The total lift of the sewage is 17 feet. The outfall sewer is a wooden flume open on top and discharging into Jamaica Bay. About once a week the settling basins are emptied and the sludge removed by pumps for that purpose. They are then carefully cleaned and disinfected. On the bottom of the basins is a track on which cars are run for collecting the sludge, which is not removed by the pumps. The effluent is clear, with no odor and practically no suspended matter. No chemical or bacteriological tests have been made to show the efficiency of the treatment.

This plant cost $250,000, and the cost of maintenance is between $30,000 and $35,000 per year. The area contributing sewage is about 3,200 acres, and has a population of about 52,000 people. Seventy-two miles of sewers were built at a cost of about $1,972,000. At the present time the plant is treating about 4,000,000 gallons of sewage in 24 hours, and can treat as much as 5,000,000 gallons in that time. This information has been obtained from the reports of the Department of City Works of Brooklyn for the years 1895 and 1896, and from Mr. Henry R. Asserson, chief engineer of the Department of Sewers in the Borough of Brooklyn.

THE EXETER SEPTIC TANK SYSTEM.

The first instance of the septic tank system sewage treatment on a fairly large scale was at Exeter, England, and in "The Engineering Record" of October 16, 1897, there was printed an explanation by Mr. Donald Cameron, city engineer of that place, of the reasons which led him to design these works. In view of the very general interest in these early works, the following extracts are printed from a paper by the same gentleman, prepared for the Sanitary Institute, in which he detailed the experience with the permanent plant at Belle Isle, Exeter, where the sewage from about 1,500 persons is treated.

The works were designed for a maximum flow of 81,180 imperial gallons per day and supersede the experimental plant, which for some time previous had been dealing with a portion of the sewage. During the drought of 1896 careful gaugings were made of the flow of the St. Leonards sewer. The daily quantity was found to be 35,000 imperial gallons, the maximum flow taking place at 10.30 in the morning, when it was at the rate of 81,180 imperial gallons per 24 hours, or 2.3 times the normal flow. On August 15, 1896, the permanent works were finished, the tank being completed first and filled. After some preliminary experiments, to ascertain the water capacities of the filters, the plant was set with regular work on August 21. From the 25th a record of the filter discharges has been kept.

The installation, which embodies several improvements suggested by the previous experiments, consists of one tank 64 feet 10 inches long by 18 feet wide by 7 to 7 feet 9 inches depth of water (10 feet deep at the grit chambers), and of five filters, four of which form the working set, one being held in reserve to permit of each filter in turn having a period of rest. The sewage flowing into the tank is subjected to no screening whatever; on the contrary, special provision was made for the uninterrupted passage to the tank of the contents of the sewer. To obtain this condition the pipe to the tank intercepting the sewage was made of such a size and laid at such a gradient as to convey a quantity of sewage and storm water not exceeding 125,000 imperial gallons a day, thus obviating the necessity for a regulating valve or penstock. The main sewer was cut across to a depth of 8½ inches below its invert, a cement weir being put in the pipe on the downstream side of the cut. The pipe to the tank is led away from the bottom of this cut, 16½ inches below the crest of the weir. At the inlet to the tanks are two grit chambers, 10 feet deep, and the inlet pipes are carried half-way down these chambers. The outlet from the tank is by a pipe, with a slot cut in its side, extending the full width of the tank, and terminating in a gauge-well outside it. The gauging is done by one of the late Prof. James Thomson's V-notch gauges. In speaking of the different stages of the work done it has been found convenient to call the flow from the tank the effluent, and the discharge from the filters the filtrate. The effluent after flowing from the gauge well passes into a shallow aerating trough, over the sides of which it falls in thin sheets into channels leading to distributing wells. In these wells valves are placed, controlling the flow to the distributing channels on the surface of the filters.

The filters have each an area of 80 square yards and a depth of 5 feet. Collecting drains are laid on the bottoms of the filters, joining main collectors, the latter terminating in discharging wells. In the case of filters Nos. 1, 2, 4 and 5 the filtrant is broken furnace clinker, and in that of No. 3 broken coke. Filtration with these filters is not by a continuous flow in and out, but when the filter is receiving its dose of effluent the outlet valve is shut down, so that the filter gradually fills up, and remains full till the next filter is filled, when it is discharged. This was the method adopted by Mr. Dibdin in Barking. During the earlier stages of the experiments leading up to the experimental plant it was evident that an automatic arrangement for filling and discharging the filters was necessary, and the simple arrangement which has made these works independent of manual attention was devised. As the filter fills, the filtrate from it at the same time rises in its discharging well, and from these discharging wells small pipes are led discharging over two pairs of buckets attached to rocking shafts. To these shafts are also attached the valves that control the flow to and from the filters. The filter that has just filled discharges the one standing full, at the same time shutting the outlet and opening the inlet valve of the filter to be filled, and so on. All the manual attention required is when setting to work the resting filter, involving, say, 15 minutes' work at intervals of two or three days. The quantity of sewage dealt with during the 12 months amounts, in round numbers, to 20,000,000 imperial gallons, or an average of nearly 54,000 imperial gallons a day. During the latter half of February the flow was 82,681 imperial gallons a day; during April, 73,576, and the first 25 days of August, nearly 38,000. The quantity dealt with during the year is 371 times the contents of the tank, on the floor of which it would form a depth of 2,848 feet.

The works throughout are constructed of concrete, with a concrete arch over the tank. In the arch are placed air-tight manhole covers and plugged openings for taking samples and for measuring the depth of deposit; and in the body of the tank an inspection well, in the sides of which are placed glass windows to enable the contents of the tank to be viewed. The only outlet from the tank is by the slotted pipe, which is situated 15 inches below the water level. On the top of the sewage in the tank a scum is formed, consisting of the floating matter undergoing decomposition. During the winter this scum attained a thickness of from 3 to 4 inches, forming a rugged and coherent layer of considerable toughness, the surface of which was covered with a variety of fungoid growths; but as warmer weather set in it gradually dwindled down, until at the present time there is less than an inch of scum over the surface of the tank. The heavier suspended matter, consisting chiefly of road grit, settles at the bottom of the tank, together with the insoluble residue from the decomposition of the sewage solids. Careful measurements of this deposit made on August 31, 1897, show the quantity to be about 66½ cubic yards. The bulk is considerably swollen by the gases which are formed during the decomposition of the organic matter still adhering to the deposit, and which would bring the whole mass to the surface were it not that the residue is heavier than water, and sinks again to the bottom as soon as it is sufficiently loosened to allow the escape of the gas. In addition to its own decomposition, the deposit is thus subjected to a continual washing action, by which it is ultimately reduced to an inert and inoffensive ash. Examination of the deposit in the permanent tank shows its composition to be as follows: Moisture, 88.14 per cent.; mineral matter, 7.91 per cent.; loss on ignition, 3.95 per cent.

The dry solid matter in the tank amounted at the time of examination to about 5½ tons, of which two-thirds are mineral matter, the remaining third being made up of water of hydration, carbonic acid gas and a little organic matter not as yet decomposed. The flow through the tank up to August 31 having been about 20,250,000 imperial gallons, the solid matter in the deposit amounts to 4.3 grains for every imperial gallon which has passed through; adding 0.2 grains for the very small amount of dry solid matter in the scum, we have in the tank 4.5 grains per imperial gallon of flow to that date. The most exhaustive examination of the sewage, as far as suspended solids are concerned, has been made by Messrs. Dibdin and Thudichum, who found in thirteen samples in April and June an average of 24.5 grains per imperial gallon, 10.0 grains being returned as mineral matter and 14.5 grains as organic. Comparing this figure with the amount of solid matter found in the tank, we find that no less than 20 grains per imperial gallon have disappeared, the organic matter in particular having been almost entirely removed. The net loss of dry solid matter over the whole year amounts to about 26 tons, or 81 per cent. of the whole. If, instead of destroying the suspended solids by bacterial agency, they had been converted into sludge, there would have been 556½ cubic yards of 90 per cent. sludge to dispose of, the production being estimated at 1 cubic yard per 1,000 persons per day, the average rate ascertained by Mr. W. Santo Crimp in several cases examined by him. Thus the tank does away with the necessity for chemicals and the filter-press or other apparatus for disposing of sludge and produces an effluent which can be filtered without risk of clogging the filters.

There are, broadly speaking, three ways in which the suspended matter which disappears from the tank is disposed of: 1. The tank effluent, while free from any palpable solid matter, contains a large number of minute dust-like particles distributed through it. These, no doubt, are the product of the constant interchange between the deposit and the scum, caught in its passage near the slotted pipe. No provision has been made for arresting this, and it is carried to the filter with the effluent. It can, however, be very easily arrested, if it should be found to be desirable to do so. The portion of the suspended matter arrested by the filter channels has always, when cleaning them, been returned to the tank. After heavy rain, in addition to the firm particles already referred to, the tank effluent is strongly colored with earthy matter derived from the roads, which is

present in such a finely divided state as to escape settlement in the tank, and even to pass through the filters, imparting its color to the discharge. Any organic particles which reach the filters appear to be retained by the surface film of vegetable matter which forms on the surface, and there destroyed by an action analogous to that which takes place in the tank; at all events there is not the least sign of clogging in the filters, which are now, after a year's working, as clear as on the day they were started, and to all appearance as fit for their work as they were then. 2. A great part of the carbon and hydrogen present in the organic matter are undoubtedly combined with oxygen, also derived from organic compounds, forming respectively carbonic acid gas and water, which pass out with the effluent. 3. The further portion of carbon and hydrogen liberated by the decomposition, in excess of the supply of oxygen available for its oxidation, appears in combination as methane or marsh gas, which, being but sparingly soluble in water, collects in the upper part of the tank. Large quantities of free hydrogen and nitrogen are also liberated, the presence of these elements in the free state showing that the decomposition of the substances yielding them has been carried to the furthest possible point. No trace of sulphuretted hydrogen is found.

No special provision was made for the removal of gases formed in the tank, nor has any such been found necessary, as at no time is there any appreciable pressure, the gases apparently diffusing freely through the concrete arch into the soil above. On lifting the manhole covers there is no smell discernible, unless the nose is brought down close to the opening, and then only a hardly appreciable heavy odor. The only smell apparent is found at the gauge well and aërator, where an ammoniacal smell is sometimes found. As yet the amount of deposit and scum in the tank appears in no way to interfere with its efficiency. The effluent has a slightly milky appearance, and if examined in a test tube in a good light minute dust-like particles are seen distributed through the liquid.

Passing now to the filters, it is easy to demonstrate that their work is not merely a straining action. It is true that any particles in suspension in the effluent are caught on the surface by the film already referred to, but this work is trifling compared with the work done in the body of the filter. Experiments were made on the filter surfaces by lightly raking the surface after resting, and in other cases by allowing the surface to remain untouched; as far as I could learn from this it would appear that the condition of the surface has no influence on the purification. If the condition of the surface were such as to seriously interfere with the aëration of the filtrant, it is conceivable that the results might not be the same. The difficulty of getting the effluent to spread evenly over a filter surface is probably known to most of you; and while the formation of a film may interfere with the aëration, it at the same time spreads the effluent more uniformly over the filter surface, and to some extent prevents its finding its way through the filtrant in a few places or spots, such as close to the distributing channels, alongside the walls, or where the material is coarser than at other parts. During dry weather the film allowed to form on the surface separates itself from the filtrant, breaking up into small saucerlike patches, leaving the filtrant surface beautifully bright and clean. On examining the undersides of these patches a few particles of the filtrant may be found adhering. These observations cannot be carried on for any length of time, especially during the growing season, if it is an object to keep the filters looking trim and tidy, as the seeds blown on the beds soon germinate and grow rapidly, giving the filter a very unkempt appearance. It has been held by English chemists that the film on the surface of water-works filters was not the cause of these filters beginning to purify, but only a coincidence, the film forming about the same time as the filters become seeded with purifying organisms. This, in my opinion, is the correct view of the case. The filtering material employed is so much alike in the case of four out of the five filters as to allow but little range of comparison; but as between the clinker and the coke breeze the results were undoubtedly in favor of the clinker. The difference in the work of Nos. 1, 2, 4 and 5 was very small, and nearly all were equally uniform in their results. The filtering material was intended to be broken to pass through a half-inch sieve and be rejected by a ⅛-inch sieve; but it was actually made somewhat coarser, a great deal of ¾-inch material being put in, while in the bottom of three of the beds still coarser material was used. While the purification effected has been highly satisfactory, I should be inclined to reduce the size of the filtrant. On digging into these filters and on getting something like a section of the material for some depth down, it must have struck any one who saw it how extraordinarily clean and fresh it is right up to the surface; in fact, it would appear almost incredible that between 4,000,000 and 5,000,000 imperial gallons of sewage had passed through each filter. These filters have to do their work, not by uniform regular doses, but according to the quantity flowing, so that most of it is done during the daytime. In the experimental plant it was uniform work, and but little difference was observed between the first and lasts parts of the discharge. In the case of some of the permanent filters the first rush in discharging is somewhat less clear than in the succceeding flow. Samples for analysis were therefore taken in nearly every instance at one, three, six, ten and twenty minutes after the outlet valve opened, these intervals being so chosen as to give equal representation in the same to equal volumes in the discharge, thus insuring a true average sample.

The works have at various times been subjected to the most searching examination by chemists of the highest standard. Visitors to the works freely availed themselves of the opportunity of taking samples for analysis whenever they thought fit to do so. In many cases the results have been published; and in no instance, so far as I know, has the state of the filtered effluent been otherwise than satisfactory. All the samples show a large production of oxidized nitrogen, often exceeding one part per 100,000, which is perhaps the best testimony to the high efficiency of the filters. The filtrate is also rich in dissolved free oxygen, nine samples examined by the city analyist giving on an average 1.15 cubic inches per imperial gallon. As might be expected in a filtrate having these characteristics, the amount of oxidizable organic matter is very small, the oxygen absorbed from permanganate in four hours at 80 degrees Fahrenheit being as a rule well below 0.5 part per 100,000. After the first few months' working the purification effected was quite independent of weather and temperature. A sample taken during the frost of January and analyzed by Dr. Dupré showed nitrogen as nitrate to the extent of 1.577 parts per 100,000, while the oxygen absorbed was only 0.405. While the main purport of this paper has been to describe what has been done at Exeter, yet, seeing that the sewage which has been dealt with has been of a purely domestic origin, it may not be out of place to refer briefly to the results obtained with a manufacturing sewage which has the reputation of being one of the worst in England.

The works at Yeovil, consisting of a tank and three filters, were laid down in the Autumn of 1896 to deal experimentally with 15,000 imperial gallons of sewage per day from a district containing several glove factories, as well as a large brewery and several slaughter houses. The fall available being limited, the filters were not so deep as I should have wished. The tank has from the outset done its work very well, producing a fairly clear effluent. The filters also after settling down to their work effected a considerable degree of purification; but the filtrate at first was not satisfactory, inasmuch as it was deficient in nitrates, in the absence of which purification cannot be regarded as complete. This result was due in a great measure to the coarseness of the filtering material, which was much larger than that at Exeter. Latterly, therefore, a much finer material has been used in a small filter with the most satisfactory results, nearly the whole of the nitrogen present being converted into nitrates, while the oxygen absorbed has been reduced to about 0.3 part per 100,000. On keeping the filtrate, either in covered or open vessels, no change is set up. These results show conclusively that a foul manufacturing sewage is completely under control by this system. These works, which are situated close to a highway and a railway, and in full view of a row of houses within a few yards of the works, have fully confirmed the experience at Exeter by the entire absence of anything constituting a nuisance.

The Exeter installation during its twelve months' work has been subjected to the severest conditions that sewage works have to contend with, and has proved thoroughly reliable in all respects. The trial has been on a sufficiently large scale to give practical results, and is the outcome of experiments, step by step, leading from smaller to larger plants. It has been shown that sewage disposal works can be designed so as practically to take care of themselves, requiring no more attention than a visit on two or three days a week to change or alternate the filters, the work of a few minutes, and a day's work every month or six weeks in tidying the filters. Once a year it may be desirable to remove the deposit from the tank; by proper arrangement this can be done by the one man who acts as caretaker. To local authorities the saving in annual expenditure thus effected is even more important than a corresponding reduction in the first cost of works. At the same time the initial cost of such works as are herein described is very moderate, being less than is often spent in laying out a sewage farm to serve an equal population.

SOME ENGINEERING FEATURES OF A BOSTON SCHOOL.

A new school-house was recently erected in Boston, Mass., under conditions which will doubtless be of interest from many points of view. It is equipped with a system of heating and ventilation which is interesting, and with a plumbing plant, to which, it is stated, considerable attention has been paid; but while the engineering features just mentioned have served for a nucleus about which the present description has been built up, it was thought quite opportune to mention some of the problems which were encountered in the design of the building. Mr. John Lyman Faxon, of Boston, was the architect.

The school-house stands at the obtuse angle formed by the junction of Chambers and Poplar Streets, in a densely populated district of Boston. The lot was somewhat irregular in shape, owing largely to the direction of the two streets, and was rather restricted in area, the architect states, especially for so large a building. The streets mentioned are narrow, and the site was surrounded by buildings in such a way that undesirable drafts and eddies of wind were likely to occur. The building front on the streets, it was also noticed, would face more or less in a northerly direction, and the classrooms were therefore all placed at the backside or south exposure of the building. This arrangement was given weight in order that all rooms might avail of sunlight, not only for the promotion of the health of the pupils, Mr. Faxon says, as "sunlight is good medicine," but also as a good auxiliary in heating.

The Mayhew, or West End School, as it is variously known, is four stories in height, and

has accommodations for 784 pupils. It is entered at its center, through a loggia opening directly into a staircase hall and extends in either direction along the two streets. Facing the entrance and across the hall, are three stairways, one leading down a few steps to the play yard, which is behind the building and partially enclosed by it, and the others ascending on each side to the floors above. The stairways and staircase halls extend up through the building, thus dividing the building into two parts, and are entirely fireproof. The halls are paved with terrazzo floors and sheathed with Olivo marble. The staircases are of monolithic concrete construction, of one, two, five Alsen Portland cement, and are of flying arch design. They are practically self-supporting, it is said, the encircling walls acting as buttresses only.

From the staircase hall, a corridor leads in each direction along the building front, opening at its distant end into spiral staircase for use as an exit in times of fire. The classrooms, of which there are four on each of the first three floors, may be entered from the corridors directly or through wardrobes on the inner side of the corridor. The wardrobes are of the open type, being partitioned off by architectural framework fitted with wire grills. The general arrangement of the schoolrooms, may be seen from Figure 2, which is a plan of the first floor, and typical of the three main floors. There are only two classrooms on the top floor, the building not having been carried up at its ends beyond the third story.

The school-house is warmed almost wholly by a heated supply of fresh air, delivered to the various rooms by a hot-blast apparatus in the basement. The plant was laid out with the same symmetry which the building itself possesses, which was considered as justified by the nature of the outside wind currents, already mentioned. Figure 1, the basement plan, shows the heating plant, which was installed by Mr. A. A. Sanborn, of Boston, from the plans of the architect.

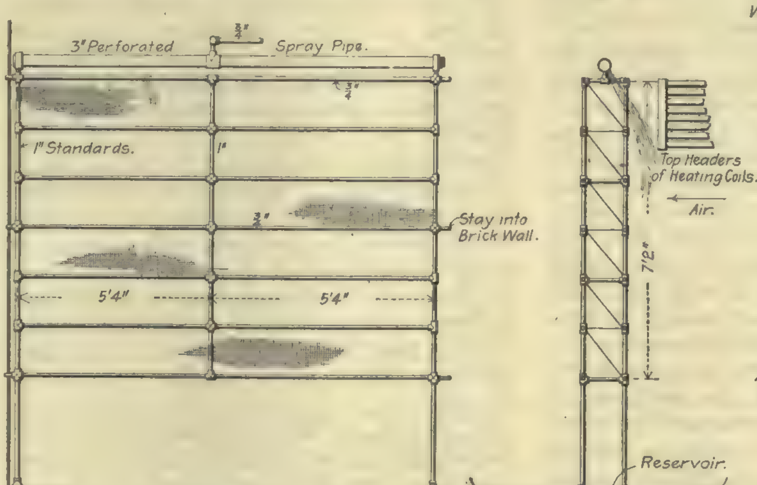
The air passes into the building from the play yard through two openings on either side of the steps, as shown, or it may be taken from about 10 feet above the roof through a vertical shaft, dropping to the basement. A cold-air chamber at this point unites all three of the inlets, and the air passes through heating coils at the inner side of the chamber. There is about 2,000 square feet of heating surface in the coils, but the steam supplied is regulated by thermostats set at 70 degrees Fahrenheit, as it is intended to distribute the air by ducts in the basement to the proper flues at a temperature least liable to subject it to losses by radiation. Beyond the coils and in the rear of the boilers, which may be seen in Figure 2, is a water spray, devised by the architect to arrest dust and other undesirable particles from the heated air. The construction of the spray may be seen in Figure 3. It consists of a frame of wrought-iron pipe, upon which a copper wire of a mesh of 200 to the square inch is stretched so as to afford a large area for screening the air. The spray is supplied with hot and cold water, which is brought to a 3-inch drum suspended above the frame. The drum is pierced with four rows of holes, staggered, and set so that the initial discharge of water is at 45 degrees against the current of moving air. The velocity of the air is sufficient to draw the water in a nearly vertical sheet, forming a continuous water curtain over the surface of the gauze. The architect says the amount of the water used is of little consequence in comparison with the benefits which he considers of most importance.

The air then enters a large duct lying on the brickwork and Portland cement covering the boilers. Notwithstanding the insulation thus afforded, it is said that the air is raised in temperature in its passage over the boilers from 5 to 7 degrees. At the front of the boilers, the duct divides into two branches, which supply the two parts of the building. Fans are placed in each of the ducts, and are of the 9-blade disk type. They are mounted on the one shaft, which pierces the two ducts, so that the fans themselves are entirely hidden from view. The shaft is driven at a speed of about 200 revolutions per minute by belt from an electric motor. The ducts are suspended from the basement ceiling and run as shown to auxiliary chambers where the air is further heated by supplementary heating surface before rising in the flues. There are six flues for each half of the building, twelve in all, one for each of the classrooms on the three main stories. The two classrooms of the top floor have separate branch ducts in the basement, leading to special auxiliary chambers, from which the air rises in the two shafts of trapezoidal section back of the stairways.

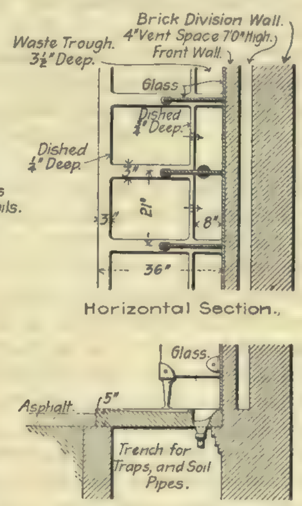
The large heating chambers partially enclose the base of the heating flues, as shown in the figure, and may be divided into two parts each by an iron door. The air may pass from the chambers into the flues through either of two openings, one at the top of the room and the other at the floor. Both of the openings are fitted with dampers of the butterfly type controlled by thermostats, to open one while closing the other. The radiators are suspenued between the two, and are each separated from its mates by galvanized-iron screens, which extend from about the level of the top of the lower opening to the ceiling. The temperature of the air in the flues is thus controlled as desired. Further provision is made to ensure a proper distribution of air to each and all of the flues by dampers, hinged to the bottom of the screens, and projecting against the direction of the air flow to intercept air for their corresponding flues.

Each flue carries the air to a register opening in the side of the room about 8 feet above the floor. The air enters the room with a linear velocity, which, by measurement, was found to be 430 feet per minute, and is delivered in sufficient quantity to change the volume of the room from ten to eleven times per hour.

Two vent registers are located in each room, one at the floor and the other at the ceiling directly above the fresh-air register. The ceiling outlet is provided with valves and is only intended for use in warm weather or whenever the room becomes excessively hot and it is desirable to cool it off quickly. The vent flues are alongside of the fresh-air flues, and rise



Elevation. Section. FIG.3



Vertical Section. FIG.4

THE ENGINEERING RECORD.

DETAILS OF HEATING AND PLUMBING WORK.

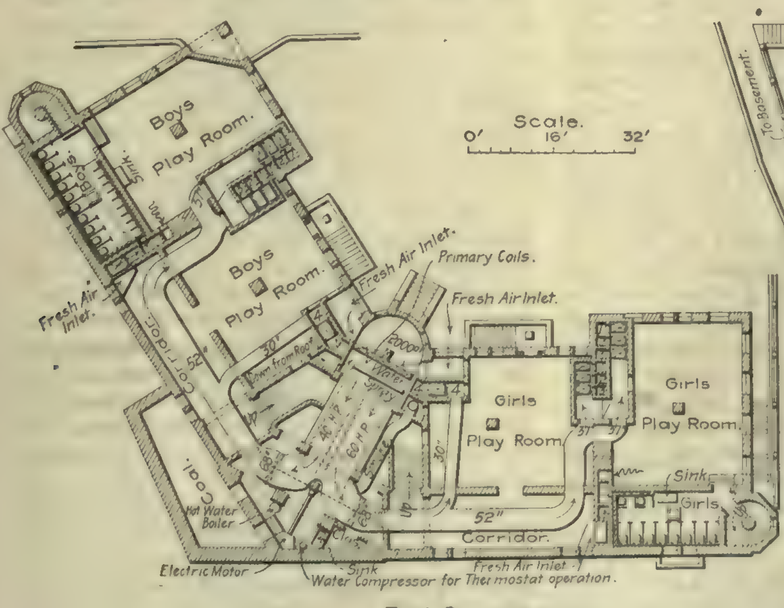


FIG.1 Basement.

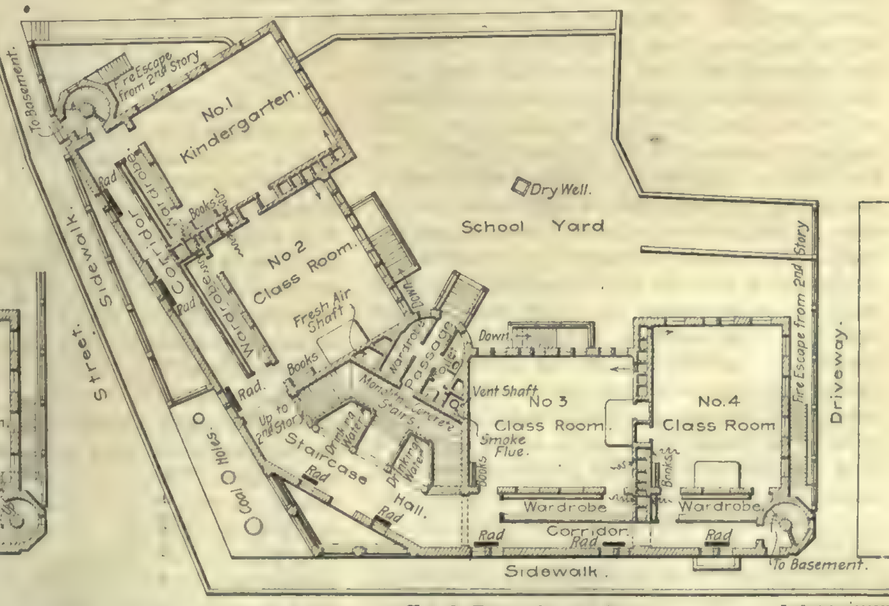


FIG.2 First Story Plan.

THE ENGINEERING RECORD.

FLOOR PLANS OF THE MAYHEW SCHOOL BUILDING, BOSTON, MASS.

MR. JOHN LYMAN FAXON, ARCHITECT.

plumb to a height of about 6 feet above the roof. The sanitaries in the basement are vented in the same way, but the toilet rooms back of the central stairway discharge into the space surrounding the boiler flue, which is designated in Figures 1 and 2. The flue in this shaft thus gives off heat which is utilized in creating a draft of air upward. In the other sanitary and corridor vent flues, special heating surface was installed for the aspirating effect and amounts to about 40 square feet each, placed in the flues above the level of the third-story ceiling. The aspirating surface for the basement sanitaries takes the form of long pipe coils, which are placed lower down in the flues, from the fact that there were no openings above.

The corridors are heated in part by direct radiation, and in part by an indirect apparatus. The fresh air is supplied, however, by natural means, entering the front of the basement from the outside, as shown in Figure 2, passing through a set of radiators, and rising up an adjacent flue. There are two flues, one for each corridor, and each has register openings 8 feet above the floor of each of the three stories. The air is carried out of the corridors through vent registers at the floor of the wardrobes.

The boiler plant consists of two tubular boilers, one of 40 horse-power and the other of 60. Steam is distributed on the gravity system, all returns dropping below the water line. Most of the steam is utilized in the basement, for the various heating coils, and the ceiling coils by which the basement rooms are heated, but a few pipes are carried up through the building for the direct radiators. In the boiler room the temperature of each room is recorded by dial, and each room may be reached by telephone, an arrangement by which, Mr. Faxon puts it, teachers may keep the janitor in touch with conditions, in case he neglects to do so.

In conclusion a reference may be made to the plumbing in the building, which is considered as quite thorough. There are three main lines of soil and vent pipes to the roofs, one in each of the two wall chases, which rise from the corners of the basement sanitaries and the third within the boiler-flue shaft, back of the central stairway. The main line of soil pipes from the basement sanitaries run alongside the corridor walls to the boiler room, where they unite and pass into the coal hole and through a trap in a manhole and thence into the sewer, some 70 feet from the building. The sewer is an old one, and comparatively high in this locality, and necessitated a rise of 18 inches in the level of the floor of the sanitaries above the general basement floor, to obtain a proper pitch. There are 30 water closets in the building, with specially made brass connections to soil-pipe joints. Closets are flushed automatically, and are vented by 2-inch brass pipes connecting each with a vent area back of the ranges. Each of the cabinets are also vented into this area through register openings and the vitiated air is carried off as already described. The urinals, which are shown in Figure 4, consist of foot slabs of Monson slate, with two dishings, one at the standing place of each stall and the other, a trough at the back for each pair of stalls. The trough is drained by a brass waste pipe with a full S-trap connection and vent extension to the roof. The back and division slabs of the urinals are of 1-inch rough plate glass. The urinals are flushed automatically by hot water from a pipe perforated with pinholes, and every other stall has a local vent through a 2-inch brass pipe, which enters a vent area at the back. The plumbing work was installed by I. N. Tucker & Sons, of Boston.

PROPOSED CHANGES IN THE HALL OF THE HOUSE OF REPRESENTATIVES.

A report of the Committee on Ventilation and Acoustics of the House of Representatives, of which Mr. Joel P. Heatwole is chairman, has just been printed, and recommends certain changes in the heating and ventilation of the hall and a radical change in its size and seating arrangement. The matter had been referred to Mr. Edward Clark, architect, United States Capitol, who submitted plans showing the extent of the proposed alterations, referred to letters of a previous investigation by Mr. Henry Adams, heating and ventilating engineer in the Supervising Architect's office, Washington, and Dr. J. J. Kinyoun, passed assistant surgeon, Marine Hospital Service, and transmitted a report on the present status of the case from Prof. S. Homer Woodbridge, of the Massachusetts Institute of Technology.

The changes which are proposed may be briefly summarized. The present chamber, it seems, is 139 feet long and 93 feet wide, including galleries, and is 36 feet high. The floor of the House is 113 feet long by 70 feet wide, and has 360 seats for members and delegates. The galleries will seat 1,184 people. Under the present arrangement, as is well known, each member has a desk at which he may transact the business incident even to his general duties as a Representative, and as a result conversations are constantly carried on, irrelevant to the parlimentary proceedings. The House of Representatives being, therefore, "a noisy body," an effort has been made to bring about a state of affairs wherein a deliberative assembly may be able to so conduct itself that every subject of legislative discussion may be heard and understood by those who are charged with the duty of legislating. The plans propose shortening the present hall from 139 feet to 80 feet, and the present floor to 60 feet, leaving the width in each case as it is. The galleries would, of course, be brought forward to the new line, and the Speaker's, clerk's and official reporter's desks would remain in their present position. The hall as reduced would be seated with benches or seats running parallel with the side walls, one-half facing the other, except those seats which would come farthest from the Speaker, which would face in his direction. There would be no desks, and the seating capacity would be 406. The space subtracted from the present hall would be made into two large retiring rooms for members, and have access to the chamber through fly-doors. These rooms would extend to a skylight roof and to cut them off from the public view, it is intended that the galleries shall be reached through bridge passageways. Other minor changes were recommended.

Mr. Adams, in his report, described the existing heating plant and gave the results of a personal inspection which he made of the apparatus, and of the results of anemometrical observations. His examination, he says, was quite thorough, having crawled through every passage and duct through which it was possible for him to pass. He found that the supply of air was more than fully sufficient for the average number of persons in the House on every-day occasions, and at a rate of 2,000 cubic feet per hour per occupant, would be sufficient for 1,100 or 1,300 people. He considered that the chambers by which the air-supply was to be equalized were faulty in construction, and he found as a result of the repeated changes which had been made in the arrangement of seats and the consequent patching of the floor that there were pockets and corners which should not be in existence. There was therefore little or no air delivered to some parts of the hall, which, he considered, could not but help to produce countercurrents of vitiated air from the galleries to the floor. In one case, indeed, he found a reverse current in an uptake flue amounting to 123 feet per minute. He also dwelt upon the fact that the floor registers through which the upward system of ventilation worked its way, were nucleui of filth, and notwithstanding the frequent cleaning, should not be used as fresh-air inlets. At any rate, the conclusion to which Mr. Adams comes is that the introduction of fresh air through the floor of the House will never be a complete success. In his opinion, the downward method should be used in the hall, and that for this purpose both the plenum and exhaust systems should be employed.

The work of Dr. Kinyoun covered an investigation of the contamination of the air qualitatively and quantitatively. This work was undertaken about five years ago at the same time that Mr. Adams was delegated to make his examination. The results of the investigations showed that the amount of carbon dioxide was never, save in a few instances, in excess of the admissible quantity, but that there were other impurities in addition that might be deleterious to health. Illuminating gas was at all times present in a large quantity. Free ammonia and nitrogenous matters were in excess of the quantity normally present in the atmosphere of a well ventilated room. He found that the cellar was a source of a considerable amount of contamination, due in a great measure to the storage of books in poorly ventilated quarters.

The report of Prof. Woodbridge is the most exhaustive of the three. He outlined in the first place an upward system of ventilating similar in many respects to that already existing for the Senate chamber (see "The Engineering Record" of October 16 and 23, 1897), and later took up the considerations affecting a downward system. He said there was a faulty distribution of air for the present arrangement of the hall, and a faulty method of discharging the "spent air." He considered that the distribution of air to the floor and to the galleries should be on the basis of approximately 3,000 cubic feet per capita per hour to 400 occupants, and 1,500 cubic feet per capita per hour for 1,200 occupants of the galleries. Including a general supply of 600,000 cubic feet per hour for the chamber floor, the total hourly quantity would amount to 3,600,000 cubic feet. "The pressure to be maintained beneath the floor of the hall," he says, "must be gauged by that required to move 30,000 cubic feet of air per minute to the galleries. The aggregate area of the present flues connecting the spaces beneath the chamber and the gallery floors is 30 square feet. This may be increased to 40 square feet. The required velocity of air flow through these flues must, therefore, be 730 linear feet per minute. The pressure needed for such flow is 0.18 of a pound per square foot. Such a pressure would induce a velocity of 730 linear feet air flow through openings made in the chamber floor also, and this velocity must necessarily determine the size of openings needed to give to each desk its quota of 50 cubic feet of air per minute. The opening will be found to equal about 10 square inches." Prof. Woodbridge also spoke of the desirability of providing for a cooling plant for summer months, and cited the experience of a refrigerating system installed in the chamber of the Reichstag in Berlin. He quoted from a letter of Mr. David Grove, the engineer for the plant, who wrote: "For cooling the house the ventilating fans are started at about 3 A. M. and are allowed to run until 7 A. M., when the outside temperature is not above 64.4 degrees Fahrenheit. No further ventilation then takes place until the chambers sit, which is generally about 1 P. M. The ventilators are then set slowly to work, a minimum quantity of air is passed through, according to the attendance, and although the outside temperature last summer ran up to 84.2 degrees Fahrenheit (average maximum temperature for last fifty years was 91.4 degrees), the inner temperature never exceeded 66.2 degrees to 68 degrees Fahrenheit." In the present case, Prof. Woodbridge did not think it would be necessary to cool and dry the air for both floor of the hall and the galleries, but that it was enough that the floor should be cooled and the galleries be given such share in the cooling as might be derived from the cooling of the floor.

For the successful downward ventilation of the hall, he considers that the quantity of air supplied to the hall must be larger for downward ventilation than for upward, because the air brought to the floor by a slowly descending movement of air must, in his opinion, inevitably bring back upon the breathers the currents of vitiated air which ascend from them. "The heat yielded by the body, being nearly that given off by a burning candle, is sufficient to raise 30 cubic feet of air per minute through 10 degrees temperature. The air in contact with the body or clothing, or expelled from the lungs," he continues, "rises in a current which has a far more rapid rate of upward movement than any descending rate which can possibly be given to the mass of air ventilating a hall." The experience gained at the new House of Parliament in Berlin, it is asserted, proves that the upward is desirable. Experiments were made with the down draft and the air in the room was found to be very oppressive. The operation of the plant, which Prof. Woodbridge takes from a report of Mr. Grove, is as follows: "For the sake of economy, for an hour or so before the sitting commences, according to the outer temperature, warm air is let in at the top of the chamber and drawn away at the bottom, there being, of course, no occupants in the chambers at the time to contaminate the air. As the chamber is filled the system is reversed and updraft ventilating takes place, and it has been proved that in sittings lasting from 10 in the morning until 5 in the afternoon, the temperature has not risen more than 1 degree Celsius in any part of the chamber, although it may have been crammed to excess."

On the subject of ventilation and acoustics, Prof. Woodbridge has this to say: "Sound waves are disturbed by travel through air of unequal density. When air lacks homogeneity, because of decided inequalities of temperature and moisture, the travel of sound is affected in somewhat the same manner as is that of light when it passes through heated air rising from a stove or other heat source. When, however, the movement is diffused and the air temperature is approximately even throughout the whole mass, that slow movement, whether upward or downward, has no appreciable effect on sound travel."

STRESSES IN STEEL FOUNDATIONS.—III.

[By Samuel B. Durand.]

A record of the most important tests that have thus far been made in this line, can be found in an article on the "Practical Application of Iron and Concrete to Resist Transverse Strains," by Mr. G. W. Percy, in Volume v. of the "Transactions" of the Technical Society of the Pacific Coast; and an account of some of the principal works in which the method has been used was published in "The Engineering Record" for March 24, 1894.

The tests so far made show that the deflections of well-proportioned composite beams, acting under one-third of their breaking loads, are but one-twelfth of their deflections at rupture, and that the concrete in the tension flanges cracked only after half the final deflections had been reached and two-thirds of the ultimate loads applied. Since concrete yields much less to compression than steel does to tension, the position of the neutral axis of a composite beam, when bending occurs and as it increases, must move toward the compression flange of the beam; but the calculations on actual cases of composite beams as designed to meet the requirements of the special problem at hand, show that there can be but little error introduced into the moments of resistance of such cases by regarding the neutral axis as being fixed and at the point where it is situated when the structure is acting under no load; for the amount of steel used in the section in proportion to the concrete is so small that its effect upon the location of the neutral axis is scarcely perceptible so long as the concrete in the tension flange does not crack, of which there is little danger when proper unit working stresses are used, as the smallness of the deflections under maximum loading prove.

In calculating the position of the neutral axis of such a section, the ordinary method will not be applicable on account of the moduli of elasticity of the two materials being different; but the following general method may be used, and, when thus located, the moment of inertia of the whole section can be calculated by the usual methods.

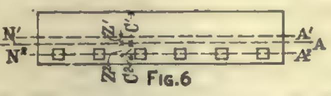


Fig. 6

Let Figure 6 represent the cross-section of a composite beam, the modulus of elasticity of whose matrix has the value E_c, while that of its tension rods is E_s. Gen. Q. A. Gillmore in his book entitled "Notes on the Compressive Resistance of Freestones, Brick Piers, Hydraulic Cements, Mortars and Concretes," gives the following values for the modulus of elasticity of concretes, as obtained from tests made at the Watertown arsenal. The average in pounds per square inch for concrete made from National Portland cement was 1,386,300 pounds; from the Newark Company's Rosendale cement was 538,300 pounds; and from Norton's cement was 617,000 pounds. All concretes tested consisted of one volumn of cement paste, three volumns of sand and six volumns of broken stone.

Referring to the figure, N_1A_1 is the position of the neutral axis of the matrix, and in all practical cases will be at the center of the section. N_2A_2 is the position of the neutral axis of the rods, and is determined by their position; and NA is the position of the neutral axis of the section as a whole, whose position is required. Let $g =$ the distance between N_1A_1 and N_2A_2. Let c_1 and $c_2 =$ the distance of the outermost fibers of the concrete and steel respectively from NA. Let $z_1 =$ the distance between NA and N_1A_1, $z_2 =$ the distance between NA and N_2A_2 and $z =$ the ordinate from the neutral axis NA, to any element of area, da, and reckoned positive when drawn upward from NA. Let $da_1 =$ any element of area in the matrix, and $da_2 =$ any element of area in the rods. Let $p_1 = s_1 \div c_1 =$ the unit stress in the matrix at unit distance from NA; $p_2 = s_2 \div c_2 =$ a similar quantity for the rods. Let $B_1 =$ the area of the section of the matrix, and $B_2 =$ the area of the section of the rods. Since the experiments proved that the concrete in tension cracked only after two-thirds of the ultimate load had been applied to the test beams, the resistance of the whole section of the matrix can be calculated upon in figuring the moment of inertia. Therefore, if the upper part of the section be considered as being in compression, the total stress in

$$B_1 = \int p_1 z da_1 \text{ and in } B_2 = \int p_2 z da_2.$$

The total stress in B_1 is obtained by integrating $p_1 z da_1$, and that in B_2 by integrating $p_2 z da_2$. If R is the radius of the elastic curve then $s \div c = E \div R$. Hence the total stress in B_1 is the integral of $(E_c \div R)\, z da$ and that in B_2 is the integral of $(E_s \div R)\, z da$. The horizontal forces at the section are equal to zero, so the sum of the two integrals may be placed equal to zero. Since the integral of $z da_1$ is $B_1 z_1$ and that of $z da_2$ is $B_2 z_2$, the equation of the horizontal forces reduces to $E_c B_1 z_1 = - E_s B_2 z_2$. As $z_1 - z_2$ is g, the following equations result:

$$(XIII.) \quad z_1 = E_s B_2 g \div (E_c B_1 + E_s B_2)$$

$$(30) \quad z_2 = E_c B_1 g \div (E_c B_1 + E_s B_2)$$

In determining the position of the neutral axis by either formula (xiii.) or (30), it must be noted that when z_1 is positive the neutral axis of the section as a whole is below that of the matrix and vice versa. The neutral axis now being located, the ordinary methods for computing the moment of inertia can be applied and the moment of resistance for the whole section will be:

$$(XIV.) \quad \text{Moment} = p_1 I_c + p_2 I_s$$

where I_c and I_s are the moments of inertia for the matrix and rods respectively about the neutral axis just found. The fiber stresses s, however, in the terms p_1 and p_2 cannot be assumed independently of each other, but the value of one being taken the moment of resistance allowable for the whole section can be determined in the following manner. Since a resisting moment is the algebraic sum of the moments of the internal horizontal stresses in any section with reference to some point in that section, it is evident from what was stated in deducing equations (xiii.) and (30) that the total moment of resistance for this composite section is the sum of the integrals giving the values of B_1 and B_2. Therefore the equation of the elastic curve is:

$$(31) \quad M = (E_c I_c + E_s I_s) \div R$$

Since $s \div c = E \div R$ is true for both parts of the section, it follows by equating the values of R in the two cases that $p_1 = p_2\ E_c \div E_s$. The substitution of either of these values in equation (xiv.) gives:

$$(XV.) \quad M = (p_1 \div E_c)\,(E_c I_c + E_s I_s)$$

$$(XVI.) \quad M = (p_2 \div E_s)\,(E_c I_c + E_s I_s)$$

In computing the allowable bending moment of a composite section, both of these formulas are to be used, and the one giving the lesser value of M is the one to be taken. Note that in the term p_1 the allowable value of the unit compressive strength of concrete is to be used, while in p_2 it must be that of the tensile strength of steel. Since the term $E_c I_c + E_s I_s$ in these formulas is equal to the term $E_0 I_0$ of the general equations, it is now possible to apply the theoretical results to a practical example.

(To be continued.)

THE ARRANGEMENT OF PUBLIC BATHS.

At the recent meeting of the Royal Institute of British Architects a paper was presented by Mr. A. Hessell Tiltman on the arrangement of public baths and washhouses, a class of structures with which he has been connected as architect for many years. The address was not so much a description of existing establishments as a general discussion of the best methods of arranging new structures. His address is particularly interesting because in many respects it is in a line with recommendations made by "The Engineering Record" fifteen years ago, subsequently taken up by the Mayor's Committee for Public Baths of New York, and more recently carried out in a few details in Boston under the direction of Hon. Josiah Quincy, mayor of that city.

In Great Britain the organization and management of public baths and washhouses come under various parliamentary acts. Mr. Tiltman criticises the general method in which these regulations have been carried out, and states that there has been too frequently a disposition to deal with the problems in a piecemeal fashion, following the examples of neighboring parishes or districts. The great initial blunder in almost every establishment, he says, is the forced association of the different classes of the bathing community to be catered for by public baths. The various classes for whom such establishments will do the most good desire different accommodations, and the remedy proposed to correct the fault is: "The practical adoption of some system of central and branch establishments classified and distributed to suit the special needs of each district. The visitors to our swimming and the best of the ablutionary baths can very reasonably be expected to go any distance within a mile or so

for their baths, whereas those using the public washhouses are seldom found to come from within a greater distance than a quarter of a mile and never beyond half a mile. The cleansing baths, especially those for the very poor, should be within an equally convenient distance. This being so, it would appear as if the ablutionary baths and the public washhouses should be decentralized and located at much more frequent intervals throughout those districts requiring them, forming really a series of branch establishments. The swimming baths, providing larger and even better accommodations than at present obtains, should constitute centralized establishments at one or more points equally dividing the whole district."

The complete plan which this architect advocates comprises the central establishment, which would be the most attractive of the district, and branch establishments of two types. The central establishment would have four swimming baths and possibly a small pond where the art of swimming would be taught to bathers of each sex alternately. There might also be a number of tub and hot-air baths. The building would also accommodate the head offices of the administration of the district and have a laundry for washing the towels and linen of all the baths in the district. The first type of branch establishments would have from 30 to 50 tub and douche baths and a public washhouse with 30 to 50 washing compartments. Its business would be carried on at very similar rates to those now charged in the washhouses so frequently found in British cities. The second type of branch establishments would have an arrangement of douche baths like those used on the Continent and now being introduced extensively in the United States.

The advantages of such a system are referred to by the author as follows: "It will be seen that with establishments of varying scale and of three different principles of arrangement, as here suggested, the wants and means of all classes of visitors to our rearranged bathing and washing institutions are properly provided for; and, as in the branch establishments, the buildings are placed within very short distances of the home of the working and poor classes and are, moreover, small in size and would be found economical in working. Our present large and ornate establishments, placed great distances apart and in very prominent positions do not by any means sufficiently attract the poor bather, who, more often than not, fights shy of being seen to enter them."

So much of Mr. Tiltman's plan as relates to washhouses or public laundries, it is unnecessary to review here, because such establishments scarcely exist outside of Great Britain. Neither is it necessary to repeat his arguments in favor of the douche bath, for its advantages over the tub bath in public establishments are evidently more widely recognized in the United States than in Great Britain, to judge from the author's somewhat long explanation of its principle and use.

A central establishment of the size contemplated by Mr. Tiltman for a large community would cover an area of from 30,000 to 40,000 square feet, and, if possible, front on two roads. Its position should be on a good thoroughfare easily accessible from all parts of the town. It is important that there should be an abundant supply of water, both pure and salt. Hard water is not only disagreeable to use, but it is also troublesome in the boilers, and in the laundry requires so much soap and rubbing that clothes are subjected to considerably more wear and tear than when soft water is used. The annual water bill of some of these establishments is very large, that of the Hornsey Road baths in London being considerably over $6,000. It is, therefore, desirable to secure the water from artesian wells or other less expensive source than the public mains.

The difficulty of obtaining sites for these central institutions would be materially lessened if the people in charge would be satisfied with a small frontage on the main thoroughfare. The baths can be extended back of existing buildings and frequently given a less costly second frontage on a side street or alley, affording ample means for handling supplies. Mr. Tiltman reproduces in the paper plans of two large central establishments designed by himself, in both of which only enough frontage was secured for one main entrance. This, however, was arranged to open into a quadrangular space around which were arranged the necessary entrances to the different classes of baths, to the laundry and to the administration offices. So far from such an arrangement being objectionable, it is stated to have proved so convenient for working purposes as to become almost a necessity in large bathing establishments fronting on busy main streets.

With regard to swimming pools, the author believes that the limit of size has already been reached in a number of places. It is only in the most frequented baths that it is desirable to maintain pools 132 x 40 feet in area. One London vestry is now building a bath measuring 150 x 50 feet, to be used alternately by men and women; it will cost $38 to fill it each time, and some doubt is expressed whether it will be used to any extent during more than two months of the six in which it will be open to the public. Mr. Tiltman believes in keeping the size of the pools down to about 90 x 30 feet and increasing their number in any establishment when the existing facilities prove inadequate. His experience indicates it is only by this means that the consumption of water and the management of the heating apparatus can be adapted to the actual attendance of bathers. In a large central establishment he would advise two baths for each of the sexes, and a small pool in addition, which may be used by men or women on special occasions, but principally as a place in which to teach swimming. These teaching pools are quite commonly provided on the Continent, but seem to be practically unknown elsewhere; the two in the Kent Street baths in Birmingham are said to be the only instances of their use in Great Britain. Such a bath need not be larger than about 3 x 20 x 12 feet. The dimensions of the four main basins are approximately as follows: Men's, first-class, 100 x 35 feet; depth, 3½ to 7 feet. Men's, second-class, 90 x 30 feet; depth, 6½ to 3½ feet. Women's, first-class, 75 x 25 feet; depth, 6 to 3½ feet. Women's, second-class, 50 x 20 feet; depth, 6 to 3½ feet.

With regard to the management of these baths, Mr. Tiltman says: "It is the general practice in England to close the swimming baths during six months of the year with the exception of the smallest ones. I cannot, however, but think this is to be regretted, as the pleasure and benefit of swimming could be very well maintained throughout the year were we not so wedded to the large-sized ponds, and if only the warming and other arrangements were more adequate for their purposes. Germany, with a much colder climate keeps its swimming ponds open through the year, but to do this in this country would necessitate several changes of a structural character, and these being made, the various swimming clubs would gladly use them throughout the winter months." There is another use made of the establishment which seems somewhat incongruous to the American. The pools are frequently floored over and are used for public entertainments of various sorts, one public bath house in London doing duty as the vestry hall.

As regards the general dimensions of the swimming pools, Mr. Tiltman states that the ratio of length to width is generally about 3 to 1. He advises having all the internal angles square, and the whole surface free from projections, and the steps removable. An open self-draining channel near the top of the water and running continuously around its edge serves as an overflow; an iron or copper safety rail an inch and a half in diameter should also be run around the pool for the use of tired swimmers. The depth of water in British baths generally runs from 3½ feet at the shallow end to 6 or 7 feet at the deeper. On the Continent the swimming pools frequently have much greater depths. The shallow end begins at a depth of about 3 feet below the water level and slopes gently to a point near the middle of the length. The inclination then changes to a much steeper gradient and a depth of 8 to 12 feet is finally reached. At every foot of difference in the depth of the water throughout the whole length of the pond, the depth of the water should be indelibly indicated on the wall just above the safety rail, in plain figures.

The gangways should have a width, according to Mr. Tiltman, of at least 4 feet in the clear at the sides and 6 to 8 feet at the ends. The flooring of the gangway, he finds, after experimenting with a number of materials, is most satisfactory when constructed with a well-rubbed, hard, fine-grained stone. Its color is not very decorative, however, so it may be advisable to use the more expensive mosaic pavements where appearances must be considered. The British swimming baths are not generally provided with the railing around the pool which is employed in both American and continental baths, but the author considers its use advantageous.

The temperature of the water in the ponds should be, it is said, from 70 to 72 degrees for men and 72 to 75 degrees for women. The temperature of the rooms, including the douche room, should never be less than 68 degrees, and for women and children it should be equal to that of the ponds.

The simplest and best method of making a large swimming pool is stated to be, in the first place, the construction of a good, sound and uniform foundation, and in the second place to employ a shell of Portland cement concrete, the inside of which should be rendered with cement and lined with asphalt. After the tank has been tested by being filled with water, it may then, if found water-tight, be paved with white glazed bricks or other equally suitable material. There is no particular novelty in this method of construction, but by using care, there has never been a serious leakage in any of the pools built under Mr. Tiltman's supervision.

The dressing boxes, where they are arranged along each side of the plunge bath, need not be greater than 3½ feet square, according to Mr. Tiltman, in the case of the men's bath and 4 feet square in the case of the women's bath. The fittings should be as simple and few as possible; a seat, foot board, brush and comb shelf, and a few hooks for garments. There is always a certain amount of theft taking place in the dressing boxes of public swimming baths, and many unavailing efforts have been made to stop the practice. In some places insurance is given if valuables are left in the ticket office.

The best tub baths should be designed to have two compartments, according to the author; the inner one containing a glazed fire-clay bath, white inside and outside. The fittings should be a foot board, towel rail, electric bell and soap dish. The other compartment serves as a small dressing room and should contain a dressing table and glass, chair, rug and hooks for clothing. Each of the tubs should have a warm and cold douche apparatus over it. Such accommodations have been provided in some of the Birmingham establishments, and are very popular. Second-class baths for the central establishment should consist of a single apartment at least 6 feet square. It should contain a glazed fire-clay bath, although the glazing need only be on the inside and on the roll rim. Cheaper baths can only be provided satisfactorily by means of the douche.

BACILLITE SEWAGE DISPOSAL AT HANLEY, ENGLAND.

The sewage of the town of Hanley is treated by what is known as the bacillite process. The crude sewage is first dosed with 5 5/6 grains of lime to the gallon, and shortly afterwards receives an addition of 2½ grains of protochloride of iron. These precipitants are thoroughly mixed with the sewage by agitators in the channel leading to tanks where the solids are allowed to settle. The effluent is then treated with carbonic acid gas forced into the water by an induced current of carbolic steam. This carbonic acid gas is said to neutralize any alkalinity that exists, and the object of the carbolic steam is to destroy existing germ life. It is then passed over a small plot of land belonging to the works.

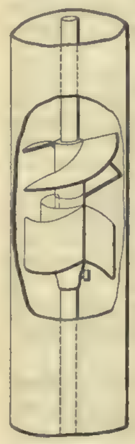
The lime used in the process is prepared in two ordinary mixers, each 5 feet high and 3½ feet in diameter. The shaft working the rotary arms has a piece of piping around it to conduct the water to the under side of perforated horizontal plates on which the lime is placed. The water instead of being thrown on top of the lime passes up through it in a constant stream and becomes a saturated solution before leaving the mixer. The water used in the lime mills is tank effluent taken from the last tank in the series by means of a small pipe connected to a 4-inch centrifugal pump which discharges into a wrought iron cistern. The tank containing the iron used in the process is also fed from this cistern. There are five precipitation tanks, four of them being about 200 feet long, 30 feet wide and 6 feet deep each with a capacity of about 276,000 gallons. The fifth is much larger and has a capacity of about 900,000 gallons. They are worked on the continuous system and are so arranged that any one can be shut off for the removal of sludge or for repairs without interfering with the others. The sludge is forced down a discharge pipe into a well where it is treated with lime. It is then pressed into cakes and used for filling.

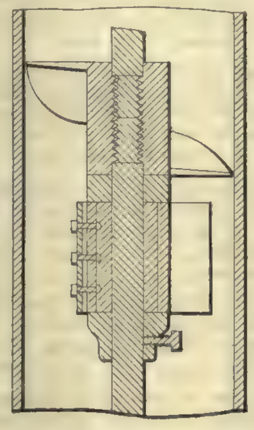
A Shone ejector was recently erected on the sewage farm in connection with the works. It is situated about 1,350 feet from the outfall and lifts the sewage 12 feet from a district formerly discharging into the river by way of a small stream. Owing to the fact that the level of the sewer was near the surface, a building was decided upon instead of a simple chamber such as is usually placed underground. On the excavation being carried down it was found that the bottom of the foundation was 7 feet below the saturation level of the valley. Consequently during the work of excavation, and while the foundation, which consisted of a bed of concrete 18 inches thick, all over the site was being put in, a pulsometer had to be continually at work in a jack well at the side. This took nearly three weeks, the pump being worked by two shifts of men. The flow was about 7,200 gallons per hour. In order to prevent the matrix of the concrete being washed away, owing to the flow of water to the pump, a layer of 6 inches of ballast was first laid in the bottom, through which it passed while the work was setting. The concrete was composed of three parts ballast, two of sharp sand and one of Portland cement. On this foundation the walls were built. The mortar was composed of sharp sand and Portland cement in the proportion of two to one, and great care was taken that all joints should be flushed through. The walls were built in two thicknesses. The outer walls, of 14-inch work in cement mortar, were laid with cement and sand in equal proportions up to 1 foot above the saturation level of the ground and a 4½-inch lining in cement mortar was built inside this. Above, the walls were built in cement mortar up to the ground line and were 14 inches thick. The surface of the concrete floor was floated ¾ inch thick with the same mixture as the walls, on which was laid a floor of bricks on edge thoroughly grouted with neat cement. The walls and floor have not allowed any water to percolate through up to the present, and the station is perfectly dry inside. The ejectors are of 120 gallons capacity, and are in duplicate, working at 40 pounds pressure. The rising main is 5 inches in diameter, and the air main 3 inches in diameter, all cast-iron pipes.

These facts have been obtained from a paper by Mr. A. Burton, assistant to the borough surveyor of Hanley, read at a meeting of the Birmingham Association of Students of the Institution of Civil Engineers and printed in the "Surveyor."

NOTES.

A New Form of Deep-Well Pumps designed by Mr. P. K. Wood of Los Angeles, Cal., was mentioned in these columns some weeks ago. Since that note was printed additional information has been received concerning the apparatus, which is being introduced extensively for irrigating from wells where the lift is sometimes over 200 feet. The principle involved is





the same as that of the propeller of a vessel. A shaft is run down the well and provided every 3 to 5 feet with a pair of runners. These runners are of slightly less diameter than the well casing, and are made in various pitches to suit the local conditions at each well. Below each pair of blades is a guide consisting of a set of spring blades which press against the casing and align the shaft, although they do not carry any of the weight, which is all borne by a large ball bearing in the working head at the surface of the ground. The guides are so formed as to interrupt the whirling motion imparted to the water by each pair of runners, and turn the stream back in the opposite direction to the revolving blades of the next pair above. The pump is usually driven by a belt from a small gasoline or steam engine.

A Light Hanging Scaffold recently used for ceiling work in a New York parish house deserves the attention of builders. At this house there is a suspended ceiling about 40 feet above the floor, having a light iron framework, which required considerable fitting before it was completed. It would have been a comparatively tedious and expensive plan to put this up by trestling from the lower floor, so scaffolds suspended from the floor above were employed. In order to avoid cutting this floor more than was absolutely necessary, long scaffolds were required, which it was also desirable to have as light as possible consistent with the requisite strength. The system adopted was to convert ordinary 35-foot wood ladders into light trussed bridges by two pairs of vertical struts running down from the side pieces of each ladder and fitted with a wire-cable bottom chord. This made each side piece the upper chord of a queen-post truss. The posts were not spaced equally, but so as to develop the greatest strength in the combined scaffold. Each pair of posts consisted of a frame having a top and a bottom plank the width of the ladder, two vertical planks nailed at each end of these top and bottom pieces, and a pair of diagonal boards for X bracing. The frame was set across and perpendicular to the ladder at the proper place, lashed to the rungs and then stayed by light braces running out on each side from its bottom to the side pieces. A half-inch steel rope was attached firmly to each end of each side piece, carried down under a groove in the bottom of the corresponding post, and the ends connected by a turnbuckle. These turnbuckles enabled a positive initial tension to be put on the ropes, and thus make a fairly stiff, light scaffold for half a dozen men. The work was done by the New Jersey Steel & Iron Company, under the direction of Mr. H. A. Greene, Assoc. M. Am. Soc. C. E., its superintendent of erection.

TRADE PUBLICATIONS.

The Standard Silica Cement Company, 66 Maiden Lane, New York, has ready for distribution a pamphlet describing the method of making sand cement, tables giving the results of a number of tests of the material and views of works in which it has been used.

Messrs. Jenkins Brothers, 71 John Street, New York, have a new catalogue ready for distribution, which describes the great variety of globe, angle, cross, check, blow-off, safety, back-pressure, radiator, corner, gate and air valves they are manufacturing, as well as a number of specialties they sell.

A new edition of the handsomely illustrated list of streets paved by the Warren-Scharf Asphalt Paving Company, New York, has appeared. In addition to the maps and records of the 4,600,000 square yards of asphalt laid by the company to date, the pamphlet contains a number of standard specifications and many good illustrations.

The Watertown Steam Engine Company, Watertown, N. Y., is distributing some interesting pamphlets describing its lines of machinery, which include stationery and portable engines and boilers for general use, high speed automatic engines designed more particularly for electric service, slow-speed automatic engines for factories and similar establishments, compound and triple-expansion engines, and high-pressure boilers. One of these pamphlets contains an interesting record of the present condition of the first 50 automatic engines built by the company.

The National Meter Company, New York, has prepared a new pamphlet concerning the Nash gas and gasoline engines, which contains much valuable information for designers and users of small power plants. The pages relating to the direct-connected generator sets are particularly interesting and contain a brief mention of the company's centrifugal clutch coupling between the generator and engine, which is used to maintain a constant armature speed under varying loads. The pamphlet also gives some useful figures concerning a small water-works pumping station.

The International Correspondence Schools, Scranton, Pa., have prepared a short account of the history and methods of their system of instruction, which has had a great vogue and undoubtedly does much good. The first pupil was enrolled in October, 1891, and about 77,000 names have been registered since then; the average age of the pupils has been 25 years. The methods of instruction are as nearly personal as is possible by mail, and seem better adapted to the needs of artisans, draftsmen and others who cannot attend trade schools, than the home study of text-boks without assistance over the hard places.

PERSONAL AND OBITUARY NOTES.

Mr. Thomas J. Peck has been elected city engineer of Waycross, Ga.

Mr. Earl Thompson has been appointed borough surveyor of Collingswood, N. J.

Mr. John W. Thompson has been re-elected clerk and water-works superintendent of Atlantic City, N. J.

Mr. Joseph A. Ashmead, Jamaica, N. Y., has been appointed an assistant engineer in the Department of Highways of New York City.

Mr. F. G. Rogers has been appointed chief engineer of the Lehigh Valley Transportation Company, with headquarters at Buffalo, N. Y.

Messrs. Julian Scholl & Company, mechanical engineers, 126 Liberty Street, New York, have opened an office in the Betz Building, Philadelphia.

Professor Louis Bauer has resigned his chair at the University of Cincinnati to take charge of the magnetic work of the Coast and Geodetic Survey.

Mr. Charles H. Black, of Chelsea, Mass., President of the Massachusetts Highway Association, has been appointed superintendent of the paving work to be done in Havana.

Mr. Emil Kuichling, M. Am. Soc. C. E., chief engineer of the water department of Rochester, N. Y., delivered a lecture on riveted steel pipe before the students of Rensselaer Polytechnic Institute on March 27.

M. Jean Baptiste Sebastian Krantz, formerly director-general of bridges and highways of France and the author of some of the most valuable engineering monographs produced in that country, died recently at the age of 82 years.

Mr. Chester B. Albree, of Pittsburg, Pa., delivered a lecture on ornamental iron work before the Engineers' Club of Western Pennsylvania on March 21. It was illustrated by several hundred photographs and a large number of examples of such work from the valuable collection of the lecturer.

Mr. Robert C. Gemmell, M. Am. Soc. C. E., has been re-appointed State engineer of Utah. He is a graduate of the engineering department of the University of Michigan, and has been connected for a number of years with the mining enterprises of Capt. J. R. De Lamar. Previous to this he was associated with Mr. Arthur L. Adams, M. Am. Soc. C. E., in hydraulic work on the Pacific slope.

Mr. A. C. Rice has resigned his position as general superintendent of the Stilwell-Bierec & Smith-Vaile Company in order to devote his entire time to private professional work. He has been connected recently with a number of large hydraulic power works, and is at present engaged in designing several large pulp and paper mills. Among the power development undertakings he has in hand is one of 80,000 horse-power at Grand Falls, N. B., for a syndicate of American and Canadian capitalists.

Mr. Arthur S. C. Wurtele, M. Am. Soc. C. E., died in Albany on March 20. He was a descendant of a family prominent in Canadian public affairs and one of his brothers was at one time on the Dominion bench. He was an engineer of marked theoretical and practical attainments, and an expert mathematician. For many years he was connected in different capacities with the public works of the State of New York. He was made Deputy State engineer under Mr. Elnathan Sweet in 1887, when Mr. John Bogart resigned that office, and held the position when the latter gentleman became State engineer. He resigned in 1892. He contributed a number of important papers to the "Transactions" of the American Society of Civil Engineers on the wind pressure on bridges, wrought iron columns and railway spirals, and his technical contributions to the reports of the State engineers contain much valuable material for hydraulic engineers. He was a man who had the respect of all with whom he was associated, and may be said to have lived in his profession.

CONTRACTING NEWS

OF SPECIAL INTEREST TO
CONTRACTORS, BUILDERS, ENGINEERS, AND MANUFACTURERS
OF ENGINEERING AND BUILDING SUPPLIES.

For Proposals see pages xi, xii and 392.

WATER.

Ballston Spa, N. Y.—The question of securing a standpipe is under consideration.

Sleepy Eye, Minn.—M. B. Haynes, Mankato, has prepared plans for the water system to be constructed this summer.

Enfield, Mass.—A committee has been appointed to investigate the matter of a water supply.

Chicago, Ill.—An appropriation of $200,000 has been made for the construction of a water tunnel from the new Carter H. Harrison crib to the Chicago Ave. crib.

Montgomery, Ala.—Bids are wanted April 15 for a horizontal compound duplex pumping engine having 5,000,000 gal. capacity, with surface condenser and accessory appliances. R. H. Sommerville, Treas. City Water-Wks.

Mayville, N. D.—Bids are wanted April 5 for a water-works and electric light plant. Samuel Jorgerson, City Aud.

Monroe, La.—Bids are wanted April 17 for $155,000 improvement bonds issued for a water-works plant, sewerage system, street improvements, electric light plant, school and hospital. A. A. Forsythe, Mayor.

Yonkers, N. Y.—Bids are wanted April 6 for 206 lengths 8-in. pipe at 600 lbs. per length of 12 ft. and 208 lengths 6-in. pipe at 400 lbs. per length of 12 ft. John C. Shotts, Pres. Bd. Water Commrs.

St. Paul, Minn.—Bids are wanted March 27 for laying water mains. John Caulfield, Secy. Bd. of Water Commrs.

Michigan City, Ind.—Bids are wanted March 27 for a pumping engine having 4,000,000 gal. capacity. A. W. Frehse, Supt. Water-Wks.

Atlanta, Ga.—Bids are wanted March 28 for sinking an artesian well at Tybee Island. John Simpson, Dept. Q. M. Gen., U. S. A., Ch. Q. M.

Mt. Gilead, O.—The city has under consideration the proposition to construct water-works and an electric light plant.

Sacramento, Cal.—Wm. Mullenney, City Surveyor, writes that the issue of bonds will be voted upon in a few months, for water-works and sewerage extensions.

Wykoff, Minn.—It was voted on March 14 to construct a system of water-works.

Correll, Minn.—A committee is investigating various water systems with a view to installing one here for fire protection.

Frazee, Minn.—It has been voted to issue bonds for water-works.

Walker, Minn.—The proposition to bond for water-works carried at the recent election.

Sparta, Minn.—Dowling Bros., of Eveleth, are stated to have received the contract to construct a water system.

Louisburg, N. C.—Authority has been granted to the city to issue $30,000 light and water bonds. W. H. Yarbore, Mayor.

Sioux Falls, S. D.—A vote will be taken April 4 on the issuance of $130,000 bonds for the construction or purchase of water-works.

Rosebud, Tex.—A company has been incorporated for the purpose of boring an artesian well. Capital, $10,000. P. B. Water, Pres.

Stratford, Ont.—Press reports state the City Council has under consideration the purchase of the water-works plant, at a probable cost of $120,000.

Linton, Ind.—The proposition to construct water-works and electric lights will be voted upon by the people.

Pottsville, Pa.—The County Commissioners have decided to replace the present reservoir at the almshouse with an 8,000,000-gal. reservoir.

Plymouth, N. H.—It has been voted to purchase, at a cost of $35,000, and rebuild the water system of the Plymouth Aqueduct and Water Co.

Salem, Mass.—An appropriation of $25,000 has been voted for the purchase of iron pipe to replace cement-lined pipe.

Reidsville, N. C.—It was voted on March 14 to issue $25,000 bonds for water-works.

San Luis Obispo, Cal.—An ordinance is before the City Trustees calling for the issuance of bonds to the amount of $36,000 for a sewer system and $80,000 for the purchase and improvement of a water system.

Woodruff, Cal.—The Woodruff Irrigating Co. has filed articles of incorporation, with a capital of $20,000. The incorporators are: George A. Neville, Anson C. Call, John Dean and others.

Wilmington, Del.—The Water Commissioners are considering the advisability of erecting a water tower in Rockford Park.

St. Joseph, Mo.—Papers have been filed for the incorporation of the Citizens' Water Co. The company desires to be incorporated for a term of 50 years. Capital stock, $800,000. The shareholders are: Joseph Morton, of St. Joseph; John H. Brown and John P. Miller, of Chicago, and others.

Charleston, S. C.—A correspondent writes that the survey for new water supply from Edisto River is being pushed rapidly. J. G. Ludlow, Engr., Winston, N. C.

Meadville, Pa.—Bids are wanted March 30 for furnishing water pipe, hydrants, valves, stop cocks, etc., as advertised in "The Engineering Record."

Austin, Minn.—Bids are wanted April 7 for furnishing 4,000 ft. of 20-in. pipe, 7,300 ft. of 15-in. pipe, 1 20 x 15 x 15 Y, 2 20-in. bends and 1 15-in. bend, as advertised in "The Engineering Record."

New Brunswick, N. J.—The Board of Water Commissioners have decided to purchase a new pump having a capacity of 6,000,000 gals. per day. Probable cost, about $25,000. F. A. Hoffman, Supt. of Water-Works.

Boise City, Idaho.—The Boise City Irrigation & Land Co. has been organized. The incorporators are: J. M. Satterfield, Charles N. King and R. P. Ryan, all of Jersey City, N. J., and the capital stock is $300,000.

Penngrove, N. J.—The proposed water-works for the borough will cost $30,000, according to the Engineer's report, and will furnish 350,000 gal. daily.

Washington, D. C.—The Camden Iron Wks. have received the contract to furnish cast-iron water pipe to the District of Columbia for the sum of $21.08 per ton of 2,240 lbs.

Leadville, Colo.—Municipal ownership of the water-works plant is being considered.

Reading, Pa.—Bids are wanted March 28 for cast-iron pipes, specials, water gates, fire hydrants, etc., and for laying water mains for the fiscal year 1899-1900. F. P. Heller, Pres. Bd. Water Commrs.

Baird, Tex.—Bids are wanted April 3 for a system of water-works. Arthur Yonge, Mayor.

Philadelphia, Pa.—The Council's Committee on Finance has agreed to report favorably an ordinance to appropriate $35,000 for the introduction of filters in all buildings occupied as public schools.

Berea, O.—It is stated that bids are wanted April 4 for a stand-pipe 16x100 ft. and for laying 570 tons of cast-iron water pipe. T. J. Quayle, Mayor.

West Springfield, Mass.—The Board of Water Commissioners have received the report of Snow & Barbour of Boston giving the result of their investigation of the sources of water supply for West Springfield.

Pittsburg, Pa.—The Finance Committee of the Councils has approved the report of the Filtration Commission, which recommended a bond issue of $3,000,000, to be used for the construction and operation of a filtering plant.

Lakeport, Cal.—Bids are wanted April 17 for a system of water works. H. V. Keeling, Town Clk.

Ontario, Cal.—Bids are wanted April 8 for a tunnel; probable cost, $30,000. B. C. Shepherd, Secy. San Antonio Water Co.

Newport, Ky.—It is stated that bids are wanted April 5 for a 300-H.-P. water tube boiler for the water works. Geo. Hornung, Supt.

Corinth, Miss.—Bids will be called for April 1 for water works and sanitary sewerage, probable cost, $40,000. P. H. Porter & Sanders, Engrs. in charge, Louisville, Ky.

Albany, N. Y.—Bids are wanted April 4 for new water mains on Howard and William Sts. George I. Bailey, Supt. Bd. Water Commrs.

Chicago, Ill.—Bids are wanted March 29 for water service pipes, also for brick and vitrified tile pipe sewers in several streets. L. E. McGann, Pres. Bd. Local Improvements.

Altoona, Pa.—Ordinances have been passed authorizing the laying of water mains in several streets.

Prineville, Ore.—The city council has granted H. V. Gates of Hillsboro a 15 years' water and electric light franchise.

Scio, O.—The Sopi Water-Works Co. has been authorized to build and operate water-works. The company has a capital of $25,000. The incorporators are: W. T. Stewart, of Philadelphia; A. C. Le Comte, of Marietta; W. T. Hague, of Scio, and others.

Elizabethtown, Ky.—According to press reports bids have been asked for the erection of a stand pipe.

Nora Springs, Ia.—A vote will be taken on the proposition to bond for the construction of water-works.

Cincinnati, O.—Bids are wanted April 28 for the construction of settling reservoirs and for laying pump mains from Eastern Pumping Station, near California, as advertised in "The Engineering Record."

Cincinnati, O.—Bids are wanted April 12 for furnishing machine shop castings, iron pipe, specials, brass castings, street valves, boxes, etc., to the water-works department for one year. A. B. Rattermann, Pres. Bd. City Affairs.

Napoleonville, La.—Bids are wanted for constructing water-works. L. P. Herbert, Mayor.

Mankato, Kan.—Bids are wanted April 12 for a system of water-works. Bond issue $20,000. H. V. Hinckley, Engr., Topeka, Kan.

Butte, Mont.—Bids are wanted April 19 (change of date) for furnishing material and labor necessary for the construction of the following pipe line: Approximately 50,000 lin. ft. of 24-in. banded stave pipe, 16,000 lin. ft. of 26-in. riveted steel pipe with gate-valve special castings, etc., as advertised in "The Engineering Record."

San Carlos, Ariz.—Bids are wanted April 18 for a water and sewer system, a gasoline gas plant, 2 dormitories, school and other buildings at the San Carlos agency. W. A. Jones, Commr. of Indian Affairs, Dept. of the Interior, Washington, D. C.

Salt Lake City, Utah.—F. C. Kelsey, City Engr., in his report on the water supply, estimates the cost of a 5,000,000-gal. reservoir at $28,553, the estimated cost of proposed changes and improvements in the water pipe system is $18,758, and the estimated cost of proposed changes in City Creek water main is $19,558.

SEWERAGE AND SEWAGE DISPOSAL.

Norfolk, Va.—Local press reports state that the Brambleton Ward sewer contract has been awarded to Guild & Co., of Chattanooga, Tenn., for $66,330.

Sacramento, Cal.—See "Water."

Pembroke, Ont.—A. J. Fortier, Town Clk., writes that bids will be asked in April for the construction of main sewers to cost about $10,000.

Madison, Wis.—The Council has sold $40,000 special sewerage improvement bonds.

Baltimore, Md.—An ordinance has been passed appropriating $10,000 for a sewer in Lee St.

Kansas City, Mo.—According to local press reports City Engineer Wise suggests the extension of an intercepting sewer a distance of 1,200 ft. Estimated cost, $25,000.

Olneyville, R. I.—Local press reports state that the Committee on Sewers will report favorably on the petitions for sewers in the annexed district estimated to cost $21,168.

San Carlos, Ariz.—See "Water."

Southbridge, Mass.—Plans and specifications prepared by the special sewer committee have been approved by the Legislature and the issue of bonds to the amount of $50,000 has been authorized.

Bellefontaine, O.—Engineer Wonders' plans for a sewer system provide for a sewage disposal plant or farm, trunk and main sewers.

Atlanta, Ga.—Local press reports state that David Smith has secured sewer contracts amounting to $23,274.

Sioux City, Ia.—It is stated that $10,000 will be required to construct storm water sewers.

Ft. Wayne, Ind.—Bids are wanted March 27 for furnishing pipe and constructing a 24-in. sewer. J. H. Doswell, Supt. Lindenwood Cemetery.

Buffalo, N. Y.—The lowest bid received for the construction of Emslie St. sewer was from Thomas F. Moore, of Buffalo, at $84,900.

Woonsocket, R. I.—The town has been authorized to borrow $5,000 to begin work on Main, Emmons Sts. and Dean Ave. sewers.

Newark, N. J.—An ordinance has been passed for the construction of a main pipe sewer and several branch pipe sewers.

Toledo, O.—Bids are wanted April 3 for a cylindrical pipe sewer in several alleys. Wm. O. Holst, City Clk.

Chicago, Ill.—See "Water."

Kansas City, Mo.—City Engineer Wise has prepared plans for sewering part of Turkey Creek, estimated cost, $20,000.

Cohoes, N. Y.—The Public Improvement Commission has accepted plans for section 3 of the sewer system.

Cleveland, O.—The lowest bid received for the fourth portion of the Walworth St. main sewer was from Bramley & Gribben, for $127,555.

Hudson, Wis.—A vote will be taken April 15 on the proposition to construct a sewerage system.

Guthrie, Okla.—Local press reports state that it has been voted to issue $45,000 bonds for a sewer system.

Cleburne, Tex.—Cleburne Sewer Co. has been incorporated with a capital stock of $30,000. Incorporators: E. T. Kelly, P. Chambers and D. T. Chambers.

Auburn, Ind.—Press reports state that the plans of City Engineer Van Auken, for a 10-mile sewerage system, to cost about $840,000, have been adopted.

Albany, N. Y.—See "Paving and Roadmaking."

Laurium, Mich.—Joseph R. Murphy, Village Clk., writes that the following bids were opened March 14 for 29,346 ft. of 8 to 24-in. pipe sewers, 84 manholes, 34 catch basins and 4 flush tanks. C. F. Loweth, Engr. in Charge: Thos. J. Peter, Terre Haute, Ind., *$30,822; O'Neil & Son, Faribault, Minn., $31,360.50; Harding & Nelson, Racine, Wis., $31,870.82; Muir & O'Sullivan, Port Huron, Mich., $32,073.66; E. T. Webster, Dubuque, Ia., $33,146.50; J. H. Green & Son, Appleton, Wis., $34,656.25.

*Contract awarded.

BRIDGES.

Vandergrift, Pa.—The Commissioners of Westmoreland and Armstrong Counties propose to build a bridge across Kiskiminetas River at Vandergrift. Estimated cost, $30,000.

Carlton, N. Y.—It was voted on March 14 to build a bridge at Waterport; appropriation, $8,000.

Denison, Tex.—Plans have been prepared by R. L. McWillie, City Engr., for an 80-ft. span steel bridge to replace the present structure over Katy Shops.

Defiance, O.—The City Council has adopted the plans of the Wabash Railroad Co. for a new steel bridge over the track on Raston Ave.

Omaha, Neb.—The Omaha and Council Bluffs Railway and Bridge Co. is having plans prepared for a steel bridge to replace present wooden trestle over Indian Creek, at Broadway and 13th St.

Dayton, O.—See "Electric Railways."

Bainbridge, N. Y.—An election will be held March 28, to vote on the question of appropriating $15,000 for the construction of a bridge across the river.

Boston, Mass.—A bill has passed the House providing for the construction of a drawless bridge across the Charles River, between Boston and Cambridge.

New York, N. Y.—The Board of Estimate has authorized a bond issue of $644,495.63 for a bridge over Newtown Creek from Manhattan Ave., Borough of Brooklyn, to Vernon Ave., Borough of Queens.

Cincinnati, O.—The County Commissioners of Hamilton, O., and Dearborn Ind., have decided to repair the Whitewater River bridge, at Harrison, and the engineers of both counties have been instructed to prepare plans and estimate of cost of a new abutment for the bridge.

Waterford, N. Y.—A bill has passed the Assembly appropriating $3,000 for an iron foot bridge over the canal.

Kearny, N. J.—The Common Council has accepted the offer of the Erie Railroad Co. to build a new 60-ft. steel and iron bridge over its tracks where the road crosses Kearny Ave. Cost, $12,000.

Malden, Mass.—Press reports state that the Boston and Maine R. R. Co. will construct an iron bridge over its tracks at Washington St.; cost about $30,000.

St. Louis, Mo.—The House of Delegates passed a resolution requesting the Street Commissioner to prepare plans for a steel bridge over the Terminal R. R. tracks, at Ewing Ave.

Goffstown, N. H.—An appropriation has been made for a steel bridge, to replace the present wooden structure crossing Piscataquog River.

London, O.—The County Engineer has been ordered to prepare plans for bridges over Deer Creek, on the London and California pike, and over Bradford Run, on Shepherd road in Range Township.

Mitchell, S. D.—Bids are wanted April 3 for a steel bridge over James River. H. B. Anderson, Co. Aud.

Urbana, Ill.—Bids are wanted March 30 for 3 highway bridges on masonry. Ira O. Baker, Engr., 702 W. University Ave., Champaign, Ill.

Virginia City, Mont.—The contract for building a steel bridge, 3 spans of 95 ft. each, has been awarded to J. M. Luke, of Des Moines, Ia., for $4,900.

Gainesville, N. Y.—Bids are wanted April 15 for a steel highway bridge over the tracks of the Buffalo, Rochester and Pittsburg Railway Co. near Hardy's Station, also for masonry abutments and grading approaches of the same. W. E. Hoyt, Ch. Engr., Rochester, N. Y.

Boston, Mass.—Bids are wanted March 27 for a retractile draw for Malden bridge over Mystic River. William Jackson, City Engr.

Batavia, O.—Bids are wanted April 12 by the County Commissioners for a steel bridge across Big Indian Creek.

Stiles Station, N. Y.—The Berlin Iron Bridge Co., East Berlin, Conn., is stated to have secured the contract for a bridge over the Delaware, Lackawanna & Western R. R., for $6,500.

New Kensington, Pa.—The Schultz Bridge & Iron Co., McKee's Rocks, Pa., is stated to have received the contract for a bridge across the Allegheny River from 9th St. to Bouquet Station, on the West Pennsylvania R. R. for $89,000.

Somerville, N. J.—Press reports state that bids are wanted April 4 by the Board of Freeholders for a wrought-iron or steel low-truss single-span bridge across the stream of Van Zandt's, in Montgomery Township.

Ellensburg, Wash.—It is stated that bids are wanted April 3 for widening and strengthening the south approach of Durr bridge. Simon P. Forgarty, Co. Aud.

Eau Claire, Wis.—Bids are wanted April 1 for a stone abutment at the south end of Barstow St. bridge across the Eau Claire River. T. P. Cochrane, City Clk.

Dakotah, Ia.—It is stated that bids are wanted April 5 for steel bridges during 1899. Harwood Sharp, Co. Aud.

Santa Cruz, Cal.—Local press reports state the Clerk of the Board of Supervisors will ask for plans and specifications for a bridge across Valencia Creek, former bids having been rejected by the Board.

Goldbeach, Ore.—It is stated that bids are wanted April 5 for a bridge over Elk River. C. V. Woodruff, Co. Clk.

Macon, Ga.—The following bids were opened March 14 for a 2-span steel truss bridge over the Ocmulgee River at Fifth St.: Virginia Bridge Co., Roanoke, Va., $51,900; Indiana Bridge Co., Muncie, Ind., $53,000; Toledo Bridge Co., Toledo, O., $46,224 for brick flooring and $35,434 for wood flooring; Groton Bridge Co., Groton, N. Y., wood flooring $50,000, metal and concrete $53,000, and $54,500; Grant Wilkins, Atlanta, Ga., $42,108; Lasley Bros., Chattanooga, Tenn., brick flooring $44,000, wood flooring $32,000; Penn Bridge Co., Beaver Falls, Pa., $58,000; Youngstown Bridge Co., Youngstown, O., $54,875; Champion Bridge Co., Wilmington, O., $60,000; Pittsburg Bridge Co., Pittsburg, Pa., $56,800; Brackett Bridge Co., Cincinnati, O., $34,970, $41,897, $28,326.50, and $25,170; King Bridge Co., Cleveland, O., $52,384.

Chicago, Ill.—Local press reports state the following bids were opened March 17 by the Sanitary Board for the construction of two bridges at Joliet, one at Cass and one at Jefferson St. J. G. Wagner & Co., Milwaukee, Wis., $29,476 and $23,160; Chicago Bridge and Iron Co., Chicago, Ill., $30,732 and $24,834; Toledo Bridge Co., Toledo, O., $31,200 and $25,000.

Hartford, Conn.—Bids are wanted April 15 for a bridge over a portion of the East Hartford Meadows, as advertised in "The Engineering Record."

PAVING AND ROADMAKING.

Auburn, N. Y.—The Common Council has been petitioned to pave with asphalt on South St.

Goshen, Ind.—Local press reports state that it is proposed to pave several streets with brick during 1899.

Putnam, Conn.—A bill has been passed by the Legislature authorizing the issue of $40,000 street improvement bonds.

Paterson, N. J.—Bids are wanted April 3 (change of date) for brick and asphalt paving in several streets, as advertised in "The Engineering Record."

Grand Rapids, Mich.—F. A. Twamley, Secy. Bd. of Public Works, writes that the contracts for paving Jefferson Ave. and Ottawa St. were awarded to the Ayres Asphalt Paving Co., of Zanesville, O., for $18,499.27 and $7,696.45 respectively.

Worcester, Mass.—Bids are wanted March 28 for 30,000 lin. ft. of curbstone, 12,000 sq. yds. of paving blocks, etc. W. S. Prior, Street Commr.

Toledo, O.—Bids are wanted April 17 for the improvement of Broadway. Wm. O. Holst, City Clk.

Trenton, N. J.—Bids are wanted April 5 for macadamizing Asylum and Ferry roads. Josiah Jones, Dir. Bd. Chosen Freeholders.

Bellefontaine, O.—Bids are wanted April 28 for 1,240 sq. yds. of brick paving and 440 lin. ft. curbing on Main St. M. J. Nichols, City Clk.

Holyoke, Mass.—The Board of Public Works will receive bids for 1,000 ft. of curbing. Address Oscar C. Ferry, Assist. Clk.

Risingsun, Ind.—Bids are wanted April 17 for gravel and macadam roads in Randolph and Cass Townships. Robert C. Nelson, Co. Aud.

Bedford, Ind.—Bids are wanted April 10 for gravel or macadamized roads. John M. Gainey, Co. Aud.

Bridgeport, O.—Bids are wanted April 17 for improving several streets with brick and asphalt pavement. John A. Fawcett, Village Clk.

Guntersville, Ala.—The General Assembly of Alabama has authorized Marshall Co. to issue $100,000 bonds for the construction of macadamized roads, for building bridges, etc.

Richmond, Va.—Bids are wanted March 28 for street improvement, probable cost $21,000. W. E. Cutshaw, City Engr.

Waukesha, Wis.—Bids are wanted April 14 for paving. J. P. Dey, City Engr.

Nashville, Tenn.—The City Engineer recommends the construction of about 5,000 yds. of asphalt pavement, to be laid as an experiment. Public Square is to be paved with brick, probable cost $20,000.

Denver, Colo.—The Board of Public Works has adopted plans and specifications for paving Race St. at an estimated cost of $39,339.66.

Trenton, N. J.—The Governor has signed the bill appropriating $150,000 for stone road construction.

Biloxi, Miss.—On April 8 a vote will be taken on the proposition to issue $25,000 bonds for street improvements.

Bloomfield, N. J.—The proposition to issue $75,000 bonds for hard road construction will be voted upon at the election next month.

Elizabeth, N. J.—The City Council has decided to repave the streets of the city with asphalt, cost not to exceed $250,000.

Kakomo, Ind.—The contract for paving Washington St. with block has been awarded to Yeager & Dickerson, of Danville, Ill., for $20,049.

Ft. Wayne, Ind.—The Board of Works has decided on numerous streets to be paved with brick, sheet asphalt and block asphalt. Contracts will probably be let the first week in May.

Sarnia, Ont.—The Council has under consideration the purchase of a road roller.

Sioux City, Ia.—Asphalt pavement has been ordered laid on several streets.

Rye, N. Y.—The Board of Supervisors has authorized the town to borrow $10,042 for street work.

Schenectady, N. Y.—It is stated that bids are wanted April 11 by the City Council for brick paving on Clinton and Upper State Sts.

Boston, Mass.—Bids are wanted April 3 for paving the roadway of bridge on Summer St. extension across Ft. Point Channel. Wm. Jackson, City Engr.

Des Moines, Ia.—Bids are wanted April 10 for paving several alleys and streets with brick. G. A. Eberhart, Chmn. Bd. Pub. Wks.

Camden, N. J.—The City Council has adopted an ordinance authorizing the issue of $50,000 bonds for street asphalt paving.

Gloversville, N. Y.—Bids are wanted March 28 for 15,000 sq. yds. brick paving, probable cost $35,000. C. Fiske, Jr. City Engr.

Colfax, Wash.—It is stated that bids are wanted April 4 for furnishing 6 road machines. John F. Corner, Co. Aud. & Clk.

Albany. N. Y.—Bids are wanted April 3 for paving Howard and William Sts. with repressed vitrified paving bricks and granite block and for laying a vitrified pipe sewer. Thos. J. Lanahan, Clk. Bd. Contract and Apportionment.

Portland, Ind.—It is stated that bids are wanted April 17 for 25,000 sq. yds. brick paving. A. J. Frost, Engr. and Cit. Clk.

South Bend., Ind.—Bids are wanted April 10 for paving with brick on Tutt and South Scott Sts. L. A. Hull, City Clk.

Raleigh, N. C.—An election will be held June 12 to vote on the issue of $100,000 street improvement bonds and $50,000 school bonds.

Nantucket, Mass.—It is stated that bids are wanted March 29 for 2,163 sq. yds. granite block paving and relaying 3,500 sq. yds. cobble and 1,900 lin. ft. of macadamizing. Rodin M. Allen, Secy. Bd. Selectmen.

Rochester, N. Y.—Bids are wanted March 28 for repairing asphalt, not under guarantee, during 1899. Charles M. Beattie, Clk. Executive Bd.

Bedford, Ind.—Bids are wanted April 8 for 17 blocks of paving. G. C. Houston, City Engr.; W. M. Denniston, City Clk.

Akron, O.—It is stated that bids are wanted April 1 for 1,600 sq. yds. brick paving on Maple Lane Alley, and April 15 for 16,100 sq. yds. of brick or asphalt paving on Maple and Crosby Sts. John W. Payne, City Engr.

Joliet, Ill.—Local press reports state that the following bids were received for asphalt paving: R. F. Conway Co., Chicago, $104,675.85; James A. Sacley, Chicago, $110,540.50; Warren Scharf Co., Chicago, $121,506.65; Indiana Bermudez Asphalt Co., Indianapolis, $124,533.90; Bermudez Asphalt Co., Chicago, $136,388.50.

Lebanon, Ind.—H. S. Freeman, City Engr., writes that the contract for improving several streets (length 2,018 ft., width between curb 26ft.), has been awarded to Porter, Bolin, Hadley & Adams, of Tipton, Ind., at $6.17½ per lin. ft. complete with Indiana paving block for roadway, and Terre Haute sidewalk brick for walks.

Saginaw, Mich.—H. E. Terry, City Engr., writes that the following bids were opened March 17 for asphalt paving in two streets: Barber Asphalt Paving Co., N. Y. City, brick at $1.55 per sq. yd.; asphalt at $1.70 per sq. yd.; total, $56,931.70. Alcatraz Construction Co., N. Y. City, brick at $1.57; asphalt at $1.78; total, $60,173.30. F. E. Cole, Toledo, O., brick at $1.57; asphalt at $1.89; total, $61,588.40. The work includes 8,540 sq. yds. of brick, and 23,610 sq. yds. of asphalt paving, also a five-year maintenance guarantee, on which the three companies bid respectively, 8, 4 and 10 cts. per year.

POWER PLANTS GAS AND ELECTRICITY.

Liverpool, N. S.—Bids will probably be asked in May or June for an electric light plant to cost $9,000. C. O. Foss, Engr. in Charge, Bridgewater, N. S.

Osakis, Minn.—B. H. McCray is stated to have received a franchise for an electric light plant.

Vermont, Ill.—Potter & Benson, electrical contractors, of Chicago, are stated to have received a franchise to construct an electric light plant.

Oakland, Cal.—J. W. Chisholm, Vice-Pres. of the Equitable Gas Light Co., of San Francisco, writes that bids have been asked for gas engines, of not less than 250 h. p., and dynamos for a gas plant for power purposes only.

Providence, R. I.—The Providence Gas Co. is stated to have completed plans for two new buildings and an addition to one of its present structures, at a cost of about $50,000.

Indianapolis, Ind.—Albert Sahm, Chas. A. Bookwalter and others representing the Citizens' Light & Power Co., have petitioned the Board of Public Works for a franchise.

Auburn, N. Y.—The Universal Light, Heat & Power Co. has been incorporated; capital, $50,000. Directors: R. H. Huntington, of Watertown, and J. E. Ratchford, of Syracuse.

Darby, Pa.—It is reported that the new owners of the Darby Gas Co. will construct a $150,000 gas plant and extend the service pipes.

Stillwater, Okla.—An ordinance has been passed, but not yet approved, granting Abercrombie & Miller a franchise to construct a $5,000 to $7,000 electric light plant.

Easton, Pa.—A charter has been granted to the Delaware Gas Co., with a capital of $100,000, to manufacture and supply gas to Easton and West Easton. Incorporators: Alfred Clark, Lowell, Mass.; Arthur B. Childs, Boston, Mass.; Henry McKeen and Ed. J. Fox, Easton, Pa.

Red Oak, Ia.—The Red Oak Electric Co., is stated to have applied for a franchise for a hot-water heating plant.

Hanover, N. H.—See "Schools."

Pitcairn, Pa.—The Council is stated to have granted the North Versailles Electric Light Co. and the Turtle Creek Valley Electric Light Co. rights of way in the town.

Simsbury, Conn.—Both Houses of the Legislature have passed the bill granting the Simsbury Electric Co. a charter to construct an electric light plant.

Albert Lea, Minn.—The Council Committee on Electric Lights is stated to have reported in favor of a municipal electric light plant, and estimates the cost at $18,000.

Bridgeport, Pa.—There is talk of constructing an electric light plant.

Watertown, Wis.—Henry Bieber, City Clk., writes that the contract for street lighting for a period of 5 years has been awarded to the present Electric Light Co., for $60 per light per year.

Delphos, O.—The Yaryan Hot Water Construction Co., of Toledo, is stated to have received a franchise to erect and maintain a hot-water heating system.

Tuckahoe, N. Y.—The Westchester Gas & Coke Co. is stated to have received a franchise to lay gas mains and construct storage tanks in the town.

Mt. Gilead, O.—See "Water."

Spartanburg, S. C.—Joseph M. Elford, City Clk., writes that bids received March 1 for furnishing 100 arc lights of 2,000 c. p. have been rejected; new bids will be asked.

Mayville, N. D.—See "Water."

Indianapolis, Ind.—Bids are wanted April 5 for 2 30-h. p. gas engines, 2 25-k. w. dynamos, 2 jack shafts and 1 switchboard for operation in the crypt of the Indiana State soldiers and sailors' monument. E. P. Thompson, Secy. Bd. of Regents of the State Soldiers and Sailors' Monument.

Kansas City, Mo.—See "Government Work."

Scranton, Miss.—It is stated that it is proposed to improve the city electric light plant. Chas. I. Frair, Supt.

Gas City, Ind.—Some improvements will probably be made to the electric light plant. J. M. Bravo, City Engr.

Forsyth, Ga.—It is stated that bids are wanted April 3 for an electric light plant. T. J. Hardin, Mayor.

Kenosha, Wis.—The Council on March 20 granted W. H. Schott, of Chicago, a franchise to construct and maintain a hot water heating plant. The construction of the plant will begin at once, and will cost about $100,000.

Manistique, Mich.—It is reported that the electric light plant will be enlarged.

South Boston, Va.—R. H. Easley, of Houston. Va., is interested in the construction of an electric light plant, estimated to cost about $50,000.

New Rochelle, N. Y.—The contract for street lighting for the year was awarded as follows: To the East Chester Electric Co., for arc lights, $120 a yr. and incandescent at $25, and to the Welsbach Co., for gas lights at $33 a yr. The Larchmont Electric Co. now supplies the village.

Jackson, O.—It is stated that bids are wanted April 1 for the purchase of the electric light plant owned by the city and for furnishing the city with electric lights. M. D. Jones, City Clk.

Prineville, Ore.—See "Water."

Manchester, Mass.—Roland C. Lincoln and Chas. L. Martin, are stated to have been appointed to investigate the question of an improved lighting system.

Carbondale, Pa.—It is stated that the Lackawanna Valley Electric Light & Power Co. has been incorporated, with a capital of $200,000. Incorporators: Wm. D. Boyer, Scranton; T. L. Newell, Kingston, Pa., and others.

Ft. Wayne, Ind.—The Jenney Electric Light & Power Co. is stated to have applied for a franchise to place its wires in this city.

San Carlos, Ariz.—See "Water."

Milwaukee, Wis.—It is stated that plans, specifications and estimates are being prepared for a light, heat and power plant for the court house and jail.

Fairfield, Cal.—The Clear Lake Electric Power Co. is stated to have applied to the Supervisors of Solano, Sonoma and Napa Counties for permission to construct an electric power line. Richard Wylie, Pres., Napa, Cal.
Bids will be received for the above franchise by the Supervisors of Solano County, May 1.

Richmond, Va.—It is stated that the city will expend about $10,000 to improve the gas plant. W. P. Knowles, Supt.

Jersey City, N. J.—The Board of Inspectors of New Jersey State Prisons are stated to have recommended that an electric light plant be installed at an estimated cost of $22,000.

Phillipsburg, N. J.—The plant of the Warren County Gas Co. has been purchased by Edward C. Jones, 1 Nassau St., N. Y. City, and Liddon Flick, of Wilkesbarre, Pa. It is stated that the new owners will improve the system and double the present capacity of the plant.

Girard, Ill.—It is stated that the electric light question will be submitted to a vote of the people.

Linton, Ind.—See "Water."

Worcester, Mass.—The City Hospital Trustees are stated to have petitioned the Council for $60,000 for a lighting, heating and ventilating plant for the hospital.

ELECTRIC RAILWAYS.

Berlin, N. H.—C. P. Day and D. J. Dailey are interested in the proposed electric railway, which will probably be about 4 miles long.

Pottsville, Pa.—The Coal Castle Electric Ry. Co. has been incorporated to build a line 2 miles long in Schuylkill County; capital, $30,000. Directors: R. Steen Martin, John M. Emery and others, of Philadelphia.

Los Gatos, Cal.—E. N. Davis is reported to have petitioned for a franchise.

Columbus, O.—The National Traction Co. has been incorporated with a capital of $10,000 to build and operate an electric railway along or near the National road from Columbus to the west State line of Ohio, through Franklin, Madison, Clarke, Miami, Montgomery and Preble counties; principal office to be at Phoneton, Miami County. Incorporators: J. O. A. Hooker, O. P. Waymire, L. F. Hutchins and others.

Auburn, N. Y.—The Auburn Inter-Urban R. R. Co. is stated to have filed with the Secretary of State a certificate of the extension of its line from Skaneateles to Syracuse. G. R. Leonard, Pres.

Bethlehem, Pa.—A charter has been granted to the Bethlehem & Freemansburg St. Ry. Co. to construct a line from Bethlehem to Butztown; capital, $21,000. M. P. McGrath, Pres., Worcester, Mass.

Appleton, Wis.—Wm. Michelstetter is stated to be interested in the construction of an electric railway between this place and Seymour.

Wildwood, N. J.—An ordinance is stated to have been introduced in Council granting Cyrus Hoffa, of Lewisburg; Philip P. Baker, of Vineland, and John N. Reese, of Wildwood, a franchise to construct and operate an electric railroad.

Hancock, Mich.—Stone & Webster, of Boston, are stated to have received a franchise for an electric line to connect Laurium, Lake Linden and other points.

Easton, Pa.—A charter has been granted to the Northampton Southern St. Ry. Co. with a capital of $36,000, to construct a line 6 miles long from Easton to Middletown. Chas. H. Cox, Pres., Bethlehem.

Delavan, Wis.—H. T. Windsor, of Chicago, and W. F. Tyrrell, of this city, are stated to have applied for a franchise.

Frankfort, Ind.—The Indianapolis & Logansport Traction Co. is stated to have applied for a franchise through Clinton County over the Michigan road.

Neenah, Wis.—The Council on March 16 is stated to have passed an ordinance granting franchises to the Citizens' Traction Co. and the Fox River Valley Co.

Saline, Mich.—Capt. E. P. Allen, of Ypsilanti, is stated to have secured a franchise from the Township Board to continue the Ypsilanti and Saline electric road through the township to Tecumseh.

Nazareth, Pa.—A charter was granted March 7 to the Nazareth & Lehigh Ry. Co.; capital, $10,000. Directors: G. W. Mackey, Bangor, Pa.; Conrad Miller, of Nazareth, and others.

Lyons, N. Y.—Chas. W. Field and Lucius L. Moses, of the Clyde Electric Co., are stated to have secured right of way for an electric railway from Clyde to Bonnie Castle.

Niagara Falls, N. Y.—The Niagara Falls & Suspension Bridge Ry. Co. is stated to have applied for a franchise for a crosstown system of trolley lines. J. T. Jones, Pres.

Florence, Colo.—Thos. Robinson, of Florence, is stated to have received a franchise in this has received a franchise in this place and Canon City.

Home City, O.—Bids are wanted April 8 for the construction and operation of a street railroad on Independence Ave. J. O. Falkenburg, Village Clk.

North Bend, O.—Bids are wanted April 6 for the construction and operation of a street railroad. D. E. Gleason, Hamlet, Clk.

Wilmington, Del.—The Wilmington & New Castle Electric Ry. Co. is stated to have decided to extend its line from New Castle to Delaware City, a distance of about 10 miles. Harry A. Richardson, of Dover, and Peter L. Cooper, Jr., of Wilmington, are directors.

Delhi, O.—Bids are wanted April 6 for the construction and operation of a street railroad. Walter Stone, Village Clk.

Pen Argyl, Pa.—T. A. H. Hay and M. C. Sawin, representing the Slate Belt Electric Ry. Co. have petitioned for a franchise.

Youngstown, O.—It is stated that plans are being prepared for a power house for the Mahoning Valley St. Ry. Co.

Fernbank, O.—Bids are wanted April 6 for the construction and operation of a street railroad. W. E. Wynne, Village Clk.

Dayton, O.—The Dayton, Springfield & Urbana Electric Ry. Co. is stated to have received a new franchise. It will be necessary for the company to construct a new bridge across the hydraulic at Springfield St.

Norwich, Conn.—The Senate is stated to have passed a bill authorizing the Montville St. Ry. Co. to construct a railway from this place to New London.

Addyston, O.—Bids are wanted April 6 for the construction and operation of a street railroad. W. T. Coleman, Village Clk.

Chillicothe, O.—The Chillicothe, Bainbridge & Hillsboro Electric R. R. Co. was incorporated March 17, with a capital of $1,000 to build an electric railway from Chillicothe to Hillsboro. Incorporators: J. K. Duffy, T. S. Mitchell, J. F. Harmon, and others.

Huntsville, Ala.—T. W. Pratt writes that the construction of the proposed electric railway will cost about $80,000.

Cumberland, Md.—The County Commissioners are stated to have granted a franchise to the Cumberland Westernport Electric R.R. Co.

Cleves, O.—It is stated that bids are wanted April 6 for the construction and operation of a street railway. V. M. Henderson, Village Clk.

Mt. Vernon, N. Y.—The New York, Westchester & Connecticut Traction Co. on March 21 applied for a franchise.

Cincinnati, O.—The Cincinnati Connecting Belt R.R. Co. was incorporated March 21 to build a line from near Gilbert Ave. and Court St., out through Norwood, Bond Hill, Elmwood, College Hill and Mt. Healthy; capital, $300,000. Incorporators: J. G. Schmidlapp, Thos. D. Rhoads and others.

Muncie, Ind.—The County Commissioners are stated to have granted a franchise to a company to construct a line between this city and Anderson, through Daleville. Chas. Henry, of Anderson, is said to be interested.

RAILROADS.

Wautoma, Wis.—The Chicago & West Wisconsin Ry. Co., is said to be considering the matter of extending its line to this place from Princeton. J. L. Pennifill, Pres.; A. K. Welles, Secy. General office, Princeton.

Jacksonville, Fla.—The Atlantic, Valdosta & Western R. R. Co. is stated to have received a franchise.

Baltimore, Md.—Jas. F. McCabe is stated to have received the contract for improvement on the Baltimore & Ohio Railroad; contract said to amount to $500,000.

Jacksonville, Fla.—The Jacksonville Southwestern R. R. Co. has been incorporated, with a capital of $450,000, to built a railroad from Cummer's mill, through Duval, Baker, Bradford, Alachua and Levy counties to Manatee, a distance of 103 miles. Incorporators: Jacob Cummer, Wellington W. Cummer and others.

Watonga, Okla.—A charter is stated to have been granted to the Kansas, Oklahoma Central & Texas R.R. Co., with general offices at Watonga, for a railroad 650 miles long; capital, $5,000,000. F. Hagerman, of Salina, Kan., is one of the incorporators.

Alexandria, La.—The Natchez, Alexandria & Waco R. R. Co. has been incorporated; capital, $3,500,000; F. M. Welch, Pres.; I. W. Sylvester, Ch. Engr. and Gen. Mgr., both of Alexandria. survey will be started at once towards Waco, The preliminary survey will be started at once towards Waco, Tex.

Uniontown, Pa.—A charter was granted March 17 to the Coke Belt St. Ry. Co. with a capital of $600,000, to run through Fayette and Westmoreland Counties, a distance of about 30 miles. Directors: J. E. Weller, Pittsburg; F. S. Young, Wilkinsburg, and others.

PUBLIC BUILDINGS.

(See also Schools and Government Work.)

Salem, Mass.—The Council is stated to have appropriated $35,000 for a police station.

Waupaca, Wis.—The plans of Buemming & Dick, of Milwaukee, are stated to have been accepted for a $25,000 hospital for the Wisconsin Veterans' Home.

Madison, Minn.—The citizens are stated to have voted March 14 to erect a court house.

Philadelphia, Pa.—Allen B. Rorke, Bourse Bldg., has received the contract for erecting the exposition building at $298,000.

Harrisburg, Pa.—Bids are wanted April 15 for a group of buildings for the Pennsylvania State Lunatic Hospital. H. L. Orth, Pres.

Alturas, Cal.—It is stated that bids are wanted April 3 for a jail. L. S. Smith, Clk.

Saginaw, Mich.—The House is stated to have passed a bill authorizing Saginaw County to submit to the voters the question of building an insane asylum to cost $75,000.

Auburn, Cal.—It is stated that plans and specifications are wanted April 5 for a hospital; also for six burglar-proof steel jail cells, with corridor and partition screen. J. B. Landis, Co. Clk.

Oshkosh, Wis.—Local press reports state that the Building Committee of the County Board will receive bids April 10 for a jail and sheriff's residence.

Bedford, Ind.—It is proposed to build two stone churches this season.

Redfield, S. D.—The House is stated to have passed a bill appropriating $35,000 to establish an asylum here for feeble-minded.

Chicago, Ill.—Saml. A. Treat, Fisher Bldg., is said to be preparing plans for a $75,000 building for Henry Horner & Co.

Nashua, N. H.—Plans for a court house for Hillsborough County are wanted until April 19. J. F. Clough, Co. Commr., Manchester, N. H.

Birmingham, Ala.—The Special Committee of the City Council will at an early date invite plans and specifications for a new city hall.

Madelia, Minn.—Bids are wanted March 31 for a store. Address Peart, Stone & Co.

Carlington, O.—Bids are wanted April 10 for a church. W. H. Mallory, Secy.

Tacoma, Wash.—It is stated that a $40,000 wing will be erected to the Steilacoom Asylum.

New York City.—The Board of Estimate on March 17 authorized the issue of $500,000 bonds for the demolition of the old 42d St. reservoir and the construction of the foundations for the New York Library.

St. Augustine's R. C. Church is to have a new chapel, rectory and parochial school, to be located on 6th Ave. and Prospect Place; estimated cost, $150,000. Plans are said to have been drawn. Rev. L. J. McCarthy, Pastor.

BUSINESS BUILDINGS.

Martins Ferry, O.—Joseph Leiner, of Wheeling, W. Va., has prepared plans for a $10,000 brick and stone office building to be built by J. C. Gray, at Hanover and 4th Sts.

Wheeling, W. Va.—The West Virginia Printing Co. is about to erect a $10,000 brick block, with elevator, etc., on Market St. Joseph Leiner, Archt.

Jersey City, N. J.—John A. Resch, of Jersey City, has prepared plans for brick stores and apartments to be erected on Ocean and Clairmount Aves., at a cost of $50,000.

Scranton, Pa.—The Lackawanna Trust & Safe Deposit Co. is about to build a $50,000 bank building on Lackawanna Ave. Wm. Fuller, Albany, N. Y., Archt.

Colorado Springs, Colo.—Lymas S. Atkinson, of Colorado Springs, is stated to have received the contract for rebuilding the Alamo Hotel; estimated cost, $80,000.

Albany, N. Y.—It is stated that plans are about completed and bids will soon be asked for a building for the West Albany Y. M. C. A.

Richmond, Va.—There is talk of erecting a union depot here, to cost about $100,000. G. W. Stevens, Gen. Mgr. Chesapeake & Ohio R.R. Co., Richmond, is said to be interested.

Philadelphia, Pa.—It is stated that Geo. C. Boyd will erect a new hotel on the site of the Stratford Hotel, to cost about $3,000,000.

Newport News, Va.—M. J. Dimmock, of Richmond, is stated to be preparing plans for an opera house, to be erected here for Thos. G. Leath, to cost about $70,000.

Philadelphia, Pa.—It is stated that Wm. R. Warner & Co. will erect a 10-story structure at 1228 Market St., to replace building recently destroyed by fire, and have asked architects to submit competitive plans.

Pittsburg, Pa.—Plans are stated to have been completed and bids will soon be asked for the union depot; it will cost, with other contemplated improvements, about $1,645,400. W. H. Brown, Philadelphia, Ch. Engr., Pennsylvania R. R. Co.; J. A. Atwood, Pittsburg, Ch. Engr. Pittsburg & Lake Erie R. R. Co.

Boston, Mass.—Woodbury & Leighton, Boston, are to erect an 8-story steel fireproof building for stores and offices at 185 Summer St., for Atherton T. Brown, from plans by J. H. Besarick, 23 Central St. Estimated cost, above foundations, $70,000.

NEW YORK CITY.

Permits for the following buildings have been issued; o, signifies owner; a, architect; b, builder, and c, contractor.

173 Ave A, br store & tenem't, cost, $38,000; o, Wm Evans; a, J F Kelly & Co.

340 & 342 East 4th st, br store & tenem't, cost, $38,000; o, Adolph Mandel; a, Samuel Sass.

Broadway & Chambers st, br office building, cost, $700,000; o, Estate of Sarah H. Andrews; a, Cass Gilbert.

3d st & 2d ave, 4 br stores & flats, cost, $114,000 all; o, Jacob Kassewitz; a, G F Pelham.

29 East 10th st, br warehouse, cost, $50,000; o, James McPherson; a, Louis Korn.

Washington & Desbrosses sts, br loft & warehouse, cost, $28,000; o, Sylvester L Mitchell; a, Kurtzer & Rohl.

36 & 38 Delancey st, 138 Forsyth st, br store & tenem't, cost, $32,000; o, Henry C Tinker; a, Stephenson & Greene.

557 to 563 West 47th st, br factory & stable, cost, $57,700 all; o, American Meter Co; a, Edward Ogden & Son.

564 to 568 5th ave, br stores and offices, cost, $103,000; o, H A Hutchins; a, C P H Gilbert.

422 & 424 West 58th st, br telephone exchange, cost, $30,000; o, N Y Telephone Co.; a, C L W Eidlitz.

425 West 25th st, br factory, cost, $40,000; o, Eliza D Hencken; a, J A Sinclair.

37 to 41 West 44th st, br & stone club, cost, $200,000; o, N Y Yacht Club; a, Whitney Warren & Chas D Wetmore.

Broadway & 95th st, br store & flat, cost, $200,000; o, T Reinhardt; a, Henry Anderson.

Union ave & Dawson st, br store & flat, cost, $20,000; o, Fred C. Burlingham; a, David B Emerson.

Cass Gilbert, of St. Paul, Minn., is stated to have prepared plans for an 18-story building to be erected on Broadway and Chambers St., to cost about $700,000. Geo. A. Fuller, 160 5th Ave., is executor of the estate.

ALTERATIONS.

120 Broadway, interior alterations, cost, $30,000; o, Equitable Life Assur Soc; a, John B Cashman.

DWELLINGS.

Kansas City, Mo.—Van Brunt & Howe have prepared plans for 2 brick flats, one owned by E. T. Smith will be located on 9th and Oak Sts. and cost $25,000; the other, owned by F. S. Doggett, will be on 11th and Jefferson Sts., and cost $30,000.

Poughkeepsie, N. Y.—Percival M. Lloyd, of Poughkeepsie, has prepared plans for a bluff brick colonial house 40 x 40 ft.

Seattle, Wash.—The Moore Investment Co. is said to be preparing to build an $80,000 apartment house.

Manchester, N. H.—Gordon Woodbury will build a 5-story flat building this spring on Chestnut and Concord Sts.

Boston, Mass.—A block of 22 houses is to be built on Parker Hill Ave. and Coppinger St., Roxbury, by Benjamin Wm. E. Walsh, of Cambridge, owner and builder. Estimated cost above the foundations, $90,000.

Benjamin Harris, 51 Allen St., Builder, is about to build a block of 7 houses on Haskins St., Roxbury, from plans by C. A. Halstram, 7 Exchange St. Cost, $35,000.

Connery & Wentworth, Boston, have a permit for building foundations for an all-stone front dwelling for A. A. Burrage. Charles Brigham, 7 Mount Vernon St., Archt.

NEW YORK CITY.

Permits for the following buildings have been issued; o, signifies owner; a, architect; b, builder, and c, contractor.

132 & 134 West 45th st, br bachelor apartment, cost, $125,000; o, Mohawk Realty Co.; a, Neville & Bagge.

244 to 248 Clinton st, 2 br flats, cost, $50,000 all; o, Roginsky & Perelman; a, M Bernstein.

10th ave and 51st st, br flat, cost, $30,000; o, James Buckley & C F Sheehan; a, James W Cole.

992 5th ave, br dwell'g, cost, $80,000; o, Mrs. J M Livingston; a, Geo A Freeman.

91st st & 1st ave, 4 br flats, cost, $100,000 all; o, Gundlach & Koch; a, Henry Anderson.

125 East 83d st, br flat, cost, $22,000; o, Tobias Krakower; a, G F Pelham.

Amsterdam ave & 86th st, br flats, cost, $200,000; o, E Wm Wagner; a, Flemer & Koehler.

Central Park West & 100th st, br flat, cost, $100,000; o, J C Murray; a, L F J Weiher, Jr.

112th st & 8th ave, 2 br flats, cost, $80,000 all; o, J B Squier; a, L F J Weiher, Jr.

112th st & 5th ave, 5 br flats, cost, $162,500 all; o, Seglin Bros; a, Schneider & Herter.

131st st & Lenox ave, br flat, cost, $35,000; o, C H Brown; a, L F J Weiher, Jr.

Lenox ave & 129th st, br apartment house, cost, $185,000; o, Isaac L Smith; a, Richard R Davis.

Webster ave & Scribner st, 2 br flats, cost, $40,000 all; o, James De Carlo; a, Lawrence & Ringrose.

178th st & Webster ave, 4 br flats, cost, $80,000 all; o, C J Singhi; a, Henry Anderson.

Plans were filed March 22 for an apartment house on 70th St. and Central Park West; estimated cost, $650,000. Stein, Cohen & Roth, Owners and Archts.

Babb, Cook & Willard, 3 West 29th St., are stated to have prepared plans for a dwelling for Andrew Carnegie, to be erected on 5th Ave., between 90th and 91st Sts.

BROOKLYN, N. Y.

Prospect pl & Bedford ave, br tenem't, cost, $20,000; o, C W Hagedorn; a, W Higginson.

NEW INDUSTRIAL PLANTS.

E. H. Dyer & Co., New England Bldg., Cleveland, Ohio, have contracts for erecting 450-ton beet sugar works at Grand Junction, Colo., Benton Harbor and Holland, Mich.

L. W. Cherry, Little Rock, Ark., expects to put up a brewery with an annual capacity of 30,000 bbls.

P. Goforth, Bethany, S. C., is in the market for a 40-H.-P. boiler, 20-H.-P. and 15-H.-P. engines and machinery for flour mill and cotton gin.

J. N. Lipscomb and others, of Gaffney, S. C., have incorporated the Victor Cotton Oil Co., and will erect a 30-ton mill. The contract for the building has been placed.

The Gillie Engine & Machine Co., North Tonawanda, N. Y., will occupy a 30x50-ft. foundry, a 20x30-ft. engine and boiler house containing an 80-H.-P. boiler and a 35-H.-P. engine, and a 30x70-ft. machine shop.

The West Virginia Boiler & Machine Works will erect shops and a foundry at Mannington, W. Va., contracts for the buildings having been placed already. The main structure will be about 125x50 ft. The officers of the company are: President, R. D. Sheppard; secretary and treasurer, F. W. Chichester; superintendent, J. C. Sheppard, all of Greensburg, Pa.

The James H. Baker Mfg. Co., Ferguson Block, Pittsburg, will put up a plant at once, the first building to be erected being about 80x220 ft., with boiler house. A 100-H.-P. plant will be installed very soon.

The West Virginia Pulp & Paper Co., Piedmont, W. Va., will build mills on the main line of the Chesapeake & Ohio Railway, for which a power plant of about 3,000 H.-P. will be required. All of the engineering work is in the hands of Westinghouse, Church, Kerr & Co.

M. M. Sims & Son, Washington, Ga., will put up a 40x100-ft. building and install ginning and baling machinery.

McCurry & Inman, Fairburn, Ga., will put up a 4-story 100x42-ft. building in Atlanta, and also use floor space in an adjoining building for manufacturing harness and saddlery goods. They expect to use steam power.

The Florida Fertilizer Mfg. Co., Gainesville, Fla., will rebuild its plant and put in machinery for an output of 50 tons daily.

BUSINESS NOTES.

The Water Commissioners of Olean, N. Y., have placed a contract with the Snow Steam Pump Works for a vertical Corliss pumping engine.

The Dubuque, Ia., Water Co. has ordered from the O. H. Jewell Filter Co., Chicago, a 2,500,000-gal. plant of gravity filters.

The Vincennes, Ind., Water Supply Co. has placed an order for 10 filters of 500,000 gals. each, and the same number of settling tanks with the Continental Filter Co., New York.

The wide-spread popularity of compressed air for industrial purposes is shown by recent shipments of pneumatic tools by the Chicago Pneumatic Tool Co. to South Africa, Pago Pago in the Samoan Islands, South America, Australia, China and Japan.

The Buffalo Forge Co., Buffalo, N. Y., announces the removal of its offices in New York to 129-130 Taylor Building, 39 Cortlandt Street.

The Pierce Butler & Pierce Mfg. Co., Syracuse, N. Y., is erecting a 200 x 100-ft. addition to their radiator plant at Eastwood Heights. The new works will double the company's capacity for turning out radiators. The demand for their goods has led them to contract with another manufacturer for several hundred thousand feet of radiation in addition to what they can produce at their own works.

PROPOSALS OPEN.

WATER-WORKS.

Bids Close.		See Eng. Record
Mar. 27.	Pipe, Laporte, Ind	Mar. 18
Mar. 27.	St. Paul, Minn	Mar. 25
Mar. 27.	Engine, Michigan City, Ind	Mar. 25
Mar. 28.	Well, Atlanta, Ga	Mar. 25
Mar. 28.	Reading, Pa	Mar. 25
Mar. 28.	Darlington, Okla.	Mar. 11
Mar. 29.	Chicago, Ill	Mar. 25
Mar. 29.	Pump, South Bend, Ind	Mar. 11
Mar. 30.	Meadville, Pa — Adv. Eng. RECORD, Mar. 25.	Mar. 25
Mar. 31.	Pipe, etc., Minneapolis, Minn	Mar. 18
Apr. 1.	Cullman, Ala. — Adv., Eng. RECORD, Mar. 18.	Mar. 11
Apr. 1.	Fire hydrants, Washington, D. C. — Adv., Eng. RECORD, Mar. 11.	Mar. 11
Apr. 3.	Lockport, N. Y	Mar. 18
Apr. 3.	Engine, Winnepeg, Man. — Adv., Eng. RECORD Feb. 4 to 18.	Feb. 4
Apr. 3.	Supplies, Winnipeg, Man. — Adv. Eng. RECORD, Mar. 11 to 25.	Mar. 11
Apr. 3.	Baird, Tex	Mar. 25
Apr. 4.	Albany, N. Y	Mar. 25
Apr. 4.	Berea, O	Mar. 25
Apr. 4.	Pipe, Boston, Mass — Adv., Eng. RECORD, Mar. 18.	Mar. 18
Apr. 5.	Boiler, Newport, Ky	Mar. 25
Apr. 5.	Mayville, N. D	Mar. 25

Apr. 5. Pipe, Yonkers, N. Y. .... Mar. 25
Apr. 7. Austin, Minn .... Mar. 25
Adv., Eng. RECORD, Mar. 25.
Apr. 8. Ontario, Cal .... Mar. 25
Apr. 8. Fort McPherson, Ga .... Mar. 18
Adv. Eng. RECORD, Mar. 4.
Apr. 10. Boilers, Montgomery, Ala .... Mar. 18
Apr. 10. Tank, Washington, D. C .... Mar. 11
Apr. 11. Philadelphia, Pa .... Mar. 11
Apr. 11. Lakeport, Cal .... Feb. 25
Apr. 12. Seattle, Wash .... Mar. 18
Adv., Eng. RECORD, Mar. 18, 25.
Apr. 12. Manka'o, Kan .... Mar. 25
Apr. 12. Iron pipe, etc., Cincinnati, O. .... Mar. 25
Apr. 15. Golden, Colo .... Mar. 18
Apr. 15. Forestport, N. Y .... Mar. 4
Apr. 15. Pumping engine, Montgomery, Ala. Mar. 25
Apr. 17. Lakeport, Cal .... Mar. 25
Apr. 18. San Carlos, Ariz .... Mar. 25
Apr. 18. Butte, Mont .... Mar. 18
Apr. 28. Cincinnati, O .... Mar. 25
Adv., Eng. RECORD, Mar. 25.
—— Engine, Marion, Ind .... Mar. 4
—— Pumps, etc., Dubuque, Ia .... Mar. 4
—— Napoleonville, La .... Mar. 25
—— Corinth, Miss .... Mar. 25

SEWERAGE AND SEWAGE DISPOSAL.

Mar. 27. Ft. Wayne, Ind. .... Mar. 25
Mar. 28. Kearney, N. J. .... Mar. 11
Mar. 29. Chicago, Ill. .... Mar. 25
Mar. 31. East Cleveland, O .... Mar. 18
Mar. 31. Minneapolis, Minn .... Mar. 18
Apr. 1. Havana, Ill .... Mar. 11
Adv., Eng. RECORD, Mar. 11.
Apr. 1. Athens, Ga .... Mar. 18
Adv., Eng. RECORD, Mar. 18.
Apr. 3. Lockport, N. Y .... Mar. 18
Apr. 3. Plainfield, N. J .... Mar. 18
Apr. 3. Whiting, Ind .... Mar. 18
Apr. 3. Albany, N. Y. .... Mar. 25
Apr. 3. Toledo, O .... Mar. 25
Apr. 4. East Liverpool, O .... Mar. 18
Apr. 6. Submerged sewer, New London, Conn .... Mar. 11
Adv., Eng. RECORD, Mar. 11.
Apr. 6. Vitrified pipe, New London, Conn. . Mar. 11
Adv., Eng. RECORD, Mar. 11.
Apr. 12. Salem, O .... Mar. 18
Apr. 15. Honolulu, H. I .... Feb. 25
Adv., Eng. RECORD, Feb. 25, Mar. 4.
Apr. 18. San Carlos, Ariz .... Mar. 25

BRIDGES.

Mar. 25. North Adams, Mass. .... Mar. 11
Adv., Eng. RECORD, Mar. 11, 18.
Mar. 27. Boston, Mass .... Mar. 25
Mar. 30. Urbana, Ill .... Mar. 25
Mar. 31. Minneapolis, Minn .... Mar. 18
Apr. 1. Substructure, St. Joseph, Mo .... Jan. 7
Apr. 1. New Whatcom, Wash .... Mar. 4
Apr. 1. Columbus, O .... Mar. 11
Apr. 1. Eau Claire, Wis .... Mar. 25
Apr. 3. Ellensburg, Wash .... Mar. 25
Apr. 3. Mitchell, S. D .... Mar. 25
Apr. 3. Kalama, Wash .... Mar. 18
Apr. 3. Grand Forks, N. D .... Mar 18
Apr. 4. Somerville, N. J .... Mar. 25
Apr. 4. Superstructure, Sidney, O .... Mar. 18
Apr. 5. Columbus, O .... Mar. 11
Apr. 5. Dakotah, Ia .... Mar. 25
Apr. 6. Goldbeach, Ore .... Mar. 25
Apr. 7. Superstructure, Cleveland, O .... Mar 18
Apr. 8. Columbus, O .... Mar. 18
Apr. 10. Chicago, Ill .... Feb. 18
Adv., Eng. RECORD, Feb. 18.
Apr. 12. Columbus, O .... Mar. 18
Apr. 12. Batavia, O .... Mar. 25
Apr. 15. Hartford, Conn .... Mar. 25
Adv., Eng. RECORD, Mar. 25.
Apr. 15. Gainesville, N. Y .... Mar. 25
Apr. 23. Raleigh, N. C .... Mar. 18
—— Quincy, Ill .... Feb. 25
Adv., Eng. RECORD, Feb. 25.
May 10. Chicago, Ill .... Mar. 18
Adv., Eng. RECORD, Mar. 25.

PAVING AND ROADMAKING.

Mar. 27. Nebraska City, Neb .... Mar. 18
Mar 27. Toledo, O .... Mar. 4
Mar. 28. Buffalo, N. Y .... Mar. 18
Mar. 28. Bellefontaine, O .... Mar. 11
Mar. 28. Gloversville, N. Y .... Mar. 25
Mar. 28. Rochester, N. Y .... Mar. 25
Mar. 28. Richmond, Va .... Mar. 25
Mar. 28. Worcester, Mass .... Mar. 25
Mar. 29. Nantucket, Mass .... Mar. 25
Mar. 29. Hartford, Conn .... Mar. 18
Adv., Eng. RECORD, Mar 18, 25.
Mar. 30. Reading, Pa .... Mar. 18
Adv., Eng. RECORD, Mar. 18, 25.
Apr. 1. Athens, Ga .... Mar. 18
Adv., Eng. RECORD, Mar. 18, 25.
Apr. 1. Akron, O .... Mar. 25
Apr. 3. Boston, Mass .... Mar. 25
Apr. 3. Union City, Pa .... Mar. 18
Adv., Eng. RECORD, Mar. 18, 25.
Apr. 3. Albany, N. Y .... Mar. 25
Apr. 3. Paterson, N. J .... Mar. 25
Adv., Eng. RECORD, Mar. 25.
Apr. 4. Road machines, Colfax, Wash. .... Mar. 25
Apr. 5. Trenton, N. J .... Mar. 25
Apr. 5. Asphalt, Winnipeg, Man. .... Mar. 11
Adv., Eng. RECORD, Mar. 11 to 25.
Apr. 8. Bedford, Ind .... Mar. 25
Apr. 10. Lafayette, Ind .... Mar. 18
Adv., Eng. RECORD, Mar. 18, 25.
Apr. 10. South Bend, Ind .... Mar. 25
Apr. 10. Bedford, Ind .... Mar. 25
Apr. 10. Des Moines, Ia .... Mar. 25
Apr. 11. Schenectady, N. Y .... Mar. 25
Apr. 11. Huntington, Ind .... Mar. 11
Apr. 12. Salem, O .... Mar. 18
Apr. 14. Waukesha, Wis. .... Mar. 25
Apr. 15. Akron, O .... Mar. 25
Apr. 17. Portland, Ind. .... Mar. 25

Apr. 17. Risingsun, Ind .... Mar. 25
Apr. 17. Bridgeport, O. .... Mar. 25
Apr. 17. Toledo, O .... Mar. 25
Apr. 28. Bellefontaine, O .... Mar. 25

POWER, GAS AND ELECTRICITY

Mar. 28. Kansas City, Mo .... Mar. 25
Mar. 30. Defiance, O .... Mar. 18
Mar. 31. Telephone, Shanghai, China .... Nov. 19
Mar. 31. Springhill, N. S .... Mar. 11
Mar. — Fonda, Ia .... Mar. 4
Apr. 1. Cullman, Ala. .... Mar. 11
Adv., Eng. RECORD, Mar. 18.
Apr. 1. Palo Alto, Cal .... Mar. 18
Apr. 1. Jackson, O .... Mar. 25
Apr. 3. Forsyth, Ga. .... Mar. 25
Apr. 4. Picton, Ont .... Mar. 18
Apr. 4. New York, N. Y .... Mar. 11
Apr. 4. Transmission line, Benica, Cal .... Mar. 11
Apr. 5. Mayville, N. D .... Mar. 25
Apr. 5. Indianapolis, Ind .... Mar. 25
Apr. 8. Norfolk, Va .... Mar. 11
Apr. 10. Dayton, O .... Mar. 4
Adv., Eng. RECORD, Mar. 4, 11.
Apr. 18. San Carlos, Ariz .... Mar. 25
May 1. Franchise, Fairfield, Cal. .... Mar. 25
—— Pleasantville, O .... Dec. 24

GOVERNMENT WORK.

Mar. 27. Santa Fe, N. M. .... Mar. 11
Mar. 28. Water, Darlington, Okla. .... Mar. 11
Mar. 28. Chicago, Ill .... Mar. 4
Adv., Eng. RECORD, Mar. 4 to 25.
Mar. 28. Kansas City, Mo .... Mar. 25
Mar. 30. Ice plant, Manila, Philippine Islands .... Mar. 18
Apr. 1. Tompkinsville, N. Y .... Mar. 18
Apr. 1. Rock Island, Ill .... Mar. 11
Adv., Eng. RECORD, Mar. 11 to 25.
Apr. 5. Vicksburg, Miss .... Mar. 4
Adv., Eng. RECORD, Mar. 4 to 25.
Apr. 6. New Orleans, La .... Feb. 11
Adv., Eng. RECORD, Feb. 11 to 25.
Apr. 6. Wilmington, Del .... Mar. 11
Adv., Eng. RECORD, Mar. 11 to 25.
Apr. 8. Norfolk, Va. .... Mar. 11
Apr. 10. Tank, Washington, D. C. .... Mar. 11
Apr. 10. Kansas City, Mo .... Mar. 11
Adv., Eng. RECORD, Mar. 11.
Apr. 13. St. Paul, Minn .... Mar. 18
Adv., Eng. RECORD, Mar. 18, 25.
Apr. 13. Steam heating plant, Grand Junction, Colo .... Mar. 25
Apr. 14. Louisville, Ky. .... Mar. 11
Apr. 17. San Francisco, Cal .... Mar. 11
Adv., Eng. RECORD, Mar. 11.
Apr. 17. Cement, etc., Marquette, Mich. .... Mar. 25
Adv., Eng. RECORD, Mar. 25.
Apr. 18. Chicago, Ill .... Mar. 18
Adv., Eng. RECORD, Mar. 18, 25.

BUILDINGS.

Mar. 27. Montgomery, Ala .... Mar. 18
Mar. 27. Schools, New York, N. Y .... Mar. 18
Mar. 28. Mansfield, O .... Mar. 4
Mar. 29. Hart, Mich .... Mar. 18
Mar. 30. Uvalde, Tex .... Mar. 11
Mar. 30. Schools, Brooklyn, N. Y. .... Mar. 25
Mar. 30. School, Ashland, O. .... Mar 25
Mar. 31. Madelia, Minn .... Mar. 25
Mar. — Portland, Ind .... Mar. 4
Apr. 1. School, Hannaford, N. D .... Mar. 4
Apr. 1. School, Cleveland, O .... Mar. 11
Apr. 1. Houghton, Mich .... Mar. 18
Apr. 1. Louisville, Ky .... Mar. 18
Apr. 1. School, Badaxe, Mich .... Mar. 25
Apr. 3. School, West Hoboken, N. J .... Mar. 25
Apr. 3. Alturas, Cal .... Mar. 25
Apr. 3. School, Brooklyn, N. Y. .... Mar. 25
Apr. 3. Htg School, Clifton Heights, Pa .... Mar. 18
Apr. 3. Library, Jersey City, N. J .... Mar. 18
Apr. 3. Many, La .... Jan. 21
Apr. 3. School, Wells, Minn .... Mar. 11
Apr. 3. School, Lakota, N. D .... Mar. 18
Apr. 4. School, Columbus, O .... Mar. 18
Apr. 4. Plumbing, etc., New York, N. Y. .... Mar. 11
Apr. 4. School, Ellsworth, Minn .... Mar. 25
Apr. 4. School, Irvington, N. J. .... Mar. 25
Apr. 5. Auburn, Cal .... Mar 25
Apr. 5. School, Cohoes, N. Y .... Mar. 25
Apr. 6. Jail, Keyser, W. Va .... Mar. 11
Apr. 10 Oshkosh, Wis. .... Mar. 25
Apr. 10. Carlington, O. .... Mar. 25
Apr. 13. Htg. school, Fairmont, W. Va .... Mar. 25
Apr. 13. Htg. school, Athens, W. Va .... Mar. 25
Apr. 14. Plans, Bradford, England .... Jan. 21
Apr. 15. Plans, etc., Birmingham, Ala .... Mar. 4
Apr. 15. Harrisburg, Pa. .... Mar. 25
Apr. 18. Schools, San Carlos, Ariz. .... Mar. 25
Apr. 19. Plans, Nashua, N. H .... Mar. 25
Adv., Eng. RECORD, Mar. 25.

MISCELLANEOUS.

Mar. 27. Street cleaning, Rochester, N. Y .... Mar. 25
Mar. 27. Collection of garbage, Rochester, N. Y .... Mar. 25
Mar. 29. Wharf, Baltimore, Md .... Mar. 25
Mar. 30. Garbage disposal, Providence, R. I. Mar 11
Mar. 31. Garbage disposal, Rochester, N. Y. Mar. 4
Apr. 3. Dredging, Philadelphia, Pa .... Mar. 11
Apr. 6. Electric Ry., Fernbank, O .... Mar. 25
Apr. 6. Electric Ry., North Bend, O .... Mar. 25
Apr. 6. Electric Ry., Delhi, O .... Mar. 25
Apr. 6. Electric Ry., Addyston, O .... Mar. 25
Apr. 6. Electric Ry., Cleves, O .... Mar. 25
Apr. 6. Dimension stone, Pittsburgh Landing, Tenn .... Mar. 25
Apr. 8. Electric Ry., Home City, O .... Mar. 25
Apr. 10. Ditch, etc., Fremont, Neb .... Mar. 4
Apr. 12. Dam, Cincinnati, O .... Mar. 18
Apr. 13. Greatbend, N. Y .... Mar. 25
Adv., Eng. RECORD, Mar. 25.
Apr. 15. Wapakoneta, O .... Mar. 25
Apr. 17. Levee work, West Memphis, Ark. Mar. 18
Apr. 17. Garbage disposal, Louisville, Ky .... Mar. 18
Apr. 20. New Orleans, La .... Mar. 25
June 30. El. Ry., Shanghai, China .... Mar. 4
Oct. 1. Railroad, Moscow, Russia .... Feb. 25

SCHOOLS.

Paris, Ill.—The citizens are stated to have voted to erect a $15,000 school.

Madison, S. D.—The House is stated to have passed a bill appropriating $22,000 for a dormitory at the Madison Normal School.

Niles, O.—It is stated that at the election April 3 the citizens will vote on erecting a high school.

Sioux City, Ia.—Plans are being prepared by W. W. Beach for the completion of College of Arts building at Morningside. Estimated cost, $40,000.

Badaxe, Mich.—Bids are wanted April 1 for a school in Sherman Township. Frank Regier, Chmn.

Spearfish, S. D.—The House is stated to have passed a bill appropriating $25,000 for a dormitory at the Spearfish Normal School.

Munhall, Pa.—Bids are wanted March 29 for $35,000 bonds. Joseph Myford, Secy. Mifflin Township School Dist.

San Carlos, Ariz.—See "Water."

Buffalo, N. Y.—Bids are wanted April 3 for $100,000 school bonds and $18,703.45 grade crossing bonds. Erastus C. Knight, City Compt.

Geneva, O.—It is stated that a vote will soon be taken on the question of issuing $30,000 school bonds. Plans for the school are stated to have been prepared by Owsley & Bouchere of Youngstown.

Emmetsburg, Ia.—The citizens are stated to have voted to erect a $20,000 school.

Kahoka, Mo.—The citizens will soon vote on the question of erecting a $20,000 school.

Cohoes, N. Y.—Bids are wanted April 5 for a 2-story addition to School No. 11; also for ventilating and heating the same. R. A. Ross, Clk. Bd. Educ.

Ashland, O.—Bids are wanted March 30 for a school in Dist. No. 2. J. W. Gardner, Clk. Bd. Educ.

Irvington, N. J.—Bids are wanted April 4 by the Board of Education for a school. E. D. Harrison, Clk.

Brooklyn, N. Y.—Bids are wanted March 30 for alterations in and additions to schools Nos. 63 and 75. Bids are also wanted April 3 for an addition to School No. 84. Richard H. Adams, Chmn. Com. on Bldgs., New York City.

Bridgeport, Conn.—Two schools are to be built at a total cost of $60,000.

Merrill, Wis.—There is talk of erecting a $20,000 high school.

Council Bluffs, Ia.—The citizens have voted to issue $65,000 bonds to erect a high school.

West Hoboken, N. J.—Bids are wanted April 3 for a school. Adolph Schleicher, Clk. Bd. Educ.

Athens, W. Va.—It is stated that bids are wanted April 13 for low-pressure gravity return steam-heating plant at girls' dormitory. R. S. Carr, Secy. Bd. of Regents, Charleston, W. Va.

Fairmount, W. Va.—It is stated that bids are wanted April 13 for low-pressure gravity return steam-heating plant at State Normal School. R. S. Carr, Secy. Bd. of Regents, Charleston, W. Va.

Bedford, Ind.—W. M. Denniston, City Clk., writes that a $10,000 school will be built this season.

Baraboo, Wis.—An election will be held April 18 to vote on issuing $30,000 bonds for a high school.

Raleigh, N. C.—See "Paving and Roadmaking."

Ellsworth, Minn.—It is stated that bids are wanted April 4 for a school in district No. 40. F. W. Stanton, Clk. School Bd.

Worcester, Mass.—Barker & Nourse, of Worcester, are stated to have prepared plans for a school, to cost about $26,500.

Hanover, N. H.—The trustees of the Dartmouth College are said to be considering the matter of erecting a memorial hall and administration building, another dormitory, a college commons and a new gymnasium; they are also said to be considering the advisability of establishing a lighting plant in connection with the heating plant.

Glenwood, O.—The citizens will probably soon be asked to vote on erecting a $25,000 school.

Sault Ste Marie, Mich.—It is stated that a $20,000 school will be erected.

Denison, Ia.—The citizens will soon be asked to vote on erecting a $20,000 high school.

Port Chester, N. Y.—At the election in April the citizens will be asked to vote on expending $35,000 in enlarging Primary School No. 1 and building a new high school.

New York City.—It is stated that a $350,000 high school will be erected on 120th St. and Broadway for the Horace Mann School of Teachers' College.

A permit has been issued for a brick and stone school for the city, to be erected on 66th St. and Amsterdam Ave., to cost $80,000. C. B. J. Snyder, Archt., 585 Broadway.

The following bids were opened March 20 for school No. 72, indicated by *a*, and on March 23 for school No. 46, indicated by *b*: H. Probst, 1180 Broadway, *a*, $154,300. Farrell & Hopper, *a*, $157,531. P. Gallagher, 150 5th Ave., *a*, $151,875; *b*, $78,900. Mapes-Reeve Constn. Co., 150 Nassau St., *a*, $149,000; *b*, $79,828. Harry McNally, 287 4th Ave., *a*, $144,975; *b*, $77,000. P. J. Walsh, 503 5th Ave., *a*, $148,000. Murphy Bros., 407 E. 101st St., *a*, $142,474; *b*, $77,474. Alfred Nugent & Son, *a*, $159,419; *b*, $78,550. Richard L. Walsh, 47 Cedar St., *a*, $183,236. Thos. Cockerill & Son, 550 W. 51st St., *a* $147,800; *b*, $87,900. Bath & Wahlig, *b*, $89,947. Mahoney Bros., 52 New Bowery, *b*, $85,875.

STREET CLEANING AND GARBAGE DISPOSAL.

Rochester, N. Y.—Bids are wanted March 27 for the collection of garbage. George Belknap, Clk. Bd. of Health.

Rochester, N. Y.—Bids are wanted March 27 for sweeping and cleaning several streets. Chas. M. Beattie, Clk. Executive Bd.

Memphis, Tenn.—The City Council has authorized the construction of two garbage crematories; cost not to exceed $5,700.

Fall River, Mass.—Arthur B. Brayton, City Clk., writes that a five years' contract for the collection of garbage has been awarded to Isaac E. Willetts, of 37 South Main St., Fall River, for $56,500.

Binghamton, N. Y.—The Senate has passed a bill authorizing Binghamton to contract for the collection and disposal of garbage.

Allentown, Pa.—The contract for the removal of garbage for a period of two years has been awarded to Barney F. Gallagher, at $1,900 per year.

GOVERNMENT WORK.

Milwaukee, Wis.—The following bids have been received by the Superv. Archt., Treas. Dept., Washington, D. C., for steel shelving for vaults in the Post Office and Court House: St. Louis Art Metal Co., St. Louis, Mo., $3,900; Gendry & Parschke, Milwaukee, Wis., $2,700; Yarman & Erbe Co., Rochester, N. Y., $3,225.50; Fenton Metallic Mfg. Co., Jamestown, N. Y., $3,000.

Kansas City, Mo.—Bids are wanted March 28 for installing a system of conduits and wiring for electric lighting in the U. S. Court House and Post Office. O. L. Spaulding, Acting Secy., Treas. Dept., Washington, D. C.

San Francisco, Cal.—The lowest bid received by the Navy Department for constructing the buildings and quarters for the naval training station, to be located on Yerba Buena Island, San Francisco Bay, was from Campbell & Pettus, of San Francisco, at $74,400.

Marquette, Mich.—Bids are wanted April 17 for furnishing natural and Portland cement, broken stone, sand, etc., for concrete superstructure to breakwater. Major Clinton B. Sears, Corps of Engrs., U. S. A., Duluth, Minn.

Grand Junction, Colo.—Bids are wanted April 13 for a steam heating plant at the Indian Industrial School. W. A. Jones, Commr. Indian Affairs, Dept. of the Interior, Washington, D. C.

Philadelphia, Pa.—Local press reports state that plans are being prepared at Washington for the repair of the timber dock at League Island Navy Yard. Estimated cost, $60,000.

MISCELLANEOUS.

Bermuda.—Plans have been prepared and submitted for approval to Messrs. Coode, Son & Mathews, consulting engineers, of Victoria St., London, England, for deepening and widening channel at St. Georges to a uniform depth of 24 ft.

Terre, Haute, Ind.—The County Commissioners are considering the proposition to build a levee along the west side of the Wabash River, opposite Terre Haute.

Baltimore, Md.—Bids are wanted March 29 for repairing Bowly's wharf. N. H. Hutton, Engr. Harbor Bd.

New Orleans, La.—Bids are wanted April 20 for the excavation by dredge of the main outfall canal. A. Schreiber, Secy. Drainage Commrs.

Marietta, O.—Final surveys for the Ohio River dam to be built below the mouth of the Muskingum will be made within the next few months by Edmund Moeser, of Zanesville, engineer in charge of the Muskingum and Little Kanawha rivers.

Jersey City, N. J.—Gov. Voorhees has signed the bill giving the city the right to build a dock on the east bank of the Hackensack River, and allowing an expenditure of $112,000.

Buffalo, N. Y.—Local press reports state that the following bids were received for dredging; *a*, Blackwell Canal, 60,000 yds.; *b*, Buffalo Harbor, 15,000 yds.; *c*, Peck's Slip, 5,000 yds.; *d*, Buffalo River, 100,000 yds.: Buffalo Dredging Co., *a*, *b*, *c* and *d*, 17¾ cts. per sq. yd. Hingston & Woods, Buffalo, N. Y., *a*, 18¼ cts.; *b*, 17¾ cts.; *c*, 19 cts.; *d*, 18 cts. L. P. & J. A. Smith Co., Cleveland, O., *a* and *d*, 18½ cts.; *b* and *c*, 20 cts.

Greatbend, N. Y.—Bids are wanted April 13 for excavating about 300,000 cu. yds. of earth and rock for a hydraulic canal for the St. Regis Paper Co., as advertised in "The Engineering Record."

Wapakoneta, O.—Bids are wanted April 15 for widening and deepening Prairie Creek. Estimated cost, $3,486. Samuel Craig, Engr.

Pittsburg Landing, Tenn.—Bids are wanted April 6 for 1,264 pieces dimension stone for head walls to road culverts, with right to increase supply 50 per cent. Cornelius Cadle, Chmn. Shiloh Battlefield Com., War Dept.

PROPOSALS.

Notice to Contractors.

Department of Streets and Sewers,
Office of the City Street Commissioner,
Room No. 2, City Hall
PATERSON, N. J., March 9th, 1899.

Sealed proposals will be received by the Board of Aldermen of the City of Paterson until Monday evening, April 3d, at Eight o'clock, in the Office of the City Street Commissioner, Room No. 2, City Hall, for the following work:

To pave with brick pavement—

Broadway, from East 18th Street to East 33d Street; Van Houten Street, from Prospect Street to Main Street; Prospect Street, from Van Houten Street to Market Street; Paterson Street, from Market Street to River Street, and Grand Street from Erie Railroad to Spruce Street.

To pave with asphalt pavement—

Mill Street, from Market Street to Grand Street; Washington Street, from Broadway to River Street; Church Street, from Broadway to Market Street, and Ellison Street, from Church Street to Straight Street.

Plans, specifications and information can be obtained upon application at Room No. 2, City Hall.

THOMAS McLEAN,
City Street Commissioner.

PROPOSALS.

Earth and Rock Excavation.

Sealed proposals will be received up to 2 o'clock p. m., of April 13th, 1899, at the office of Frank A. Hinds, Civil Engineer, No. 28 Flower Building, Watertown, N. Y., for excavating about 300,000 cubic yards of earth and rock, for a Hydraulic Canal for the St. Regis Paper Co., on their property near Great Bend, Jefferson County, N. Y.

Specifications, maps and further information can be obtained from the above Engineer's office after March 30th.

Bids for Water Pipe, Etc.

The Select and Common Councils of the City of Meadville, Pa., will receive sealed proposals until Thursday, March 30, 1899, at 8 o'clock P. M., for furnishing the City of Meadville with the following water plant supplies, prices to be f. o. b. Meadville:

19 tons (2,000 lbs.) of 6-in. standard water pipe, 34½ lbs. per foot.
13 tons (2,000 lbs.) of 4-in. standard water pipe, 22 lbs. per foot.
1½ tons (2,000 lbs.) of specials.
2 standard hydrants, 2 nozzles, 6-in. bottom con. 6-ft. grade to bottom pipe.
7 standard hydrants, 2 nozzles, 4-in. bottom con. 6-ft. grade to bottom pipe. All hydrants to have standard secondary gate valves and cast iron extension boxes. (Give price with and without these valves and boxes.)
6 standard hub end 6-in. gate valves, C. I. extension boxes.
14 standard hub end 4-in. gate valves, C. I. extension boxes.
1,000 lineal feet of ½-in. standard galvanized iron service pipe.
60 service boxes, for ½-in. stops, brass covers; No. 11.
100 ½-in. standard stop-cocks, round way, for services.

The foregoing quantities are approximate only, and the said councils reserve the right to increase or diminish the same; also, reserving the right to reject any or all bids, or to accept separate bids for any portion or portions of said supplies.

Bids, indorsed "Bids for Water Pipe, Etc.," to be sent to the City Clerk, Meadville, Pa.

D. T. McKAY, JR.,
City Clerk.
W. A. DOANE, City Engineer.

Sanitary District of Chicago.

TO CONTRACTORS.

"Sealed Proposals addressed to the Sanitary District of Chicago for One Railroad Bridge crossing the Main Channel of the Sanitary District" will be received by the clerk of said Sanitary District at Room 1110 Security Building, Chicago, Illinois, until 12 M. (Standard Time) of Wednesday, the 10th day of May, A. D. 1899, and will be publicly opened by the said Board of Trustees at its regular meeting held on that day.

The Railroad Bridge for which said tenders are invited is a swing four-track structure, having a span of 334 feet 6 inches, on the line of the Belt Railway of Chicago, crossing the Main Channel at the east end of Section "K."

The work for which said tenders are invited includes the supplying of all materials for Sub and Superstructures of said bridge, and erecting completely in accordance with plans and specificatons furnished by the said Sanitary District of Chicago.

Each bid must be accompanied by a certified check or cash to the amount of three thousand ($3,000) dollars.

Said certified check must be drawn on some responsible bank doing business in the city of Chicago, and be made payable to the order of the Clerk of the Sanitary District of Chicago.

Said amount of three thousand dollars will be held by the Sanitary District until all of the bids for said structure have been canvassed and the contract awarded and signed. The return of said check or cash being conditioned upon the appearance, within ten (10) days after receiving notice of award to him, of the bidder to whom the award of said work shall have been made, with bondsmen, and executing a contract with the Sanitary District for the work so awarded, and giving a bond satisfactory to the said Board of Trustees for the fulfillment of said contract, the amount of said bond to be thirty thousand ($30,000) dollars.

All bids received to be upon blank forms furnished by the Sanitary District.

No bid will be considered unless the party making it shall furnish evidence satisfactory to the Board of Trustees of his ability and experience in this class of work, and that he has sufficient capital to enable him successfully to prosecute the same in case the contract therefor shall be awarded him.

Bidders are required to state in their bids their individual names and places of residence in full.

Design of bridge may be seen and plans and specifications may be obtained at the office of the Chief Engineer of the Sanitary District of Chicago. Room 1010 Security Building, Chicago, Illinois.

Said board of trustees reserves the right to reject any and all bids.

SANITARY DISTRICT OF CHICAGO,
By WILLIAM BOLDENWECK,
President.

Attest:
JOSEPH F. HAAS,
Clerk.
Chicago, March 8th, A. D. 1899.

PROPOSALS.

Notice to Contractors.

Proposals will be received by the City of Austin, Minn., until 6 o'clock P. M., Friday April 7th, 1899, for furnishing 4,000 ft. 20-in pipe, 7,300 ft. 15-in. pipe, one 20 x 15 x 15-in Y, two 20-in. bends, one 15-in. bend.

The material is required to carry water gravity fall, 1 in 1,000.

Bidders may specify Cast Iron, Roota Spiral Riveted, Sewer or Culvert Pipe.

The city reserves the right to reject any and all bids.

WM. TODD,
Superintendent.

Notice to Material Men.

Sealed proposals will be received by the undersigned for the city of Athens, Ga., until noon, city time, of April 1st, for a considerable quantity of stone curbing, Belgian blocks, vitrified brick, terra cotta pipe, cement and sewer castings.

Specfications are on file at my office, and will be mailed to parties desiring them.

J. W. BARNETT,
City Engineer.
Athens, Ga., March 10th, 1899.

Bridge.

HARTFORD, CONN.

Proposals for furnishing materials and labor for the construction and completion of a bridge over a portion of the East Hartford Meadows, on the line of Hartford Avenue, will be received by the BOARD OF COMMISSIONERS for the CONNECTICUT RIVER BRIDGE AND HIGHWAY DISTRICT, at the office of the ENGINEER, Room 64, Ætna Life Insurance Building, Hartford, Conn., up to five o'clock p. m. on APRIL 15TH, 1899.

The bridge is to be about four hundred (400) feet long by sixty-six (66) feet wide. Bids will be received for a stone bridge, also for a steel bridge on stone foundations.

A certified check or bank draft on New York for Ten Thousand ($10,000) Dollars, made payable to the order of MEIGS H. WHAPLES, TREASURER of the CONNECTICUT RIVER BRIDGE AND HIGHWAY DISTRICT COMMISSION, shall be deposited with the said TREASURER, at his office in the Connecticut Trust and Safe Deposit Company, corner of Main and Pearl Streets, Hartford, Conn., on or before twelve o'clock noon of the day above mentioned, for the receipt of proposals. No proposal will be considered unless the aforesaid check is deposited, as above required, and approved by the said TREASURER.

A bond equal to one-half the amount of the contract must be given by the successful bidder. This bond must be guaranteed by a regularly organized surety company doing business in the State of Connecticut, and approved by the PRESIDENT of the COMMISSION.

CONTRACTORS are especially invited whose record includes the successful completion of similar work of equal magnitude, and who own a modern plant for doing such work economically. Intending bidders must state, upon inquiry by the ENGINEER when and where they have done work of this class and magnitude, and the name and address of the ENGINEER of the said work.

The COMMISSION reserves the right to open the proposals and award the contract at such time and in such manner as may seem to them for the best interest of the BRIDGE DISTRICT. They may reject all proposals, if in their judgment such a course is advisable.

The right to waive minor defects in any proposal is reserved.

Plans and specifications for both styles of bridges are on file in the office of the ENGINEER, where they may be examined by intending bidders. Appointments for estimating from the plans should be secured by intending bidders at the earliest possible moment, as no requirement will be waived on account of lack of time for estimating at the closing of bids.

All proposals on these plans must be made on blank forms, which shall be supplied, together with any other necessary information, by the ENGINEER.

MORGAN G. BULKELEY, President,
Board of Commissioners, Connecticut River Bridge and Highway District.
EDWIN D. GRAVES, Engineer,
Room 64, Ætna Life Insurance Building,
Hartford, Connecticut.

U. S. ENGINEER OFFICE, DULUTH, Minn., March 16, 1899.—Sealed proposals for furnishing natural cement, Portland cement, broken stone, sand, timber, rubber boots, iron and hardware supplies for concrete superstructure to breakwater at Marquette, Mich., will be received here until noon, April 17, 1899, and then publicly opened. Information furnished on application. CLINTON B. SEARS, Major, Engrs.

Proposa's continued on pages xi and xii

The Engineering Record.
Volume XXXIX. Number 18

TABLE OF LEADING ARTICLES.

The Engineering Record, conducted by Henry C. Meyer, is published every Saturday at 100 William Street, New York. Its opinions on technical subjects are either prepared or revised by specialists.
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ENGINE SPECIFICATIONS.

The character of specifications which should accompany invitations for steam engine proposals is a matter about which there is a great variety of practice, as well as difference of opinion, among engineers. Some prefer a specification of merely a few lines covering essential requirements, while others write a great number of pages specifying the character of material and kind of design and construction of each detail of the machine, and binding the engine builder in every particular. Some, who believe in brief specifications, say facetiously that the length of a specification measures the ignorance of the person who prepares it, and that elaborate specifications are writen by engineers who desire merely to impress their clients with the value of their services and the depth of their knowledge of engineering.

The more pronounced differences of opinion regarding this subject have arisen from the fact that there are two leading conditions under which proposals are solicited, and these call for entirely different treatment. The practice of engineers employed in public or semi-public work calling for competitive bids which are without limit as to the number of bidders, the contract being let to the one who makes the lowest bid, is necessarily different from that of engineers who are acting for private corporations or individuals. In the first case the public interest must be protected from unscrupulous or incompetent builders, by making the specifications so complete that no opportunity will be given for misunderstandings or improper construction. Doubtless elaborate specifications drawn up for work of public character have had an influence on those for undertakings of a more private nature, and have led some engineers to the idea that this class of specification is a worthy model on which to pattern others. Much detail, however, in a specification when the bidding is limited seems unnecessary. Of course there are instances where plans for an engine of entirely new design are prepared which naturally require full detailed instructions and working drawings of every part that is of special design, but these are not considered in this discussion. It is in specifications for factory, mill or electric service that great detail seems unnecessary. In such cases the engineer should invite proposals only from reputable firms, for there is a sufficient number of them in business to give all the competition necessary.

If an engineer has not sufficient knowledge to determine the cylinder sizes of an engine he wishes to purchase, it is best perhaps to invite bids on a brief specification describing the type of engine wanted and defining certain limitations in the way of dimensions, so that all bidders will figure on an equal basis. The call for tenders should state the steam pressure, back pressure, the number of revolutions at which the engine is to run, and limit the piston speed. The piston speed and number of revolutions practically determine the stroke of the engine. It should be stated that the engine should develop its rated horse-power when cutting off at a certain point in the stroke, if it be of the simple type. If the engine is of the compound type, the number of expansions should be given. The proper point of cut-off and number of expansions will be discussed later, and is a most important subject, for upon it depends whether the engine will develop its rated load economically and have the proper capacity to withstand an overload. The specification should ask the builder for the diameter and length of the cylinders he proposes to furnish, the length and diameter of the main bearings, the crank pin and crosshead pin, the dimensions of the crosshead bearing surfaces, the dimensions and weight of the flywheel and the weight of the whole engine.

When the bids are in the engineer can tabulate the details of the engines on which bids are made and properly compare them. If a dimension of any engine differs widely from that of another, the builder can be requested to change his design so that his engine will conform to the average of the others, or, if it is necessary, the bid can be rejected if a good reason for the discrepancy cannot be given. An engineer should not, however, go too far in needlessly asking a builder to depart from his standard patterns, as this considerably increases the cost of an engine. Generally on receiving bids it is found that one builder will offer a cylinder a little longer, but smaller in diameter, than another proposes to use, but this does not matter as long as the cylinder volumes are the same. It is unfair for an engineer to insist that a cylinder should be of certain dimensions, as the builder whose standard patterns conform to them will be greatly favored over another builder who proposes to furnish a cylinder of slightly different dimensions but the same volume. This same idea governs other parts of engines than cylinders, and an engineer should not forget that a departure from standard patterns means increased cost.

After the engineer has considered his tabulated bids, he can select from those which appear to be based on an engine of the necessary capacity, the one most suited for his needs. If he is sufficiently posted to do so, he can fix the cylinder sizes, in a general way, in the first place.

In calling for bids for an engine in which the cylinder dimensions are not specified, it is generally the custom to specify that the engine, if it is of the simple type, shall, when running at a specified speed and range of steam pressure, develop its rated horse-power when cutting off at a certain point in the stroke. There are some objections to this method. As is well known, the point of cut-off on an indicator card is sometimes very difficult to locate, particularly in a single-valve engine. This has often resulted in difficulty and dispute, some holding that the point of cut-off is at one place, and others that it is somewhere else. One-quarter cut-off is usually taken as the proper one in simple engines, on account of the fact that it has been found with the usual steam pressures employed in single-cylinder engines to produce an expansion of the steam which gives the greatest amount of power per pound of steam used. If the steam pressure is higher than usually carried, expansion is not complete when cutting off at one-quarter stroke, and hence the engine is not working economically. The most economic cut-off, therefore, varies with the steam pressure. As the point of cut-off is sometimes difficult to locate, and as a certain cut-off insuring complete expansion with one steam pressure will not do so with another steam pressure, it would seem better to specify that the expansion should be complete rather than to ask for something that may or may not accompany complete expansion. In other words, it will evidently be better to state that the cylinder must be of such a size that the release pressure, the pressure in the expansion line at which the release valve opens, shall be a certain number of pounds above the back pressure. Another advantage of this method is that it takes into account the amount of clearance in the cylinder, which, of course, is recognized as detrimental to the economy, whereas the cut-off method does not. For instance, if an engine has 10 per cent. clearance and it cuts off at quarter stroke, the expansion of the steam will manifestly not be as complete at the end of the stroke as it would if there was less clearance. Of course, in answer to one of the arguments advanced, it might be said that it would be as difficult to find the release pressure as the point of cut-off, but this would only be likely to occur in a few instances, as the release pressure is usually more easily found on an indicator card than the point of cut-off.

In simple non-condensing engines the release pressure should not be over four pounds above the back pressure. In compound engines, the completeness with which expansion takes place depends upon the cut-off in both cylinders or the number of expansions, as the product of the expansions in the first cylinder by those in the second cylinder is called. In compound engines the number of expansions should be stated in a specification if the cylinder dimensions and number of revolutions are not given, otherwise one builder might bid upon smaller cylinders than another who was providing for a greater number of expansions. As the economy is dependent upon the thoroughness of expansion, this question is an important point. In compound condensing engines, 9 pounds absolute is as high a terminal pressure as should be allowed. In the Grosvenordale compound condensing engine, which showed the remarkable economy of 11.89 pounds of steam per horse-power per hour, the initial pressure (absolute) and the terminal pressure in the low-pressure cylinder were 157 pounds and 5.2 pounds, respectively, making the number of expansions 30.

An unfair method in specification writing which is frequently followed is asking guarantees as to steam consumption unless it is intended to test the engine to find out if they are met. Asking guarantees and then not testing the engine only encourages reckless guarantees the next time the engineer who pursues such a course invites bids.

No stipulation of a general character should occur in any specifications, such as those stating that the sizes of a bearing should be "ample," or that the performance of the engine should be "satisfactory" to the engineer. These are meaningless, and their use paves the way to misconstruction in the future. With reputable parties such clauses are entirely unnecessary, for there are many manufacturers who are as anxious to have their product satisfactory as is the engineer.

TEMPTING FATE IN MILWAUKEE.

The announcement in several papers that Mr. George H. Benzenberg was to retire from the office of City Engineer of Milwaukee, Wis., in the course of the present month has not been accompanied by a true explanation of the situation which has caused this loss to the city of an official of national reputation. This situation is one common enough in some other parts of the country, but has fortunately not often occurred before in Milwaukee, which has until recently been content to keep competent men in office as long as their services were satisfactory. One year ago, however, the present mayor of the city was elected on a platform of which the leading plank was a promise to clean out of office every member of the political party with which Mr. Benzenberg has been in sympathy. Mr. Rose, the mayor, has kept his word. The political head of every employee of the city of the party in question has been removed as soon as his term of office expired. On April 18 a new term begins in the office of City Engineer, and on that day a new man is to be placed in that position whose political views accord with those of the ruling power, no matter if his engineering experience is no greater than is necessary for a subordinate member of a railway surveying party. It is but just to the intelligent business men of the city to say that when they recognized the lengths to which the process of decapitation would proceed they at once took steps to secure the services of Mr. Benzenberg for years to come. Without regard to their party affiliations they sent a strong application to the Legislature to put the Board of Public Works and the City Engineer under the civil service and thus prevent the proposed change. When Mr. Benzenberg heard of this move, which was begun without his knowledge, he at once took steps to have it stopped, although it would otherwise have been successful in all probability. He very naturally did not care to hold office under special legislation, and the result of the whole matter is that one of the few large cities of the country which have always been regarded as administered with intelligence and on business principles, will see the most important bureau of its affairs made a plaything of politics and a laughing stock of the intelligent class in the community. The strange feature of the affair is that the personal relations of the Mayor and the City Engineer during the past year have been of the most cordial and confidential nature, and that no ground of complaint is alleged to exist as to the fitness of the retiring City Engineer to discharge the duties of his office.

It is very likely that Mayor Rose knows full well the loss that the city will suffer when Mr. Benzenberg closes his desk in the City Hall sixteen days hence, for no man who has served the city for twenty-five years with such eminent ability can leave without causing a vacancy which a mere politician will fill like the marble in a rattle. It will be a daring or an ignorant man who will accept office under the new conditions. He will have to live up to very high professional standards. The river flushing works which Mr. Benzenberg designed were a new feature in engineering, their success was considered problematical by eminent engineers until triumphantly proved by the final and conclusive test of actual work. The water-works intake tunnel was constructed by Mr. Benzenberg after contractors of ripe experience had thrown up the work in despair. The sewerage and bridge works executed under his direction have been uniformly successful. Failure on the part of the new incumbent of the office of City Engineer to live up to these standards will result in his extreme discomfort, for a community so largely German in its character will not tolerate incompetent office-holders for more than the shortest possible term. Moreover, the new City Engineer will be president of the Board of Public Works, and must therefore combine executive ability with professional knowledge, two attainments which are not always found in one individual. People who have noticed the manner in which Mayor Rose has been assisted in the past to discharge the duties of his office in a creditable manner are wondering what will happen after April 17. As for Mr. Benzenberg, he is rather to be congratulated at the turn of events. His ability has long been recognized by men of affairs, and he can look forward to a lucrative private practice with a certainty of success and the knowledge that everyone in Milwaukee whose good opinion is worth having, regards his retirement from office as a public misfortune.

THE LIGHTING OF COUNTRY RESIDENCES.

Not long ago an architect inquired of "The Engineering Record" as to the best method of lighting country residences, and asked particularly as to the value of a gas or oil engine driving a dynamo for such service. An investigation of the subject developed the fact that the lighting of large suburban residences in localities where neither gas nor electricity from a local supply company is available is a good deal of a problem. In some instances gasoline plants are used and in others extensive steam plants with engines, boilers and dynamos are installed. The only objection to the engine plant, an investigation showed, is its cost of operation, the cost of purchasing and transporting coal and removing ashes, the cost of supplies and the wages of an engineer, making this method of lighting somewhat expensive, so much so, at any rate, that architects have hesitated to use a steam engine except for the most costly establishments.

The particular advantage of the gas engine over the steam engine for lighting country residences lies in the ease with which it may be operated. Before a steam engine can be started a fire has to be made in the boilers, and a loss of heat occurs while steam is being raised. There is a further loss after the engine is shut down, and in all the loss amounts to quite a considerable portion of the total fuel used when the engine is only run a few hours each day. The gas engine on the other hand may be started at once and stopped at any time, with an immediate stoppage of fuel consumption. It requires little or no attention before or after running. It may be put in the charge of any intelligent gardener or stable-hand. It should not, however, be supposed that any one can run a gas engine. This supposition has been the cause of most of the failures that have occurred with well-designed gas engines. A number of large residences recently constructed have been equipped with gas-engine lighting plants in places where a steam plant would have been out of the question, and they have given so much satisfaction and operated so easily and cheaply that further discussion of this method of lighting would seem to be of interest.

A plant of this character may be operated by oil, by gasoline or by gas. Oil may be purchased by the barrel and gasoline, of course, comes in the same way. Considerable objection was at one time made to gasoline by insurance companies, but lately these restrictions have been removed, where proper care has been taken in locating the gasoline tank from which the engine draws its supply. In localities where gas may be had from a local supply company, it may be used to operate gas engines. Gas engines may be run with producer gas, which may be manufactured upon the premises, but the cost of a producer precludes its use. Unless gas from a company may be had at less cost, gasoline or oil engines are preferable. In selecting a gas engine, and hereafter the term will be used in a general sense, meaning a gas, oil or gasoline engine, only those made by a reputable builder should be purchased or the experience of the purchaser is likely to be a sad one. The enormous demand for gas engines in America during the past year or two has resulted in the placing on the market of some gas engines that are hardly worthy of the name.

The lighting plant may be placed in a stable or it may be in a separate building or power house. The engine should, if possible, be so located that the prevailing wind in the summer time should blow from the residence toward the power house. The products of combustion discharged by a gas engine possess a disagreeable odor, and this fact, together with the noise accompanying exhaust, make it necessary that the engine should be at least 250 feet from the residence. It is difficult to say what a power

FIGURE 1.—EXTERIOR VIEW OF POWER HOUSE.

FIGURE 2.—THE CHARGING PLANT.

THE ELECTRIC LIGHTING PLANT OF THE BROWN ESTATE, WAYNE, PA.

house would cost, as it might be a plain brick structure or it might be of elaborate design and finish to accord with the general design of the residence. Only one gas engine and dynamo need be installed, but it would be far better to have two units, particularly if the residence depends entirely upon the gas-engine plant for

FIGURE 5.—POWER HOUSE, DEER PARK, ILL.

illumination. If the residence is piped for gas and illuminating gas is available, there is not so great a need of a duplicate gas-engine plant. The engines and dynamos may be direct connected or they may be belted. The former makes a neater looking combination, but it is more costly, requiring a much larger dynamo, as it has to run at much lower speed when direct connected than when driven by belt. One disadvantage of the direct-connected rig is due to the fact that the impulse given by the explosion in the gas engine is more pronounced in the direct-connected than in the belted rig and the lights are more apt to fluctuate in brilliancy.

One of the greatest adjuncts of a gas-engine plant for a residence is a storage battery. Some engineers go so far as to state that a plant ought not to be installed without one. If a storage battery is used the plant may be run in several different ways. The gas engine and dynamo may be small and the latter wound so as to charge the storage battery only, working a certain period each day to charge the battery, from which all lights and electric motors are supplied with current. Again, the plant may have a fair-sized engine which can drive a dynamo for supplying lights and also a second dynamo or booster, as it is called, which is used in charging the storage battery. A plant of this kind, and it is probably the type that would give the best satisfaction, would be one that could be started early in the afternoon, when the demand for lights begins, the plant then furnishing the lights and charging the battery at the same time. The plant would be run in this manner until say eight or nine o'clock in the evening, when the engine could be shut down and the battery, which would then be fully charged, could supply the lights needed during the night and until the gas-engine is again started the next day. If an unusual demand for light should arise, owing perhaps to a house party, a dinner or a dance, the engine could be run later in the night, and if at any time the load should become greater than that which the engine and dynamo could supply, the storage battery could be called upon to furnish the excess needed. The value of the battery to supplement the current supplied by the dynamo, and to store it at other times for use when the dynamo is shut down is apparent. As previously stated, one dynamo may be installed and used merely to charge the batteries. This requires a much larger battery than in the system just outlined, and as storage batteries are expensive in first cost, and as the cost of renewals is an item that has to be considered, it figures out that it is not best to have an excessively large battery capacity, nor, on the other hand, advisable to depend too much upon the engine and dynamo, because of the convenience of the battery.

The cost of the plant varies with the location, the cost of fuel and the character of the plant. A gasoline engine belted to a dynamo of moderate speed with switch-board and instruments and connections between dynamo and switchboard will cost from $1,000 to $1,500 for a plant of 100-lights capacity, and from $2,900 to $4,000 for a plant of 500 lights, depending upon the character of the plant. The lower figures will pay for the simplest kind of a plant of the best grade. The cost of plants between 100 and 500 lights capacity may be determined by interpolating between the figures given. It is a simple matter to run up the cost of a plant of this character. For instance, the dynamo leads may be run on porcelain insulators overhead or they may run in a trench in the floor in armored tubing. The switch-board may be a mere frame or it may be of costly marble. The measuring instruments and switches may be plain and few, or costly and many. The switch-board may have a number of switches on its face controlling as many different circuits. There may perhaps be a circuit supplying motors in the stable or woodshed for cutting feed or for driving a stone crusher. Another may be used to charge an electric launch or a motor carriage, and so on may the equipment be enlarged.

As the cost of operating, a gasoline engine of 30 brake-horse-power, which would run 300 lights, ought to consume about a pint of gasoline per horse-power per hour. At 8 cents per gallon, a fair price for 76-degree gasoline, the cost of ten lamps for one hour would be one cent. A ten-horse-power engine would use a little more fuel, so that the cost would be about one and one-quarter cents per ten lights per hour.

The cost of a booster, extra switch-board connections for a storage battery, and battery delivered and erected, capable of supplying 30 16-candle-power 110-volt lamps for 8 hours, would be about $1,800. For one supplying 50 and 100 lamps for 8 hours, the cost would be about $2,300 and $3,500 respectively. Within certain limits the capacity of a battery is fixed by the rate at which it is discharged; the higher the rate the smaller the capacity. The battery with a capacity of 100 lamps for 8 hours could be at the rate of 140 lamps for four hours or 200 lamps for two hours.

FIGURE 3.—POWER HOUSE AND ROOF GARDEN, MARX ESTATE, ALEXANDRIA BAY.

A typical plant with a storage battery is installed in the residence of Mr. John A. Brown, Jr., at Wayne, Pa. The power house, which is shown in Figure 1, is a rough-stone structure 21 feet by 16 feet in plan, and divided into a dynamo and a battery room. A 19½-horse-power gas engine made by the Otto Gas Engine Works, of Philadelphia, is belted to a shunt-wound dynamo of 12½-kilowatts capacity for charging a storage battery. The battery was supplied by the Electric Storage Battery Company, Philadelphia, and has a capacity of 100 lights in 8 hours. The switch-board and connections are so designed that the dynamo may be run to charge the battery or to furnish lights direct, or both of these operations may occur at the same time. Figure 2 is a view of the Otto engine and the engine room. The latter is lined with white enameled brick and presents a neat appearance.

Figure 3 shows the interior of a power house for the residence of Mrs. A. R. Gazzam, at Cornwall, N. Y. There are two 120-volt Crocker-Wheeler generators, one of 30 and the other of

FIGURE 4.—POWER HOUSE, CORNWALL, N. Y.

FIGURE 6.—INTERIOR VIEW, DEER PARK, ILL.

25-kilowatt capacity, each belted to an Otto gasoline engine. The engine driving the smaller generator is also connected to a small booster, which is used in charging a storage battery of a capacity of 50 amperes in 8 hours, supplied by the Electric Storage Battery Company. The plant supplies some 800 lights, and a Sprague electric elevator. Usually the smaller generator and the booster working in series are run during the day to charge the battery, and the engine shut down about five o'clock unless there is to be an unusual demand for current, when it is run later in the evening. This plant was installed by Zimdars & Hunt, of New York City, from the plans of Mr. R. C. Reading, 120 Liberty Street, New York City.

The attractive and somewhat picturesque power station for lighting the residence of Mr. Luis Marx, at Alexandria Bay, on the St. Lawrence River, is shown in Figure 4. It contains a 6 x 6-inch Westinghouse gas engine driving a 7½-kilowatt dynamo and a triplex power pump, furnishing light and power to the residence. The roof of the power house serves as a roof garden. Figure 5 is a view of the power house for the residence of Mr. F. W. Matthiesson at Deer Park, Ill., and contains a 7 x 10-inch Westinghouse engine driving a small dynamo. Figure 6 is a view of the interior of the power house, and shows the manner of driving the power pump, fast and loose pulleys being employed. Both plants were equipped by Westinghouse, Church, Kerr & Company, of New York. "The Engineering Record" is indebted to all of the firms mentioned for data and photographs from which the above has been prepared.

ICE SHIELDS AT THE BUFFALO WATER-WORKS.

The ice problem in Buffalo, as in many other cities along the Great Lakes, is one which causes much difficulty during the winter months. That city receives its water supply through two tunnels, one of which is equivalent to a circle 6 feet in diameter, and the other to a circle 9 feet in diameter. These tunnels are about 30 feet apart, are unlined, and were driven entirely through rock. Both of them are about 1,000 feet long and extend to the center of Niagara River, where there is an inlet pier of cut stone masonry shown in Figure 1. The shaft reaching down to the smaller tunnel at this pier is 6 feet in diameter, and that of the larger tunnel has a 6 x 12-foot cross-section. The average depth of the water at the pier is 15 feet, and the bottoms of the intake are 6 feet above the river bed, or 9 feet below the mean water level. The current of the river at the inlet varies from 8 to 14 miles an hour.

During the winter months large fields of ice are continually passing down the river from Lake Erie, and to keep it from entering the intakes the latter are protected by shields of steel plates from ¾ to 1 inch thick. These shields project 2 feet from the pier and extend downward to within 2 feet of the bottom of the river. They are provided with gates opposite the intake which are somewhat larger in area than the openings into the shaft. When the ice is 5 feet below the sills of the intakes and conduits. They are operated by a steam engine and are fitted with a double row of perforated buckets working independently of each other. The ice is elevated to the top of the chutes which discharge it into the river at the pier, or the canal at the pumping station. This apparatus was designed by Mr. Louis H. Knapp,

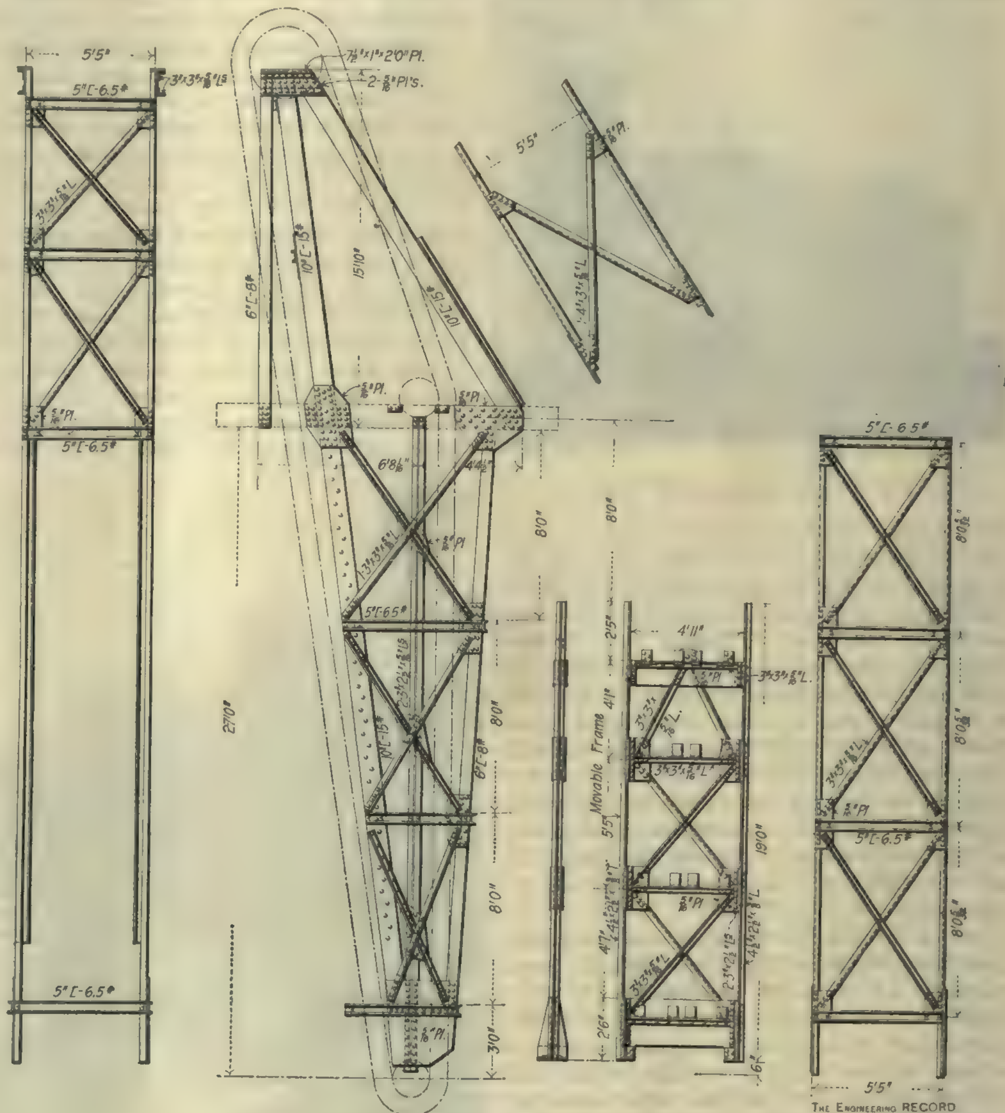


FIGURE 3.—FRAMEWORK FOR ICE ELEVATORS.

FIGURE 1.—INLET PIER.

FIGURE 2.—ICE ELEVATORS AT PUMPING STATION.

running, these gates are closed and the supply is taken from around the bottom of the shield. On ordinary occasions this effectually prevents any ice from entering the shafts.

There are times, however, when the river is filled with slush ice, extending down to the river bed. When this occurs the ice enters the intakes and the shafts in large quantities and must be removed as soon as possible. For this purpose ice elevators have been set up on the pier, and at each shore shaft of the pumping station, those at the latter place being shown in Figure 2. The elevators are placed on a rigid framework, shown in Figure 3, which extends M. Am. Soc. C. E., chief engineer of the Buffalo water-works, and built by the Howard Iron Works, of that city. In sending the above information, Mr. Knapp adds that the closing of the intakes in the inlet pier by anchor ice is prevented by raising and lowering the gates in the sides of the shield, running the ice elevator and liberally using steam and hot water from a boiler on the pier. The conditions at Buffalo are different from those at any other city on the lakes, and an uninterrupted supply of water during the winter is procured only by the constant care and watchfulness of the men at the pier and at the pumping station.

THE NEW YORK TOWER FOUNDATIONS, NEW EAST RIVER BRIDGE.

The masonry for both piers of the New York tower of the New East River bridge is now completed, ready to receive the steel work of the tower. A description of the masonry for the Brooklyn tower piers, which are similar to those on the New York side, was published in "The Engineering Record" on May 29, 1897, and descriptions of the methods and plant employed for the caissons of the New York piers was published November 6, 1897, and February 5, 1898. Other articles relating to the piers anchorages, and connecting spans were published in the issues of September 18 and December 25, 1897, February 12 and 19, May 14, and June 18, 1898.

The plant required for the caisson work at the New York end was described in the article of November 6 last; the arrangement of the derricks and location of the principal plant for the south pier is indicated in Figure 1, herewith presented. All of the derricks were of the stiff-leg type with booms from 40 to 60 feet in length and capacities of 10 tons each. Each derrick was operated by an independent hoisting engine and fitted with a horizontal bull wheel at the base of the mast for swinging the boom. The derricks were so arranged as to command all parts of both piers, and the outer end of the temporary pier between them and conveniently handle all material in and out of the material shaft as well as the masonry, the air locks, etc., and to unload stone and sand barges, and serve the concrete mixer.

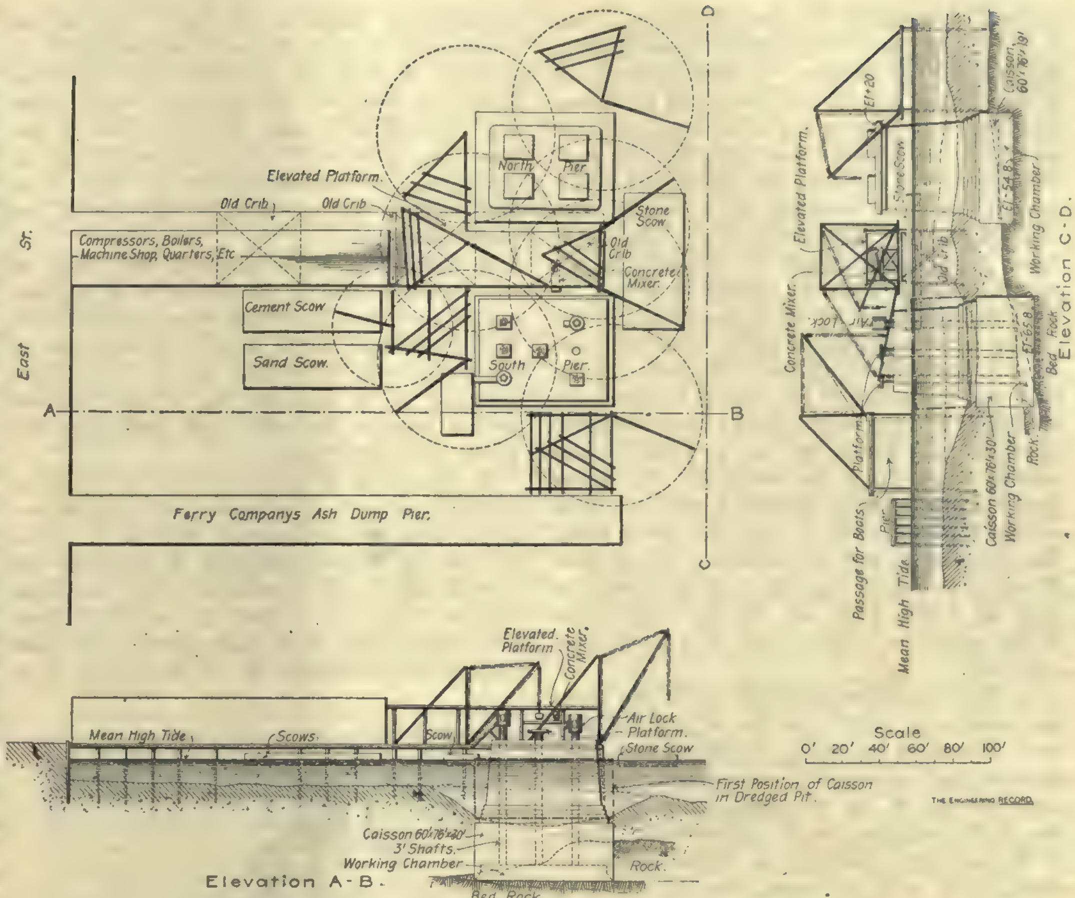
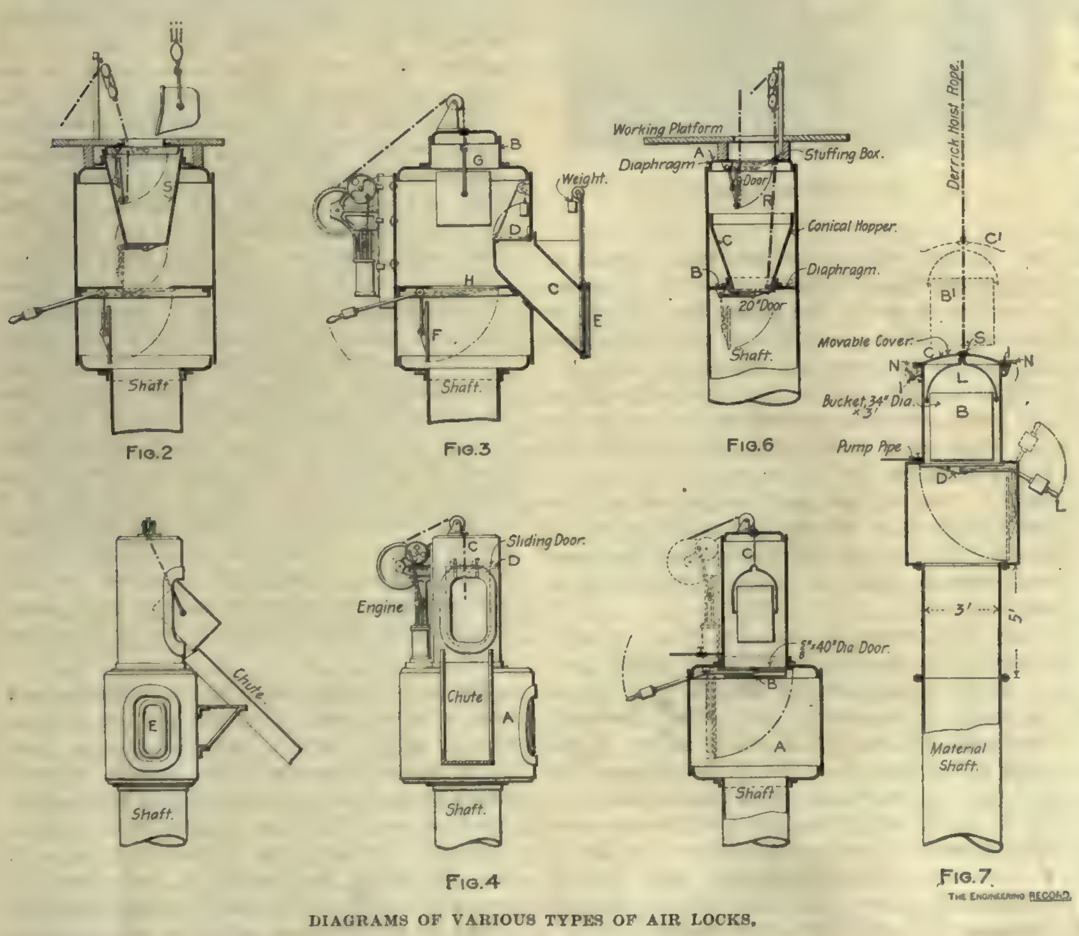


FIGURE 1.—ARRANGEMENT OF PLANT AT NEW YORK PIER.

Cement, sand and stone were stored on barges moored alongside the working pier, and small quantities of these materials were kept near its outer end, where they were shoveled into one yard iron measuring boxes for delivery to the mixer. There was a trap door in the floor through which the dry materials were constantly shoveled and fell into the hopper of a Cockburn Barrow & Machine Company tubular concrete mixing machine, set just below the deck of the pier. About twenty men were required to serve the mixer, which was driven by a 12 horse-power Erie engine furnished with steam from the main boiler plant. The amount of water used was gauged by a valve in the supply pipe, which extended horizontally into the open lower end of the mixer and was perforated on its under side. The concrete was mixed quite wet, and discharged continuously over an inclined board or flap which worked on a horizontal axis in the vertical plane of the axis of the mixer. Four one-yard steel buckets were kept in service so that one stood below the bottom of the flap, and received the continuous stream of concrete until it was filled, which usually required about one minute. Meantime another bucket was set alongside so that when the flap was revolved about 90 degrees to reverse the positions of the high and low ends, the stream of concrete was diverted into the second bucket without spilling or interruption, and the first bucket was swung to place, emptied, and returned by the derrick. Two derricks were able to serve the machine with sufficient rapidity, and an output of about 100 cubic yards of concrete in 10 hours was secured.

In order to deliver the concrete rapidly into the working chamber while a pressure of about 30 pounds was maintained, the lower door of the Mattson lock was kept permanently open and the dome cap B, Figure 2, was replaced by a conical steel funnel securely bolted by a flange angle to the top of the lock chamber. This funnel was provided with top and bottom horizontal hinged doors. The bottom door being shut and held up only by the pressure on the underside, securely closed the shaft so that the upper door could be opened, and a bucket of concrete emptied into the funnel nearly filling it. The upper door was then closed, and pressure admitted inside the funnel. As soon as the pressure became equalized in the shaft, the lower door dropped and precipitated the charge of concrete through the shaft into the bottom of the caisson where it was shoveled into position and rammed by the laborers. As soon as the charge had been dumped from the lock, the lower door was pulled up by an attendant stationed in the chamber at the top of the air shaft. Then the pressure was exhausted from the funnel, the upper door opened, another bucket of concrete emptied into it, and so on. Sometimes a charge of concrete was jammed in the funnel and failed to be discharged, so that considerable trouble was experienced in clearing it, and there was danger of a blow-out in the caisson by carelessly opening the upper door before the lower one was securely closed. This arrangement permitted as much as 10 or 12 buckets of concrete to be passed through each shaft in an hour. Only two men were required to empty the bucket and operate the lock.



DIAGRAMS OF VARIOUS TYPES OF AIR LOCKS.

The Mattson lock was described in "The Engineering Record" of November 6, 1897, and illustrated in the issue of February 5, 1898, by a photograph, which shows the exterior. The essential features of its construction are shown in Figure 3, which is a conventioned vertical section. The bucket is hoisted by a special attached engine operated by an inside lever not here shown. As soon as the bucket rises high

enough, its contents are dumped into the chute C by two men, who are constantly stationed in the lock for the purpose. A balanced door, D, is then closed, sealing the chute, and the lower balanced door, E, is raised by an attendant outside, who receives the signal from the lock men. The contents of the chute are discharged into a bucket, which is removed by a derrick and emptied into an attendant scow. The outer door, E, is again closed, air pressure is admitted into the chute by means of a cock inside the lock, and all is in readiness to discharge another bucket of spoil. Four men are usually required to operate this lock, two inside, one to attend to the bucket outside, and another to run the engine, which may be operated either from within the lock or from the outside on signal from the lock men. The lower door F and the upper opening G were provided so that the lock could be used for direct hoisting if necessary, and the suspended sliding door H was provided so that the lock could also be used for a man lock, and for the convenience of the operators inside when it was used as described.

At the commencement of the work two Mattson locks were built and one of another pattern, illustrated in Figure 4 was specially constructed and operated in accordance with designs by Mr. W. H. Gahagan, Assoc. M. Am. Soc. C. E., engineer for the contractors. There is in this lock a chamber A, surmounting the shaft, fitted with an upper door B, which is operated by a balanced lever on the outside attached to the hinge shaft in the customary manner. Above this chamber is a dome, C, just large enough to receive with proper clearance a cylindrical bucket whose capacity is 9 cubic feet. The hoist rope passes through the top of the dome with an ordinary stuffing box, and is operated by a special outside De la Vergne engine, such as was designed for the previously described Mattson lock. When the bucket has been hoisted to its extreme height, the door B is closed, and the pressure exhausted from the dome; then the sliding door D can be opened, and the bucket is tilted by hand. As the bucket is suspended by a bail pivoted below its center of gravity, it reverses easily when filled into the position indicated by dotted lines, so as to fall partly outside the dome and discharge its contents into a chute which delivers them directly overboard or, as in this case, to an attendant scow. The bottom of the bucket is counter-weighted, so that when empty it overbalances and is easily returned to a vertical position, and swung back into the dome. The door D is closed, the pressure is equalized inside the dome, the bottom door B opened, and the bucket lowered for another load. This lock can be operated very rapidly and as many as 40 buckets an hour have been hoisted through it. The chamber A is fitted with a swinging door E, so as to enable it to be used at will for a man lock, in which case the top of the shaft would be covered with a diaphragm having a lower door. The rolling door D is suspended from two grooved wheels, which travel on a horizontal bar set off from the inside of the dome wall, and is connected to their hangers by means of horizontal pivots giving it freedom to swing and sufficient adjustment to seat itself freely on the rubber gasket along the edges. The construction of this lock is so accurate that about 1,... ...hatever could be detected except of Niagara River, ...ne through the stuffing of cut stone masonry sh... ...ters. Under favor- shaft reaching down to the . operated by two this pier is 6 feet in diameter, A view of the larger tunnel has a 6 x 12-foot which shows The average depth of the water at the chute. 15 feet, and the bottoms of the intake ...ks four above the river bed, or 9 feet below the ... ons water level. The current of the river at th... inlet varies from 8 to 14 miles an hour.

During the winter months large fields of ice are continually passing down the river from constructing these locks, top and bottom diaphragms A and B, Figure 6, were attached to a shaft section and provided with gasketed doors, the lower one operated by a rope R passing through a stuffing box. A cone C was fitted inside the shaft so as to prevent the accumulation of concrete around the lower door, and the lock was operated by one man on the platform above.

In comparing these caissons with those at the Brooklyn end of the bridge it is interesting to note that the latter were provided with high cofferdams, while here it was arranged to build the piers at least as fast as the caissons sunk, so as to keep the top of the masonry always above high water, and practically dispense with cofferdams.

In connection with these improved types of material locks, it is interesting to note an entirely different construction, Figure 7, recently used by Messrs. Stephens & O'Rourke for caisson work in the foundation of tall buildings in New York City. Here the material shaft was surmounted by an enlargement just sufficient to give clearance for the lower door D of

FIGURE 5.—THE GAHAGAN LOCK.

the air lock, which was only large enough to receive the bucket itself. After the door was closed, as shown in the figure, the air was exhausted from the lock L, and its cover C was unfastened by removing the swivel bolts I I, which engaged slots in the circumference of the cover and were screwed up by handle nuts N. These bolts were disengaged, the hoist was again operated, the bucket and cover were together removed, the spoil discharged and the bolts returned to the position shown, when the cover was quickly bolted down again, the lower door opened and the bucket returned to be again filled.

Mr. L. L. Buck, M. Am. Soc. C. E., is chief engineer of the New East River bridge, and Mr. O. F. Nichols, M. Am. Soc. C. E., is principal assistant engineer. Mr. E. G. Freeman, Assoc. M. Am. Soc. C. E., is in charge of the work at the New York end of the bridge. The contract for the tower piers was awarded to Mr. P. H. Flynn, of Brooklyn, and the work has been carried on under the direction of Mr. N. K. Connolly, superintendent; Mr. W. H. Gahagan, engineer, and Mr. Samuel Mattson foreman of pneumatic caisson work.

OVERLAND FREIGHTING OUTFITS.

In many parts of this country an overland freighting outfit would be a great novelty, yet their use is becoming more common, and the O. S. Kelly Company, of Springfield, Ohio, has recently built a special line of heavy traction engines for this business. In England and on the Continent it is by no means unusual to see a traction engine drawing a car or cars along the highways, and there is no reason why the same system of transportation should not be used here, where the conditions favor it.

The engines made by the firm mentioned are shown in the accompanying cuts. The boilers are of the locomotive type, with grate surfaces varying from 9 to 12 square feet, and heating surfaces from 360 to 480 square feet. The boilers are 43 inches in diameter and made of 7/16-inch steel throughout, with double riveted seams, 1¾-inch asbestos covering and Russia lagging. They are designed to carry a pressure of 180 pounds per square inch. The tank carries a ton of coal and 600 gallons of water.

The engine proper, mounted on the front end of the boiler, has no flywheel, and thus deviates from the usual practice. The triple-throw shaft is a single forging, with its cranks set at 120 degrees with each other. It has three pairs of eccentrics, and the point of cut-off is late enough to insure the admission of steam to two of the three cylinders under any condition which may arise, in order to be sure of starting heavy loads. The shaft runs in four bearings fixed so as to avoid any strains due to the expansion and contraction of the boiler. "The reverse gear," the makers write, "is of the Marshall pattern, the eccentric rods standing perpendicular to the center line of the engine, while the valve rods attach to a point two-thirds of their length from the crank-shaft center. The reverse lever swings about a center situated above the crank shaft in a vertical plane, instead of the usual movement in a horizontal plane when link motion is used. This reverse can be clamped in any position from full stroke forward or backward to the center." One pinion only is fitted to the crank shaft, which gears directly into a large spur wheel attached to the driving axle, thus doing away with all counter shafts and intermediate gears.

The driving wheels are 8 feet in diameter, weigh 6,000 pounds each, and run on 8-inch axles, on which they bear for a length of 20 inches. They have circular steel-plate sides riveted to the casting which forms the hub, and are cut away to form part of the spokes, as shown in the illustrations. These spokes are box girders formed by riveting angles to the sides of each opening in the plates, and then riveting transverse plates across the wheel between similar angles. The steel plate which is used as a tire is provided with diagonal plates 4 inches wide and 2 inches thick, spaced at such distances apart that at least one of the strips is bedded before the preceding one is entirely free. Holes are provided for three locking pins to connect the wheels with the driving gear, although one pin is strong enough to take the whole of the strain. The diagonal plates on the tires are tapered off from a thickness of 2 inches, 3 inches from the end, to 1 inch at the end in order to reduce the bearing length from 24 to 18 inches; this is said to reduce the friction considerably in traveling over hard roads covered with two or three inches of loose material.

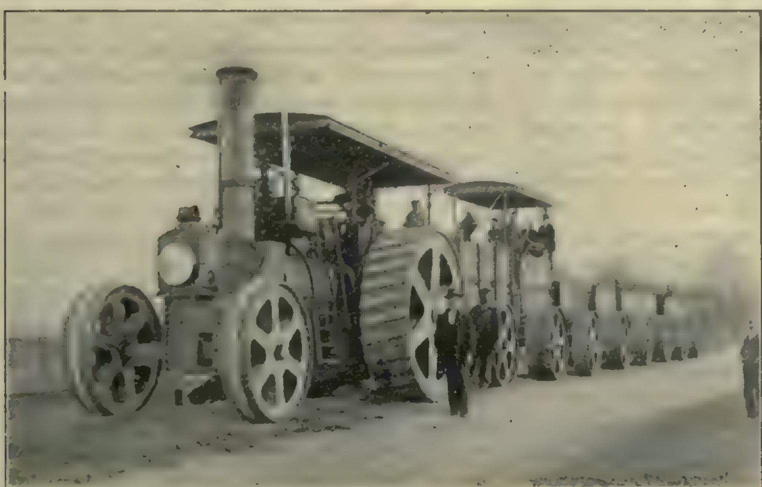
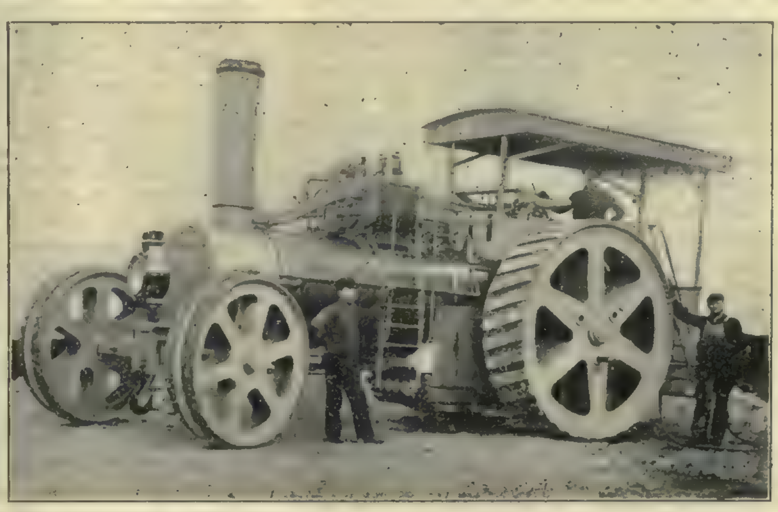
The front wheels are 5 feet in diameter and have a 12-inch face. They are built up like the driving wheel, except that the spokes have but a single tranverse plate instead of two, which gives them an I instead of a box section. The tires are fitted with a single band 4 inches wide and 2 inches thick to make steering easy, and are under the control of the driver by means of a hand wheel, shaft, worm and chains.

The three cylinders and their steam chests

are a single casting, with the chests on top, where they can be easily reached by a ladder. Steam is delivered from the boiler to the center cylinder, from which it passes to the others. The exhaust is through a Y pipe embracing the steam pipe. The pistons, slide bars, crossheads and connecting rods are of simple form, with large wearing surfaces, the aim being in designing these parts, as well as the rest of the engine, to produce a machine which will stand up under the trying conditions of running over natural ground.

The capabilities of these engines are referred to as follows in a letter from the makers: "They will give a continuous tractive force of 1,200 pounds at the wheel rim when moving at the rate of 330 feet per minute, and for short intervals this force can be doubled at the expense of the speed. The power developed will be 120 horse-power. In general it may be stated that with suitable wagons for the soil and roads free from grades exceeding 5 per cent., a load of 30 tons, exclusive of engine and wagons, can be hauled 30 miles a day. But as no two conditions are alike and the distances between water and coal supply stations make such important changes in the amount that can be hauled, it is impossible to state otherwise than above. If the road be entirely free from loose sand, a considerably greater load can be hauled. These engines have hauled over dry natural earth a total weight of 112 tons."

The engines are also adapted for steam plowing, and their arrangement of cylinders permits compounding when it is of advantage, as when the service is steady and continuous. When used for this purpose, they are fitted with a 5-foot spool carrying 450 yards of 1-inch steel rope. The spool is driven at both fast and slow speeds, and is provided with a coiling gear which allows the coiling arm with its guide pulleys to swing from one side of the engine to the other without deranging the coiling of the rope or readjusting the gear when the direction of the pulling rope is changed. The boilers of the plowing engines are longer than those of the traction engines, and have larger and longer tubes. A much lighter draft is used. The steam chest is fitted with automatic equalizing valves admitting steam to all three cylinders when starting.

TRACTION ENGINES AND CARS FOR OVERLAND FREIGHTING OUTFITS.

FIRE ESCAPES.

With regard to the reference in "The Engineering Record" of March 25 upon the Windsor Hotel fire, pointing out the inadequacy of the modern outside balcony fire-escape and suggesting the use of a stairway enclosed in a brick or fire-proof shaft to connect landings at each floor line with the street, from corridors through doorways closed by swinging doors, ex-City Engineer C. Baillargé, of Quebec, Canada, who for a number of years has given the question of fire escapes special study, has written a letter on the subject to "The Engineering Record." In general, he commends the idea of the enclosed stairway, but expresses the belief that while the spring door is an important suggestion if communication is to be directly afforded from the inside, it is open to the objection that a number of people passing through these doorways, as would be the case if the building was used for hotel or factory purposes, would hold the doors open and thus allow smoke and heated gases to reach to the stairways and thereby render escape precarious, if not impossible. Mr. Baillargé continues as follows:

"I believe that the only sure and instantaneous mode of escape from fire is by a stairway walled around, having absolutely no communication with the building, and reached by first stepping out by a door or window on to a balcony at every story and from the balcony into the stairway, to prevent any draught of hot air or smoke from being sucked into it from the burning building. The balcony should be open to the outer air, though, of course, roofed in against sun and rain; and it might even be glazed in, as, in case of having to use the emergency stairs, any one could break the glass if necessary.

"A person occupying a room on the inner side of the corridor, could, in a few seconds, and without risk of becoming asphyxiated, even if the corridors were densely filled with smoke, cross the corridor and gain access to the exit door or window in the outer wall, by which the balcony could be reached."

Mr. Baillargé suggests that if the emergency stairway were situated in the rear of a building, communication between the bottom of the stairway and the street could be had by an enclosed fire-proof passageway.

NEW LIFE FOR THE NEW YORK UNDERGROUND RAILWAY.

Soon after the election of the municipal administration now in charge of the public affairs of Greater New York, the head of the party which was successful at the polls stated that he would not be surprised to see the underground railway scheme for the city, which had been under discussion for several years, carried out before long in some form. This gentleman has not been in the habit of talking for publication unless he had something he wished the public of the city to hear, so many people have believed that the dearth of news from the commission in charge of the underground project was significant. Several months ago, the same gentleman announced that private capital was ready to undertake the construction of this great work, and it did not require a very intimate knowledge of public affairs in New York to understand the purport of the announcement, for the relations between the Metropolitan Street Railway Company and Mr. Croker are considered so close that every time he sneezes the conductors on the company's lines may be seen to wipe their eyes. On Monday of this week, these surmises as to the source of the private capital were definitely confirmed by the announcement that the Board of Rapid Transit Commissioners had instructed its counsel to apply to the Legislature for authority to consider and act on a proposition made by the company after several months of consultation between its officers and a special committee of the commission.

The parties making the proposition propose to organize a corporation to be known as the Tunnel Company, which will build the tunnel and railway proposed in the last set of plans prepared by the commission, which were outlined in "The Engineering Record" of November 20, 1897. If changes in these plans seem desirable to the company, it is to apply to the commission for its approval of them before they are finally adopted. The first section of the tunnel, from the southern terminus to a point in Harlem between Fort George and the ship canal recently built by the United States Government, is to be commenced within three months of the ratification of the agreement, and is to be completed within thirty-six months. The second section is not to be commenced until "the net earnings from the operation of the railroad upon the first section shall be sufficient to pay 5 per cent. upon the actual cost of construction and equipment."

The railway built in the tunnels is to be leased in perpetuity to the Metropolitan Street Railway Company for a rental of 5 per cent. on the cost of construction and equipment. This is the clause which is expected to give trouble when the matter reaches the Legislature, for a perpetual lease is something that body has never been known to favor. On this subject a statement has been made by Mr. George L. Rives, one of the commissioners, which deserves careful consideration: "There is a strong feeling in many quarters in favor of sticking closely to the principle laid down in the Greater New York charter of only granting rights to the streets for limited periods. That plan is probably a good one for surface roads, where the roadbed is provided by the city and the cost of construction is comparatively small. But with regard to an underground road the circumstances are altogether exceptional. Such a road is an experiment in this city, and it requires courage as well as capital to build it. It is a condition and not a theory that confronts us, and if the Legislature were to insist on only permitting a franchise for a term of years to be granted, I have no reason to suppose that it will be possible to get the owners of the Metropolitan Street Railway or anyone else to invest their money on so uncertain a tenure."

The operation of the tunnel is to be conducted mainly so as to make it relieve the present tracks of the Metropolitan Street Railway Company from through traffic. The company is now carrying about 900,000 passengers daily on the 228 miles of road under its control. The traffic on the lines in the business portions of

the city is already so large as to prevent the rapid transfer of passengers from one point to another, for the delays due to taking on and dropping passengers contribute nearly as much to slow motion as do wagons and trucks in the streets. With practically all the through passengers carried in the tunnel, the time for both local and long-distance trips may be expected to be shortened. Two classes of trains are provided for in the company's proposition, express trains on which a fare of ten cents will be charged and free transfers given to surface lines, and local trains, on which the fare will be five cents and a transfer will cost three cents more. It is proposed to make track connections between the tunnel and surface roads at four places, and to make arrangements with the railways entering the Grand Central Station to transfer passengers to their lines for points within the city limits. The express trains are to be the real thing, with speeds of twenty miles an hour south of Ninety-Sixth Street and of thirty miles an hour for at least two miles south of Forty-Second Street.

The portion of the proposal which offers compensation to the city for the franchise, reads as follows: "The city to receive as compensation, in addition to the services rendered and in lieu of all other charges upon the franchise granted hereunder, an annual rental equal to 5 per cent. on the gross receipts from the operation of the new road: provided that whenever any such payments shall leave the receipts insufficient to pay the rental of 5 per cent. on cost of construction and the operating expenses, including taxes, the percentage to be paid shall be abated accordingly."

The proposal also contains clauses providing for the auditing of the accounts of the Tunnel Company and the Metropolitan Street Railway Company, for the handling of conduits now in the streets free of charge to the city in case they are disturbed, for the arbitration of differences between the company and the commission, and for the use of any spare room in the tunnel for wires and conduits authorized by law, which evidently means that the compressed air pipes which the managers of the elevated railway recently refused to allow on their structures will find a welcome in the tunnel.

The fact that the commissioners were unanimous in passing the vote requesting the Legislature to give them authority to consider this proposal, which, as before stated, was prepared after consultation between Commissioners Orr and Rives and the Metropolitan Street Railway Company, indicates that the solution of the rapid transit problem may be nearer at hand than New Yorkers have dared to hope. There has been a strong feeling against the public construction of the tunnel, not only on account of the taxation which would be necessary to meet the cost, but also because a municipal road without connections and transfers with existing surface lines would be but a half solution of the problem. As the subject now stands, a company is ready to build the tunnel and railway under the direction of the commission which has been studying the subject for several years, and the only step to hinder the speedy commencement of actual work is the necessity of securing Legislative permission for entering into a contract with the Tunnel Company. So far the commissioners have not had the proposal before them officially, and have not taken any regular proceedings concerning it, but their action in case they obtain the desired authority seems to be pretty well foreshadowed.

TESTS OF PAVING BRICK AT THE IOWA STATE COLLEGE.

The department of civil engineering of the Iowa State University, of which Prof. A. Marston is the director, has been carrying on for some time a series of investigations into the properties of Iowa building and paving materials. In the course of these studies it became desirable to make experiments relating to the standard methods of testing paving brick in order to settle certain features of the subject which seemed to be imperfectly understood. The experiments were made in December, 1898, in the laboratories of the department, and were recently described in a paper presented to the Iowa Engineering Society by Prof. Marston and Mr. J. H. Wykoff. Through the courtesy of the former, the substance of the paper is presented herewith in advance of its publication in full, with the discussion, in the society's transactions.

One object of the tests was to determine the effect of absorption by the brick of different percentages of water on the loss in the rattler test. Another object was to make a careful study of the cross-breaking test, partly to determine the proper shape of the knife edges and whether bearing blocks of steel should be placed between them and the brick, and partly to determine by a careful study of each brick broken, the causes of the variations in the results of transverse tests, and whether the results correctly indicate the value of the brick for paving purposes. A third object was to obtain information as to the meaning and value in judging paving brick of the results of the different methods of testing, for which the National Brick Manufacturers' Association has adopted standard specifications. It was proposed to do this by applying the tests, according to the standard specifications, to brick whose relative grades were already known, and comparing the results.

Brick for the experiments were donated by two well-known paving brick companies, one in Iowa and the other in Illinois. The names of these companies will not be given, but the brick will be designated simply as A and B. Both represent makes widely used, and both are repressed shale brick. Brick A are end cut, and brick B are side cut.

Each company was asked to furnish 250 underburned, 500 No. 1 and 250 overburned brick. In Brick A it was apparent on inspection that these three grades as furnished ranked comparatively close to each other in quality. The underburned brick were not nearly so soft as those in Brick B; the overburned A were still apparently good paving brick, while the overburned B were cindery, and so warped and distorted that no one would think of using them for paving purposes. Only about one-half of the overburned B were regular enough in shape to admit of being tested at all.

Before the tests were begun the No. 1 B were sorted into three grades, designated respectively No. 1 Hard, No. 1 and No. 1 Soft. The underburned were sorted into two grades, designated Medium Soft and Soft. The external appearance was the only available guide in sorting, and hence there were some unavoidable errors in deciding in which grade to place the brick, especially those near the dividing lines. These errors in sorting undoubtedly affected some of the results of the tests, and are the probable explanation of some apparent discrepancies in the results.

Only 12 brick of the No. 1 Soft B could be found, so that only the transverse test could be applied to this grade. All of the other grades were tested in four ways: for the loss in the rattler, the transverse strength, the percentage of absorption, and the crushing strength. The N. B. M. A. specifications were followed throughout, except as noted below. In the transverse tests an adjustable knife edge was used for the upper bearing, and the brick were taken as they came, not being selected to secure regularity in shape. Many more transverse tests were made than the specifications require, and additional tests were made to investigate certain variations in the method of conducting the test. Part of the rattler tests were made on brick containing different percentages of water. In the case of the No. 1 Hard B and the Clinker B only enough brick could be had for one rattler test. In all, 19 rattler tests (of 418 brick), 532 transverse tests, 40 crushing tests and 40 absorption tests were made.

The results of these tests are shown in detail in Figures 1 to 4, and in the accompanying table of transverse tests.

Table of Averages of Transverse Tests.

Grade of Brick.	Letter.	12 in. Knife Edges without Bearing Plates.			12 in. Knife Edges with Bearing Plates.			6 in. Knife Edges with Bearing Plates.		
		No. Tests.	No. End Breaks.	Mod. Rup. Lbs. per sq. in.	No. Tests.	No. End Breaks.	Mod. Rup. Lbs. per sq. in.	No. Tests.	No. End Breaks.	Mod. Rup. Lbs. per sq. in.
Brick B.										
Soft	N	17	0	1,550	17	0	1,730	15	[illegible]	1,620
Medium soft	O	15	0	1,510	15	0	1,820	15	0	1,690
No. 1 soft	P	4	0	1,930	4	0	1,960	4	0	2,140
No. 1	Q	50	27	2,310	[illegible]	3	2,610	50	1	2,730
No. 1 hard	R	20	7	2,119	10	0	2,860*	30	1	2,450
Clinker	S	12	2	1,760	12	0	1,780	12	2	1,920
Brick A.										
Underbur'd	T	15	2	1,770	15	1	1,990	15	[illegible]	1,890
No. 1	U	[illegible]	8	2,630	30	1	2,580	30	0	2,570
Overburned	V	15	3	2,540	15	0	2,300	15	0	2,730

N. B.—An "end break" is one starting over an end knife edge.

The 12 inch knife edges were rounded longitudinally to 12 inch radii and transversely to ⅛ inch radii. The 6 inch knife edges were rounded to radii of 6 inches and ¼ inch.

* These ten brick were partly very good No. 1's tested here through error in sorting.

Perhaps the most striking thing to be noticed in a study of the diagrams is the great lack of uniformity seen in the results of the same test on the same grade of brick. So great is the lack of uniformity that it is easy to see how one could be entirely misled by the averages of paving brick tests, where only a few tests of each kind have been made. For example, if in the case of the No. 1 B and No. 1 A brick the comparison is between the best two absorption, crushing and rattler tests, and the best one-half of the transverse tests, of No. 1 B with the corresponding numbers of lowest tests of No. 1 A, No. 1 B is bound to rank better by every test. Reversing the comparison, No. 1 A would rank the better by every test, though the number of tests compared is in each case a large percentage of all. Similar possible contradictions in comparing partial averages can easily be traced between other grades.

In other words, the variation in the results of tests on different individuals of the same grade of brick, burned in the same kiln, is much greater in these experiments than the differences which were found between the average results of tests of such different grades as would be likely to come into competition with each other in the market. From their knowledge of the care with which the tests were made, and a careful study of the internal structure of each brick broken in the transverse tests, the authors believe that the lack of uniformity in the results of the tests was mainly due to a corresponding lack of uniformity in the structure of the brick. A similar lack of uniformity of structure exists in building stone, even when all specimens tested are from the same quarry and the same layer.

The lack of uniformity in the results of the rattler test would be much more striking were the losses for the individual bricks measured and platted. It must be remembered that each rattler test gives only the average loss for 22 brick. The lack of uniformity in the results of the transverse tests is especially striking. The causes were carefully studied and will be discussed later.

If it be true that the differences of structure in brick of the same grade and from the same kiln are so great as these tests indicate, the necessity of making a large number of tests

before passing judgment is at once apparent. Moreover it will never be safe to rely on averages alone. The individual tests should be given, together with all data possible to obtain regarding the internal structure. The extent of lack of uniformity should be noted, and its probable causes studied. The advantages of making such a study as this may be illustrated by comparing the No. 1 A and the Overburned A brick, as tested in these experiments. The Overburned A ranked a little higher than the No. 1 A by the averages of the absorption and the crushing tests, and only a little lower by the averages of the rattler and transverse tests. However, the individual transverse tests, as platted on Figure 2, show at once that nearly one-half of the Overburned A had serious flaws, mostly air checks, which ought of themselves to condemn the brick as not being first-class pavers. The average tests ran high in spite of the flaws, because, as the authors observed, the brick were generally burned very near to the exact point, aimed at by all brick makers, where the greatest physical strength of structure is secured.

The lack of uniformity between the individual tests seen on the diagrams suggests at once one possible cause for the failure of the N. B. M. A. commission to trace any relation between the results of the different methods of testing. The irregularities seen in the results of four kinds of tests on each of 35 kinds of paving brick, as given by Prof. Talbot in the "Technograph" for 1897-98, may be accounted for in the same way, at least in part.

Probably the only satisfactory way to study the relations which exist between the qualities of paving brick and the results of the various tests is to make experiments on brick of known relative rank and compare the results. To show the results of the present experiments in proper form for such a comparison, Figure 4 has been constructed. An examination of it shows very clearly how for brick B all the tests give poor results for the soft brick, rise to the best results for the No. 1, and then fall again to poorer results for the clinker brick. The authors believe that both the transverse and the rattler tests correctly indicate the relative ranks of all the six grades of brick B tested. The crushing test shows a discrepant result on the No. 1 Hard brick, and the percentage of absorption increases very slowly after the point of maximum excellence is reached in burning, while the quality of the brick rapidly deteriorates.

For brick A the grades are correctly ranked by the rattler and transverse tests. The crushing and absorption tests are better for the Overburned A, however, than for the No. 1 A. The authors think that this is because the Overburned A were actually burned nearer the point of maximum physical strength. However, the presence of air-check flaws in a large percentage of them brought the rank down in the rattler and transverse tests, as is clearly shown in Figure 2.

When the results for both brick A and brick B are put together, the authors believe that no one test correctly ranked all the grades tested. From their knowledge of the brick and study of the internal structure, they would rank the five best grades (not considering P) in the order, U, Q, V, R, T. While there is room for some doubt as to the absolute correctness of this ranking, T is certainly a very much poorer grade of brick than Q. If rattler tests not made by the authors are omitted, which can be done without greatly changing the result, the rattler test would rank the brick in the order U, V, T, Q, R, and certainly places the underburned brick T much too high. Prof. Talbot has already criticised the N. B. M. A. rattler test as not being severe enough on soft brick. The transverse test would rank the brick in the order Q, U, V, R, T, which the authors think in error as regards the relative position of U and Q. The transverse strength of U was lowered by the presence of several specimens having flaws. (See Figure 2.)

It has been stated that some experiments were made to determine whether the moisture in the brick would have an appreciable effect upon the losses in the rattler test. A study of Figure 1 will show that if there was any such effect it was less than the other normal irregularities in the results.

A special study also was made of the transverse test. Perhaps the greatest value of this test is, or should be, that it searches out flaws and exposes the internal structure in a way which perhaps enables the engineer, if he makes use of the opportunity, to become more familiar with the internal structure of the brick and the causes of defects than he can by any other method of testing. To take full advantage of this in the present experiments the position of each fracture was sketched in the note book on a side elevation of the brick, while on a sketch of the fractured cross section the position, extent and character of all flaws, laminations and similar defects were noted. A memorandum was also written out for each brick, stating the hardness of burning, as indicated by the appearance of the fractured section, and any other facts of interest regarding the structure and the test which could not be indicated on the sketches.

As a result of this work the authors attribute the variations in the results of the transverse tests in these experiments mainly to three causes. One of these is the presence of flaws, two kinds of which were found in the brick tested. One was air checks, and the other was caused by patches of loose red, granular material, which probably resulted from lack of uniformity in tempering. Another important cause affecting the transverse strength was the homogeneity, size of grain and density of the structure. In many of these tests nodules or granules, partly red and partly white, and sometimes nearly as large as a pea, were found, causing a lumpy, coarse-grained fracture. Such granules greatly weaken the brick, because their surfaces are not perfectly united to the adjacent material. On the other hand a uniform, fine-grained, dense structure adds greatly to the strength. Lack of homogeneity and fineness of grain in the structure of paving brick may be caused by lack of uniformity in the materials used in manufacture, by lack of fineness in grinding, by lack of care in tempering, by laminations made by the brick machine, and finally by unevenness in burning. The third important cause affecting the transverse strength was the hardness of burning. The authors think that the transverse strength is greatest, other things being equal, at that exact point in burning at which the greatest excellence in the brick for paving purposes is secured. Certainly both underburned soft brick and overburned cindery brick are much weaker than brick burned to just the proper degree of vitrification.

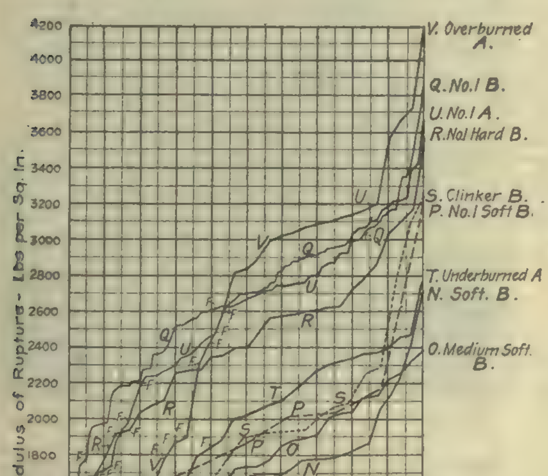


FIG.2 Transverse Tests.

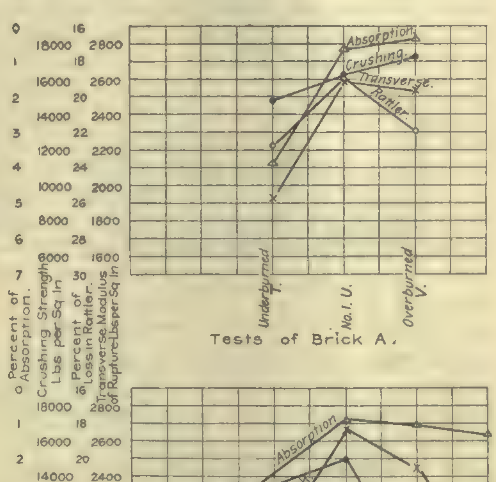


FIG.4

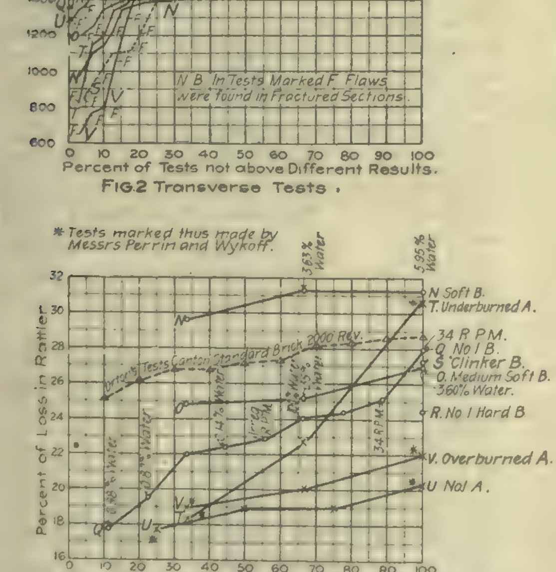
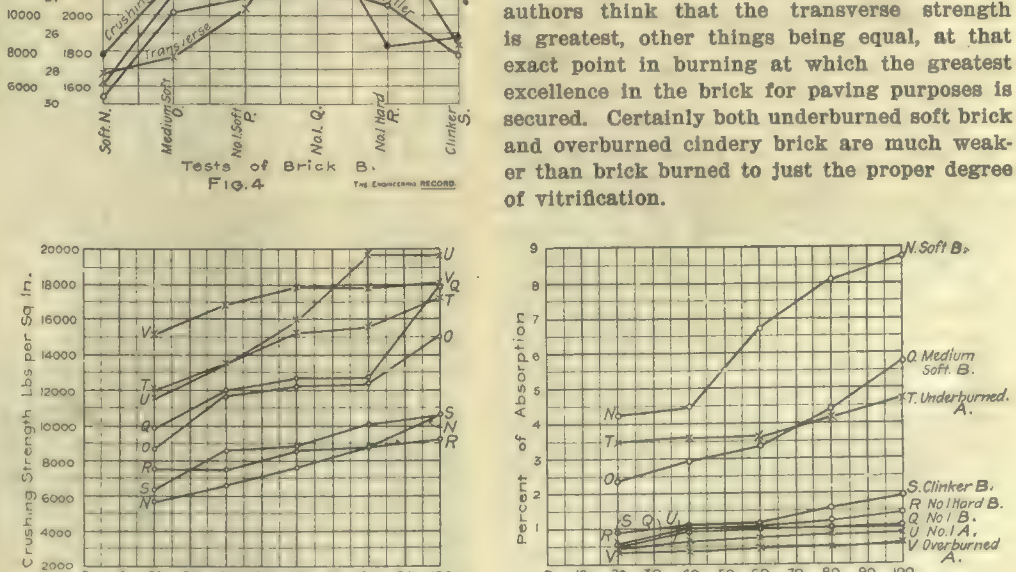


FIG.1 Rattler Tests.



Crushing Tests. FIG.3 Absorption Tests.

THE ENGINEERING RECORD

DIAGRAMS OF RESULTS OF PAVING BRICK TESTS, IOWA STATE UNIVERSITY.

PROF. A. MARSTON, DIRECTOR DEPARTMENT OF CIVIL ENGINEERING.

The three causes just named operate together, and the last two often obscure each other, making it difficult sometimes to tell just what was the reason that a given brick broke high or low. An underburned brick, if fine-grained and homogeneous, may break higher than a harder-burned but coarser-grained and non-homogeneous brick. Conversely a coarse-grained brick, if well burned, may break higher than a fine-grained but softer specimen.

While the authors consider the transverse test of paving brick to be of very great value, if a proper study of the structure of the brick is made in connection with the tests, they are inclined to think that the N. B. M. A. specifications for conducting it should be modified in several particulars. One of the most important of these is the insertion of steel bearing blocks between the knife edges and the brick.

The N. B. M. A. specifications provide that the upper knife edge shall be rounded to a 1/16-inch radius. Such a knife edge could not have an area of contact with the brick on edge exceeding 0.15 square inch, and it probably is not nearly this large. The breaking load for good paving brick on edge often runs higher than 15,000 pounds, so that the pressure between the knife edge and the brick must often exceed 100,000 pounds per square inch, which is at least five times the crushing strength of the brick as ascertained by tests in which the whole top area of the specimen is loaded. Evidently such a knife edge will cut into the brick and injure it. As the lower knife edges are rounded longitudinally to a 12-inch radius, as well as transversely to a ⅛-inch radius, they will have still smaller areas of contact. In fact, in testing brick with these knife edges, using no bearing blocks, the lower knife edges often injure the brick so much that the fracture starts at one of them, generally running with a curved fracture to the upper knife edge, giving what the authors have called an "end break" in the accompanying table. This table shows the results of tests made by the authors to ascertain the effect of using bearing plates, and of rounding the lower knife edges longitudinally to a radius of 6 instead of 12 inches, so as to reduce the eccentricity of bearing in the case of irregularly shaped specimens. From the table it will be seen that the use of 6-inch knife edges is of no benefit, but that the use of bearing blocks practically eliminates "end breaks," and appreciably increases the transverse strength. The apparent exceptions to the increase of strength in the case of grades U and V were in reality due to larger proportions of flaws in the brick tested with the bearing plates. The authors, therefore, are inclined to think that in the N. B. M. A. specifications for the transverse test a clause should be added requiring the use of bearing blocks, which, when the brick are tested on edge, should be ¾ inch wide by 1¾ inches long, by ½ inch high, with all edges and corners rounded to 1/16-inch radius.

The authors would also be inclined to omit the clause of the N. B. M. A. specifications which requires all samples for tests to be free from all visible irregularities of surface or deformities of shape, and the upper and lower surfaces to be practically parallel. In place of this clause they would insert a requirement that the upper knife edge must be made self-adjustable, which, with the use of bearing plates, will permit all brick regular enough in form to be used in pavements to be tested as they come, without any special preparation of the surfaces. The objection to testing only the most regular shaped brick is the danger that they may not correctly represent the brick as actually put into the pavement.

The authors are also inclined to question whether in view of the great lack of uniformity in the results of individual results, ten tests are sufficient to constitute a standard transverse test. To secure averages as reliable as rattler tests as many brick as are required for the rattler test must be used.

The authors would be in favor also of requiring a report of the individual results of the tests to show the degree of uniformity of the brick, and also of requiring that a memorandum be kept with each test regarding the structure of the fractured section, with a sketch of the section showing flaws, laminations, etc. The authors are of course aware that this, with a largely increased number of tests, would make necessary considerably more labor and expense than the present requirements, but they also realize that labor and expense less than are necessary to give reliable results are wasted.

With regard to the crushing tests the authors may say that the N. B. M. A. specifications are not definite enough concerning several important details of the tests. In these experiments the upper and lower faces of the specimens were ground to true planes, the rounded corners of the brick were bevelled off, and the smaller actual bearing area, whether at top or bottom, was used in the computations. The tests were made on a 100,000-pound Riehlé testing machine, between adjustable steel plates. It may be doubted whether crushing tests give results of value at all commensurate with the expense involved in making them.

NEW WATER TOWER AT SCHENECTADY, N. Y.

A new steel stand-pipe with ornamental masonry tower was completed at Schenectady, N. Y., about three years ago. It is 32 feet in diameter, 100 feet high and has a capacity of about 600,000 gallons. The specifications required that the material of the stand-pipe should be of soft open-hearth steel, having an ultimate tensile strength of not less than 54,000 nor more than 62,000 pounds per square inch; a minimum elongation in plates ⅜ inch or more in thickness, of 24 per cent. in 8 inches, and in plates under ⅜ inch in thickness, of 22½ per cent. in 8 inches; and a minimum percentage of reduction of area at fracture equal to twice the elongation. A full series of tests, both chemical and physical, were made on samples from each melt of the steel. The rivets used were of the best grade of soft charcoal iron.

The tank consists of 20 courses lapping over each other inside and outside alternately, each course having a build of 5 feet. The bottom course is ⅞ inch and the top course 3/16 inch thick, and all reductions in thickness were made by 1/16 inch. The vertical joints in the 12 lowest courses are double riveted butt joints with inside and outside cover plates varying in thickness from ½ to ¼ inch. Single riveted lap joints were used in the two courses at the top and double riveted lap joints were used in the intermediate courses. The horizontal joints are all single riveted lap joints. The bottom of the tank is ½ inch thick with single riveted butt joints having inside covering straps ½ inch thick. The bottom and side plates of the stand-pipe are connected by a 6 x 6 x ¾-inch outside angle iron, double riveted to both bottom and sides with 1-inch rivets spaced 3 inches between centers. Around the outside of the top of the tank is a 3 x 3 x 5/16-inch stiffening angle iron with ⅝-inch rivets. The bottom was riveted on supports and lowered on a 2-inch bed of dry Portland cement and sand thoroughly mixed in the proportion of one part of cement to two parts of sand. The outer joint was pointed with mortar made of equal parts of Portland cement and sand.

A 20-inch supply pipe is carried through a subway in the masonry foundation of the tank, as shown in Figure 1. It has a 90-degree upward bend ending in a slip-joint connection with a vertical pipe. The latter is riveted through a spreading flange to the bottom of the tank, which is supported at this point on a circular casting somewhat like a manhole casting with a wide top flange. The small pipe leading from the delivery main is a 10-inch cast-iron drain for emptying the tank, and is connected with the same drain which takes the discharge of the overflow pipe.

The top of the tank is cut down 12 inches for a length of 7 feet to form an overflow weir into a sheet steel box projecting about 30 inches from the tank, to which it is riveted. To the bottom of this box is fitted a 24 to 16-inch reducer connected to the overflow pipe, which is 16 inches in diameter and is carried down between the stand-pipe and tower. It is of galvanized spiral riveted wrought iron pipe in lengths of about 20 feet. The joints are made of cast-iron and consist of three rings, an inner ring fitting close to the pipe and two outer rings fastened together by bolts, as shown in Figure 2. They are supported by brackets

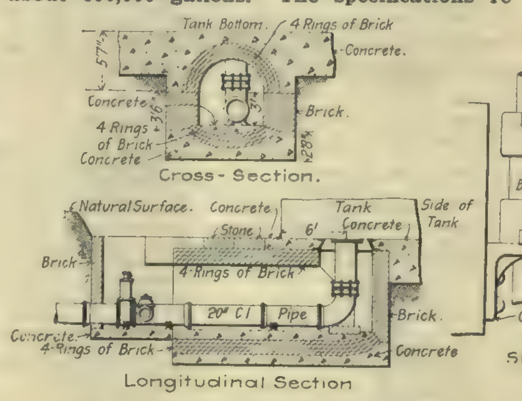


FIGURE 1.—SUBWAY IN FOUNDATION.

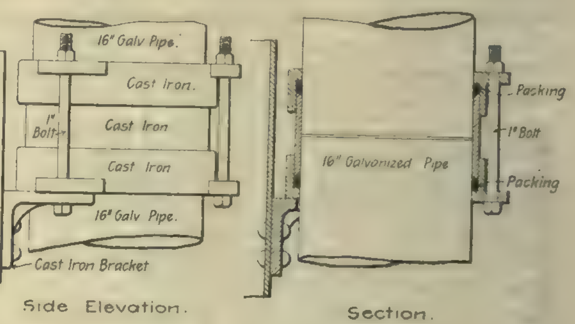


FIGURE 2.—JOINT ON OVERFLOW.

riveted to the side of the tank. Inside the stand-pipe is an iron ladder extending from the top to the bottom. All of the steel received a coating of boiled linseed oil in the shop and the stand-pipe was painted inside and out with two coats of black varnish equal to Edward Smith & Company's black bridge paint.

The tank extends 2 feet 6 inches below the surface of the ground to a 4-foot layer of concrete, which extends 18 inches beyond the tank on all sides. Outside of the concrete is the rubble masonry foundation for the tower, 4 feet thick, 7 feet wide on the bottom, and 5 feet 8 inches wide on top. Beneath this is a layer of concrete 1 foot thick and 7 feet wide. The concrete was made of one part of Rosendale cement, two parts of sand and four parts of broken stone of a size that would pass a 2-inch ring.

The masonry tower is built of local blue sandstone, and is octagonal in plan. At the surface of the ground the walls are 4 feet thick, decreasing to 2 feet at a point 11 feet above the ground. This portion of the walls is of heavy rock-faced coursed ashlar with no course less than 18 inches high. On top of this is an 18-inch belting course with fine bush-hammered work on the exposed faces. The tower walls from the belting course to the bottom of the cornice are 2 feet thick. They are of rock-

faced ashlar laid in broken range and backed with rubble stone masonry. This backing is laid in courses level with the corresponding courses of ashlar. Near the top of the tower is an arcade with columns of the same material as that used in the ashlar work. At the bottom of one side of the tower is an arched doorway. Over the doorway are three windows and on the other sides there are four, each 1 foot 4 inches by 4 feet 5 inches. All of the masonry work was laid in Rosendale cement mortar with Portland pointing outside and Rosendale inside.

From the surface of the ground to the cornice is 92 feet and to the top of the roof is about 135 feet. Figure 3 shows a general elevation of the tower. The roof trusses, rafters, roof framing and upper platform are all of soft steel. The roof is of 16-ounce copper underlaid with two thicknesses of tarred paper nailed to 1¼-inch matched cypress sheathing. The cornice is also of 16-ounce copper securely fastened to cypress

FIGURE 3.—WATER TOWER AT SCHENECTADY.

forms, spiked to cypress bonding pieces built into the walls and to 2 x 4-inch cypress scantling cut between the ends of the rafters. Between the masonry tower and the stand-pipe is a space 2 feet wide, in the narrowest place, in which is carried a stairway with wrought-iron framework and cast-iron treads. The entire structure was designed by the Stanwix Engineering Company, Rome, N. Y., and is now under the charge of Mr. George T. Ingersoll, superintendent of the Schenectady waterworks.

AN INNOVATION IN PUBLISHING SOCIETY PROCEEDINGS.

When the members of the American Society of Civil Engineers received their March copy of "Proceedings" and glanced over the pages devoted to society affairs, they must have experienced a mild shock on reading the new rules governing the publications of this society. Even those members whose connection with the organization goes back but a comparatively few years can remember the time when the only intimation they received of what was taking place at the society meetings was in "Transactions" issued several months after the regular date of publication. Advance copies of the papers to be presented were practically unseen by most of the members. Once in a while some engineer of exceptional experience in a special branch might receive an extra copy with a request to discuss it or send in a written communication concerning it. A very large proportion of the membership, however, saw nothing of a paper, let alone its discussion, until it had been finally printed. This prevented the papers from being of the most advantage to their authors and the society at large.

Three years ago a marked change was made in this old system. All papers have since then been published in the "Proceedings" in advance of the date set for their presentation, thus giving all members a nominal opportunity to discuss them. This, in many cases, has been literally nominal, because a paper sometimes appeared within not much more than a week of the time of its presentation, and it is well understood by those familiar with the workings of the society's machinery that at times such a publication was only possible by the hardest kind of work in the Secretary's office. Moreover, while all papers have been sent to the members before the date of presentation, there has been no preliminary printing of the discussions, which are oftentimes as important as the papers. Hereafter all correspondence and discussions will be printed in the "Proceedings" together with the author's closure, and after the latter appears an additional month will be allowed for further correspondence before the complete paper is sent to press for the next volume of "Transactions." Provision is made for still further continuing the period of discussion if it seems desirable. It will be seen that this new plan makes the advantages of a non-resident member nearly equal to those of the residents who are able to attend in person the semi-monthly meetings. How well the plan will work experience alone can determine, but the desire of the Board of Direction to make the society of the greatest usefulness to all its members is evinced by their adoption of this decidedly novel system of independent preliminary and final publications. If the plans are carried out successfully as proposed, the members of the society will have greater advantages from a technical point of view than those of any other society with whose management "The Engineering Record" is familiar.

Another innovation is announced by the Board of Direction which will probably be generally approved. This is the decision to have no papers presented at the annual conventions of the society. No important secrets are revealed when it is stated that the practice of presenting papers at the conventions has probably caused as much trouble in the society's publishing business as any one feature of its work. It was mentioned above that at times the Secretary's office was barely able to obtain from the Publication Committee enough papers to ensure their appearance in advance of the semi-monthly meetings, as required by the rules in force up to this time. The Committee is frequently obliged to spend much time in examining the papers sent to it, sometimes sending them to specialists for an opinion, and as the members of the Committee carry on the work, which is often tedious, at the expense of their own private affairs, there has been at times a scarcity of material for the next number of "Proceedings." This dearth of papers during the greater part of the year was undoubtedly due in large part to the desire of the members intending to present such contributions to have them discussed at the annual conventions. Now that no paper whatever is to be presented at these times, it is safe to expect that the work of publishing papers for the remainder of the year may be conducted more easily. Moreover, the discussion of papers will doubtless be better than was possible, on account of limited time, at some of these meetings. Although most of the members attending conventions do so for the social features of these gatherings, there are some who desire to discuss professional subjects at such times, and it has accordingly been decided that all papers presented during the six months preceding an annual convention or an annual meeting may be discussed at these gatherings, and a provision is also made for presenting informally topics of current engineering interest. This plan probably involves the most radical change of any in the new schedule, for until now the annual meeting has been, as the constitution provides, solely a business assembly, and the social features which attended it were provided under the direction of a local committee of arrangements, with which the Board of Direction had very little to do.

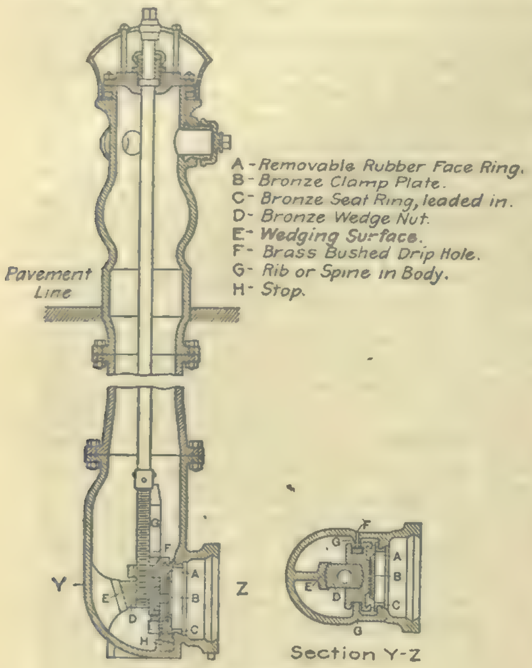
Still another new feature appears in the society's "Proceedings," a brief index to articles in the engineering publications. This places the American Society of Civil Engineers on the same basis as the national engineering societies of Germany and Austria, which have conducted such work for many years. The Association of Engineering Societies of this country published such an index for some time under the direction of Prof. J. B. Johnson, but finally turned it over to a private publication, which still conducts it. The Institution of Civil Engineers prints abstracts of articles in a wide range of papers, which abstracts, it must be confessed, are not always of remarkable value. The Western Society of Engineers also prints some abstracts, which seem to be an improvement on those of the British society. The first installment of the index of the American Society of Civil Engineers shows that it intends to carry on this work in a different manner, for the index is merely a compilation of titles of leading articles without reference to their length or illustrations. The society states frankly that it does not expect to be able to print a complete index, but it is intended to continue that started in the March "Proceedings" if it is found of sufficient value to the members. There is no doubt that a carefully-prepared analytical index to current technical literature, printed on one side of a page so that the individual notes can be cut out and pasted on cards, will prove of value to many engineers if the notes are sufficiently full to give some further indication of the contents of the articles than their titles alone. It will be interesting to follow the progress of this more restricted index undertaken by the American Society of Civil Engineers, for such efforts have heretofore not been received very warmly.

THE CHAPMAN RUBBER-SEAT POST HYDRANT.

In order to meet the demand for a post fire hydrant which can be repaired without the delay and expense of tearing up a paved street, the Chapman Valve Manufacturing Company of Indian Orchard, Mass., has brought out the design shown in the accompanying illustration. It is of the gate type, with a cast-iron body, bronze mountings and special rubber faces. The water inlet at the bottom is closed by a gate with a vertical face, operated by means of a screw on the main rod in the same manner as the older types of hydrants made by this firm. The gate is faced with a heavy renewable seat ring of a special grade of rubber, which closes against a bronze ring in the body of the hydrant. The rubber is held in place by a bronze clamping plate, as shown in the cut.

The gate is guided by vertical ribs in the body, which engage in grooves, as shown in the cross-section. Enough play is left between the gate and the ribs to allow the wedging of the faces when the hydrant is closed and prevent the water inlet being shut so quickly as to produce hammer in the water main. The closing consists in first lowering the gate clear of the

seat until it reaches the stop on the casing or body. When this occurs the gate is unable to drop farther, but the water still flows in a thin sheet between the two faces. On turning the stem farther the wedge behind the gate is driven downward against the sloping surface of a rib projecting from the back of the body; this wedge forces the two faces together and shuts off the supply. It will be seen that the pressure of the water in the street main insures the separation of the two faces until the gate is finally forced horizontally against its seat by the final wedging.



NEW CHAPMAN HYDRANT.

The orifice through which the body of the hydrant is kept drained when not in use is bushed with brass and opened and closed automatically by the gate. The opening is closed as soon as the gate begins to rise, and remains sealed until the gate is closed again. The operating nuts and those on the covers of the nozzles, as well as the threads of the nozzles, are made to conform with the standards of the works for which the hydrants are ordered. The bodies are furnished with bell, flange, screw or spigot ends, and with or without frost cases, and can be provided with a steamer nozzle if desired.

A CINCINNATI STEEL CHIMNEY.

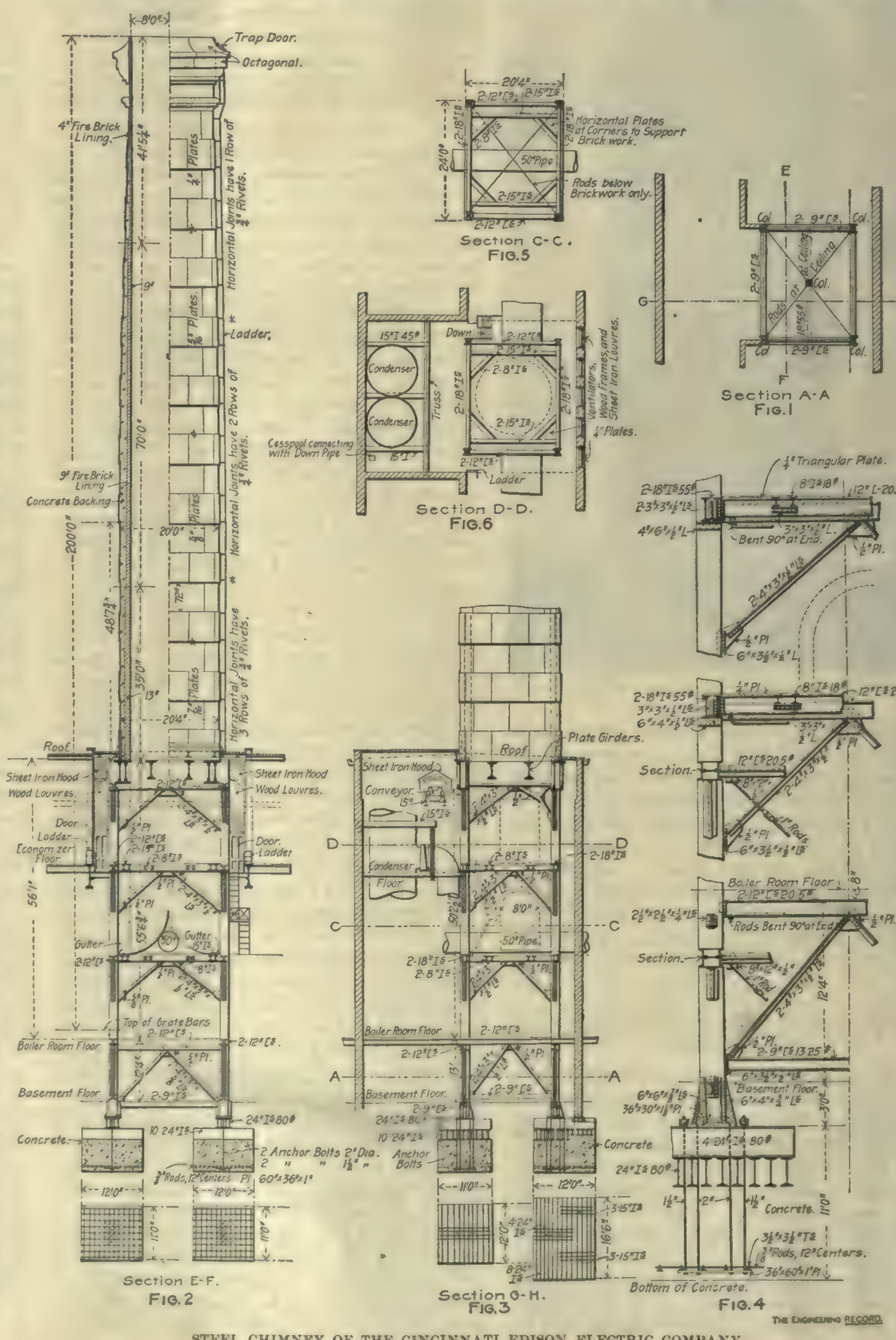
A chimney which is thought to be the largest of its class in existence, has recently been completed in Cincinnati, O., in connection with the erection of a power station for the Cincinnati Edison Electric Company, and it is described herewith as an interesting addition to the literature bearing upon the construction of large stacks. The chimney is a steel structure, self-supporting, and standing entirely independent of the power house to which it belongs. It is 200 feet high from the level of the grate bars of the boilers to the top of the coping, and has a constant internal diameter of 16 feet; its total height as measured from its foundation bottom is nearly 230 feet. The stack was designed by Messrs. Elzner & Anderson, of Cincinnati, O., who are the architects for the power station, and was built by the L. Schreiber & Sons Company, of Cincinnati. The height and area of the flue were determined by Messrs. Sargent & Lundy, of Chicago, who were the mechanical engineers of the plant.

The chimney rises through a part of the station where there are three stories, and is near an exterior wall. It passes through the boiler room, dividing it into two sections, traversing about 67 feet of its height from the basement floor to the roof of the station. The boiler room is about 34 feet high, and the basement below is 13 feet from floor to ceiling. The space above the boiler room extending to the roof is occupied by economizers on either side, and the smoke and gases from each group of boilers enter the stack in opposite directions from the economizers. Above the roof the chimney towers a cylindrical column over 145 feet high.

The chimney is supported by a steel structure within the building, extending to the roof. It consists of four steel columns formed of riveted plates and Z-bars, and of horizontal beams connecting the columns at various heights. Diagonal bracings of angle steel extend from the columns midway between the beam connections to about the center of the beams. The steel work is further braced by horizontal rods tightened between diagonally opposite columns. The plan of the structure a short distance above the foundation work is given in Figure 1. The four columns are pitched in the four corners of a rectangle, and a vertical section of the chimney has been taken along both the lines E-F and G-H. These are designated in the accompanying drawings as Figures 2 and 3.

The foundation work of each of the columns is separate, and consists of a concrete block built within a special excavation carried down to 14 feet below the present basement-floor level, and of a superincumbent footing of I-beams. The concrete blocks are all 7 feet deep and two of them measure 11 x 12 feet. The other pair are larger, to form also a foundation for the columns of an adjacent wall. The weight supported by the columns is distributed over the concrete by two layers of 24-inch I-beams, nine in the lower, spaced over the whole block, and four across these at right angles. The base of each of the columns is expanded by the addition of triangular web plates attached to the plates of the column, and rests upon a plate lying on the four top I-beam footings. The expanded case affords, of course, in addition to added bearing surface, greater facility for bolting to the foundation.

The construction may be seen from the sectional elevations already referred to, but may be more readily followed from Figure 4, which shows in greater detail certain of the connections. The bolts anchoring the expanded base pass through the upper flanges of the upper four I-beams. Besides this, the I-beams themselves are held fast to the concrete block by four rods, imbedded at the lower ends in the concrete and brought into tension at their upper ends by tightening nuts fitted upon them. Two of these are 2 inches in diameter and pass through the bed plate, upon which the



STEEL CHIMNEY OF THE CINCINNATI EDISON ELECTRIC COMPANY.

base of the column lies. The other two are 1½ inches in diameter and hold the outer ends of the beam footings to the concrete. All the four beams are brought under the pressure of these outer anchor rods by two angle beams, one sitting on the other, as shown, and a nut bearing on a deep cast-iron washer between the two. The method by which the lower ends of the anchor rods are held in the concrete is also interesting. Each of the rods has a head forged upon it, and is held by an anchor plate 1 inch thick, and measuring 3 x 5 feet. The anchor plate is within 6 inches of the bottom of the block, and bears on the under side of a number of tee-beams, which are inverted and spaced over the whole area. All of the tee-beams do not, therefore, touch the anchor plate, and through holes punched every foot along their web, ⅝-inch rods were slipped thus distributing the pressure to a greater extent over the whole area. The base of each column was figured for a dead load of 370 tons and a wind pressure of 152 tons. The dead load of the entire structure is 1,480 tons, exclusive of wind pressure.

The structure within the power house may be seen in Figures 2 and 3 also, and some of the details in Figure 4. The method by which the diagonal bracings are fastened and the position and fastening of the horizontal diagonal tie rods is shown in the latter. The brickwork starts at about the half-height of the boiler room, and a section of the chimney at this point may be seen in Figure 5. The shorter I-beams, it will be noticed, are supported by the longer beams instead of by direct connection with the columns. A square is thus formed and short, light beams are riveted in the corners to form an octagon. Triangular plates are laid on the corners and support the brickwork, which is built to form the circular shaft. The flue, however, is octagonal in section within the power house, not assuming the circular until the level of the roof is reached. On two opposite sides brick openings with arching tops are left for connecting the boiler breeching to the chimney whenever it is desirable to by-pass the economizers, and the piercing of the chimney by a large exhaust-steam pipe below the boiler connection may be mentioned. The same arrangement of beam work prevails on the economizer floor, and the brickwork is continued. The openings into the stack from the economizers are rectangular, and to supplant in strength the brickwork displaced, are made of steel frames. The horizontal section through this portion of the chimney is given in Figure 6. Deflector plates form the bottom of the flue. They are large steel plates suspended from the girders above, and are lined with fire brick and placed at the lower entrance of the breeching.

The columns end at the roof, and massive girders span their tops, supporting other girders, and forming another octagon, as already described for the beam work immediately below. Figure 7 is a plan of the girders. Those marked A are made of two 60-inch web plates with 3 flange plates at top and bottom; girders, B, are composed of 48-inch webs with double flange plates at top and bottom; and the diagonal corner girders, C, are made of a single web 36 inches high. The girders A are riveted to the columns, and are anchored by angle beams riveted to the girder ends and the plates of the columns, extending down the latter a distance of about 4 feet.

The stack above the roof is formed of steel plates, four around the circumference of the stack, and laid 6 feet one above the other. The bottom ring of plates is provided with internal ribs of steel, and the plates and ribs stand on a flat plate curving in an annular ring, which follows closely the octagon formation of the supporting girders. The ribs are riveted to the plates, and the plates are also fastened by continuous curved angles. The annular ring plate is 25 inches wide and is bolted to the top flange plates of the girders.

The steel plates of the chimney vary in thickness from 7/16 of an inch at the roof to ¼ of an inch at the top. The successive rings of plates are connected by lap joints, triple riveted. The vertical joints of plate to plate are butt joints, with an internal splice plate and a row of rivets on each side of the seam. The inside of the stack, as already mentioned, is 16 feet in diameter, and is lined with fire-brick, which extends to the top with thicknesses of 13, 9 and 4 inches, as shown in Figure 2. The thickness of the column at the base is 26 inches, and the steel-plate exterior is given a batter, which brings the steel shell at the top of the chimney close to the brickwork. This portion of the chimney is not conical, however, but has been designed with an entasis, that is, with the diminishing curve from base to top that is characteristic of classical columns, serving to give them the appearance of absolute stability. The space between the bricks and the steel is filled with concrete.

The top of the chimney is surmounted by a cap formed of sheet steel, supported by a framework of angle-iron riveted to the top ring of plates, and projecting outward in an octagon. The sheet steel covers the angle-iron frame slipping over the circular top of the chimney flue. The top of the chimney is accessible from the station by a ladder mounting up one side.

THE HARRISBURG STANDARD SELF-OILING ENGINE.

The accompanying cuts show the "Harrisburg Standard" engine which has recently been put on the market by the Harrisburg Foundry & Machine Works, of Harrisburg, Pa. This engine, which is of the simple, single-valve automatic-cut-off type, contains the company's former engine known as the "Ideal," differing only in certain modifications which practice has shown to be an improvement.

The engines are made in various sizes up to a 36 x 36-inch cylinder. They are built with side cranks, as will be noticed, for both direct-coupled and belted service, and require but two main bearings, thereby reducing the excessive friction and bad alignment which sometimes attends the operation of three and four-bearing engines. This method of construction has lowered the power lost in the friction of the present machine to less than 2 per cent. of the indicated horse-power.

THE NEW HARRISBURG STANDARD ENGINE.

The crank disks, the connecting rod and the cross-head are enclosed, and the case is provided with a hinged hood over the crank disks and a plate on the side at the cross-head travel, which may be removed for the inspection and the adjustment of the reciprocating parts, as shown in the illustration. The oil for lubrication is taken by the rim of the disk, as it revolves, and is splashed over the wearing parts, the cross-head included. A large portion of the oil is intercepted by a lateral internal trough across the inside of the cover, and is led through a pipe and directed in a stream upon the main bearing adjoining the crank disk. The lubrication of the crank pin is accomplished by a diagonal hole drilled through the disk and coming out at about the middle of the surface of the crank pin, so that a supply of oil is obtained in this case by centrifugal force.

The governor is of the centrifugal-inertia type. Roller bearings are provided in the governor bearings and the principal mechanism consists of two balanced levers, which are connected to an eccentric sleeve on the shaft and pivoted at one side. The makers guarantee the governor sufficiently sensitive to regulate to one-half of one per cent. from no load to one-quarter overload.

The pillow blocks for the crank shaft have covers which are fitted in a diagonal position, and the shell is provided with an oil chamber with recess for oiling chains. The engine frame is extended with stuffing box exposed in such a position as to provide for constant and easy access, and make it also desirable as preventing water of condensation from getting into the oil supply, should a leak occur. A guard or fender is placed upon the cross head to prevent the oil from being splashed upon the rod, thus eliminating the use of a stuffing box in the partition.

In the process of manufacture, pistons, piston valves, pins and other special parts are ground to an accurate fit, and micrometer records are kept for each piece, so that parts may be easily duplicated after leaving the works.

Every engine is tested before it is shipped, and is so adjusted and balanced that it will run upon metallic points without any clamping to the temporary foundation.

ARCHITECTURAL LICENSES IN ILLINOIS.

On June 3, 1897, a legislative act was approved by the Governor of Illinois, which provided for the licensing of architects and a regulation of the practice of architecture as a profession in that State. Under the terms of that act Prof. N. Clifford Ricker, the head of the architectural school of the University of Illi-

nois, Messrs. Peter B. Wight, William Zimmerman and Dankmar Adler, of Chicago, and Mr. William H. Reeves, of Peoria, were appointed a Board of Examiners to carry its provision into effect. The leading requirements of the act will be given later. Illinois was the first State in the United States to place architecture on a par with the law and medicine by the enactment of regulations which require the architect to be a man of sufficient knowledge to be safely entrusted with the design and construction of buildings and forbid him to exercise these privileges if found, on trial, to be grossly incompetent, reckless or dishonest. The Board of Examiners was organized on September 3, 1897, and its biennial report just issued shows that 726 applications for licenses have been granted to architects in practice before the passage of the act and 43 licenses have been issued to architects who passed examinations before the Board. The operation of the law, like the law itself, is so largely an experiment in this country, and throws so much light on the constantly recurring subject of licensing civil engineers as well as architects that a review of the report of the Board is presented herewith. Before examining the proceedings of the Board, however, several of the clauses of the act must be quoted; these are as follows:

"Section 4. Provisions shall be made by the Board for holding examinations at least twice in each year, of applicants for license to practice architecture, and any person over 21 years of age upon payment of a fee of $15 to the secretary of the Board, shall be entitled to an examination for determining his or her qualifications. All examinations shall be made by said Board, or a committee of two members delegated by the Board, and due notice of the time and place of such examinations shall be published. The examination shall have special reference to the construction of buildings, and a test of the knowledge of the candidate of the strength of materials, and of his or her ability to make practical application of such knowledge in the ordinary professional work of an architect, and in the duties of a supervisor of mechanical work on buildings, and should also seek to determine his or her knowledge of the laws of sanitation as applied to buildings. If the result of the examination of any applicant shall be satisfactory to a majority of the Board, the secretary shall, upon an order of the Board, issue to the applicant a certificate to that effect, and upon payment to the secretary of the Board by the candidate of a fee of $25 he shall thereupon issue to the person therein named a license to practice architecture in the State. If an applicant fails to pass said examination his or her fee shall be returned.

"Section 5. Any person who shall, by affidavit, show to the satisfaction of the State Board of Examiners of Architects that he or she was engaged in the practice of the profession of architecture on the date of the passage of this act, shall be entitled to a license without an examination, provided such application shall be made within six months after the passage of this act. Such license, when granted, shall set forth the fact that the person to whom the same was issued was practicing architecture in this State at the time of the passage of this act and is entitled to a license to practice architecture without an examination by the Board of Examiners, and the secretary of the Board shall, upon the payment to him of the fee of $25, issue to the person named in said affidavit a license to practice architecture in this State in accordance with the provisions of this act. In the case of a co-partnership of architects, each member whose name appears must be licensed to practice architecture. No stock company or corporation shall be licensed to practice architecture, but the same may employ licensed architects. Each licensed architect shall have his or her license recorded in the office of the county clerk in each and every county in this State, in which the holder thereof shall practice, and he or she shall pay to the clerk the same fee that is charged for the recording of notarial commissions. A failure to have his or her license so recorded shall be deemed sufficient cause for revocation of such license.

"Section 7. Every licensed architect shall have a seal, the impression of which must contain the name of the architect, his or her place of business and the words, 'Licensed Architect,' 'State of Illinois,' with which he shall stamp all drawings and specifications issued from his office for use in this State.

"Section 8. After six months from the passage of this act it shall be unlawful, and it shall be a misdemeanor punishable by a fine of not less than $50 nor more than $500 for each and every week during which said offense shall continue, for any person to practice architecture without a license in this State, or to advertise or to put out any sign or card or other device which might indicate to the public that he or she is entitled to practice as an architect.

"Section 9. Any person who shall be engaged in the planning or supervision of the erection, enlargement or alteration of buildings for others, and to be constructed by other persons than himself, shall be regarded as an architect within the provisions of this act, and shall be held to comply with the same; but nothing contained in this act shall prevent the draftsmen, students, clerks of works or superintendents, and other employees of those lawfully practicing as architects under license as herein provided for, from acting under the instructions, control or supervision of their employers; or shall prevent the employment of superintendents of buildings paid by the owners from acting, if under the control and direction of a licensed architect who has prepared the drawings and specifications for the building. The term building in this act shall be understood to be a structure consisting of foundations, walls and roof, with or without the other parts, but nothing contained in this act shall be construed to prevent any person, mechanic or builder from making plans or specifications for or supervising the erection, enlargement or alteration of any building that is to be constructed by himself or employees, nor shall a civil engineer be considered as an architect unless he plans, designs, or supervises the erection of buildings, in which case he shall be subject to all the provisions of this act and be considered as an architect.

"Section 10. Architects' licenses issued in accordance with the provision of this act shall remain in full force until revoked for cause. Any license so granted may be revoked by unanimous vote of the Board for gross incompetency, or recklessness in construction of buildings or for dishonest practices on the part of the holder thereof, but before any license shall be revoked such holder shall be entitled to at least 20 days' notice of the charge against him and of the time and place of the meeting of the Board for the hearing and determining of such charge. * * * After the expiration of six months from the revocation of a license the person whose license was revoked may have a new license issued to him by the secretary upon certificate of the Board of Examiners issued by them upon satisfactory evidence of proper reasons for his reinstatement, and upon payment to the secretary of a fee of $5.

"Section 11. Every licensed architect in this State who desires to continue the practice of his or her profession shall annually, during the time he or she shall continue in such practice, pay to the secretary of the Board during the month of July a fee of $5, and the secretary shall thereupon issue to such licensed architect a certificate of renewal of his or her license for a term of one year. Any licensed architect who shall fail to have his or her license renewed during the month of July in each and every year, shall have his or her license revoked at the discretion of the Board. But the failure to renew said license shall not deprive him or her of the right to renewal upon the payment of said fee."

The expenses of the Board are met by the fees paid to it, and all money in excess of these expenses is held as a special fund for meeting any extraordinary accounts against the Board and the cost of publishing its reports. When the sum in the treasurer's hand exceeds $2,500, however, the excess is to be paid into the State treasury, where it will be placed to the credit of the Board.

When the Board was organized, Mr. Dankmar Adler was elected president, and Mr. Peter D. Wight secretary and treasurer, and these gentlemen still hold office. From the outset the Board consulted the Attorney General on all subjects requiring legal advice, and in this way it was enabled to avoid many complications which might otherwise have arisen. By the end of November, 1897, which is the close of the fiscal year of Illinois, 426 applications for license under Section 5 had been filed, 306 had been approved and 132 had been paid for. A balance of nearly $1,700 was then standing in the secretary's hands. The Board was nearly overwhelmed with the demand for licenses, and the 1,000 application blanks which had been printed were exhausted. Many applicants sent checks in advance to pay their fees, and as the cases could not be acted upon at once and the Board could not receipt for the money, it was necessary to notify the senders that the amounts were held subject to their order until their applications could be finally taken up. The last days of December, 1897, were marked by very large collections, and the receipt of a great number of belated applications. The total number of applications from architects previously in practice which was received within the time allowed by law was 794.

The application of Section 4, which provides for examinations was made the subject of prolonged study before definite plans were adopted. The first step was to prepare a form of application for an examination, which would enable the applicant to show the nature and extent of his preliminary education and his experience. Applications would probably come from students fresh from schools, apprentices and draftsmen of long experience, and architects with large practice in other States, who might have occasion to extend their work to Illinois. Twelve questions were finally selected as best fitted to bring out a concise statement of the applicant's fitness for a license. The twelfth question, which the candidate may not fill out as he wishes, reads as follows: "If you have acted independently as the architect of any building or buildings, enumerate not more than three of such buildings, state their location, give the names and post-office addresses of their owners, and illustrate them by submitting photographs and descriptions or plans and specifications thereof." If this question is not answered it is assumed that the applicant is without actual experience and entitled only to a class examination. If the question is answered and exhibits are submitted they are examined, and, if favorable, the applicant is asked to appear before the next meeting of the Board for an examination in connection with the exhibit. These examinations are generally oral, and in the case of architects from other States the personal appearance of the applicant is waived.

The first examinations lasted three days, and were held in the Chicago City Hall. The second examination, also covering three days, was held in June, 1898, at the University of Illinois at Urbana. The subjects of the examinations were as follows: "Materials and Construction of Build-

ings," ten subjects, classed as Foundations, Stone Masonry, Mortar, Brick Masonry, Cast-Iron Work, Carpentry, Joinery, Tinner's Work, Plastering and Painting. "Strength of Materials," seven subjects, classed as Tension, Compression, Cast-Iron Columns, Shearing, Transverse Strains, Steel Floor Beams, Roof Truss. "Supervision," seven subjects, including Excavations, Stone Masonry, Brick Masonry, Iron and Steel Construction, Carpentry, Roofing and Plastering. "Sanitation," seven subjects, embracing Soil Pipes and Traps, Plumbing Fixtures, Cold-Water Supply and Fixtures, Hot-Water Supply, Hot-Air Furnaces and Pipe Steam Heating, Ventilation. One day of the examination was given entirely to making a preliminary study of a problem such as is given by a client to an architect, to ascertain the ability of the applicants to make a practical application of their knowledge in ordinary professional work.

After the first examinations held by the Board had been finished, the question arose as to whether diplomas of architectural schools should be accepted in lieu of part of the examinations for a license. In order to ascertain the graduating requirements of different schools, a letter was addressed to each asking for full particulars, but the information received was very meager. The Board then determined to ascertain by personal observation all that could be known of the courses of study pursued in the State University of Illinois, and it accordingly met at the university of the time of the June examination. The result of this personal examination was eminently satisfactory to the Board, which reports that all of its examinations in January in the Department of Building Materials, Construction and Sanitation were completely covered by the university course. "The theses of the graduating class were mainly problems and designs, and all of them were well executed; but the subjects were not such as usually fall within the experience of architects in continual practice. The supervising of work could hardly be expected to be covered in a university course, and it appeared that the practical application of architectural knowledge to be shown in the elucidations of an architectural problem as well as the qualification of a supervisor of construction must necessarily be covered in the Board's examinations." The Board accordingly decided to accept the diploma of the full course in architecture or architectural engineering of the State University as a satisfactory evidence of a competent knowledge of architectural construction, the laws of sanitation and the strength of materials, provided that in each case the applicant offering such a diploma also presented evidence satisfactory to the Board of his ability to apply this knowledge successfully to the design and construction of buildings.

It was not long after most of the architects in Illinois practicing at the time the law went into effect had been granted licenses, that complaints of violations of the act began to reach the Board. These complaints were either against parties who had not taken out licenses or others assuming to act as architects. As a matter of fact, very few men who claim to be architects in the State continued to practice in defiance of the law. After a careful examination of the text of the act under which it was organized, the Board decided it would be unjustified in undertaking the prosecution of violators because this would have been expensive and was not among the duties which the act states should be done at the expense of the fund entrusted to the Board. Nevertheless it issued a circular of information, many copies of which were distributed among the licensed architects, which gave full information as to what constitutes a violation of the law, and acted as a warning to those supposed to be violators of it. The City of Chicago, where three-fourths of the licensed architects of the State reside, greatly assisted the Board by requiring in its new building ordinance that all plans submitted to the Department of Building for structures above a certain grade, must be stamped and sealed by a licensed State architect. No permits will be granted for new work or alterations unless this is done. At the time the report was written a suit had been begun against the Board by a number of licensed architects to compel it to use its funds for prosecuting violations of the law.

The renewals of the licenses which have to be made during the month of July, seem to have been somewhat neglected. The number of licenses in force on July 1, 1898, was 729. The number of renewal fees received during that month as required by law was 600, and the number received since that time was 65, leaving 64 still unrenewed at the beginning of the present year. It is believed that many of these unrenewed licenses belong to architects who have moved away from the State or given up the practice of the profession.

STRESSES IN STEEL FOUNDATIONS.—IV.

[By Samuel B. Durand.]

Take the case of a footing carrying a column load of 800,000 pounds and resting on a compressible soil capable of carrying a load of 3,000 pounds per square foot safely. The clay area necessary to carry the column load is 266 2/3 square feet, but 15 per cent. more must be added to allow for the weight of the footing itself. From this approximation the weight of the footing, allowing for the steel, can be figured for a check. Should the approximated and actual weights not agree the area must be adjusted and the weight refigured until a check is obtained. Assuming the design of the footing for the case in hand as shown by Figure 3, page 354, the actual weight is found to agree with the approximation to within 2,000 pounds. Note that a 9-inch offset is allowed for the concrete base, which makes the lengths of the steel beams in both the third and second courses but 16 feet.

Turning back to formulas (vi.) to (x.), the following quantities are known: $R = 800{,}000 \div 4 = 200{,}000$ pounds; $w = 800{,}000 \div (4 \times 12 \times 17.5) = 1{,}905$ pounds. This omits the weight of the footing itself, because the maximum part of it is due to the concrete, which in reality the steel does not carry. $E_1 = 29{,}000{,}000$ pounds; $l = 24$ inches, $hl = 9$ inches, $h = 3/8$.

The first unknown quantity, which must be found is K, as the values of all the general equations are dependent upon it. Turning back to equations (xiii.) and (30) $E_s = 29{,}000{,}000$ $F_c = 1{,}380{,}000$, assuming concrete made with national Portland cement to be used. Having no condition by which the relative strengths of the upper and lower beams can be determined, as stated above in the general case, it is necessary to assume a value of I_1 and then employ equation (xi.) to find the approximate value of I_0. It will be found in practical cases that, unless K has a value of about 2½, that is to say, unless E_1I_1 be made 2½ times greater than E_0I_0, the bending moment on the composite beam will be greater than its safe moment of resistance, because of the term wld of the general equations then having a value less than one-seventh of R, causing too great a concentration of loading near the center of the footing. In order to find the depth of the composite beam by this formula, it will be necessary to assume it to be a homogeneous concrete beam. This will give a value of d, which will be satisfactory in the general equations.

Under these conditions equation (xi.) becomes

$$I_1 = 6{,}157{,}628\, f - (E_0I_0 \div E_1)$$

If 16,000 pounds is used as the unit working stress of steel in compression, and a depth of 20 inches is assumed for the third course of beams, f becomes $1 \div 1{,}600$. Since $K = 2.5 = E\, I_1 \div E_0I_0$, $0.4\, I_1 = E_0I_0 \div E_1$. Substituting this value in the equation and solving gives 2,740 as the value of I_1. This value is so near 2,898 biquad. inches, the figure for two 20-inch 80-pound steel beams, that the latter may be adopted to obtain the value of I_0 from $E_0I_0 \div I_1 = 950$. Since this value, 20,000 biquad. inches, is equal to $105\, d^3 \div 12$, $d = 13.2$ inches.

The width of the section of the first course is 105 inches, for but half the width of the footing, see Figure 4, acts with each steel lower beam. Since the value of I_1 chosen would make the value of K over 3, assume the depth of the composite beam to be 14 inches instead of 13.2 inches; and let its tension be strengthened by 32 ½ x ¼-inch steel tension rods, centered 2¼ inches from its upper face. Since the centers of gravity of both the concrete and the tension rods will be practically on their center lines in the section, $g = 4\frac{3}{4}$ inches. $B_2 = 16 \times \frac{1}{2} \times \frac{1}{4} = 2$ square inches and $B_1 = 105 \times 14 - 2 = 1{,}468$ square inches. From (xiii.) $z_1 = 0.132$ inch. The neutral axis of the section as a whole is therefore 0.132 inch below the center line of the beam; therefore $I_c = 24035.6$ biquad. inches; $I_R = 42\ 7$ biquad. inches; and $E_0I_0 \div E_1 = I_c \div K = 1{,}185.5$.

Solving equation (xi.) again for a check, $I_1 = 3{,}840.5 - 1{,}185.5 = 2{,}665$. Therefore, use as assumed two 20-inch, 80-pound steel I-beams and I_1 will then have the value 2,898 instead of 2,665. Now $K = 2.444$; $d = K \div (1 + K) = 0.7096$; $dwl = 32443$. From equations (vi.) to (x.), $P_5 = 27{,}900$ pounds, $P_4 = 33{,}100$ pounds, $P_3 = 32{,}200$ pounds, $P_2 = 90{,}600$ pounds, and $P_1 = 32{,}400$ pounds.

The maximum moment on the concrete is $M_2 = -1{,}879{,}200$ inch-pounds. This value of M_2 must now be equated with those of M_c and M_s given by equations (xv.) and (xvi.) in order that the values of the fiber stresses in the composite beam can be obtained. If either of the unit working stresses proves to be too large for safety, the design must be so changed as to cause safe values in both materials to result. In the composite beam let s_1 be the stress per square inch on the outermost fiber of the concrete and s_2 be the stress per square inch on the outermost fiber of the tension rods, then $p_1 = s_1 \div 7.132$, and $p_2 = s_2 \div 4.868$. Using (xv.), $p_1 = 75.37$, and $s_1 = 537½$, which is a factor of safety of 5.6, as the average compressive strength of National Portland cement concrete as given by General Gillmore is 3,000 pounds, which is a safe factor for concrete in compression. From (xvi.) $p_2 = 1{,}583\ 82$ and $s_2 = 7{,}700$, which is a factor of safety of 8 for steel in tension, therefore the number of rods could be reduced were it not for spacing them too fart apart. The minus sign in the value of M_2 shows that the upper side of the beam, as shown in Figure 5, is in tension, as it actually must be.

Having the values of the P_n the beams in the second or intermediate course can now be designed.

FIG. 9

Figure 9 shows the loading as they are distributed in this case for this course of beams. Assuming the depth of this course to be 15 inches, the required moment of inertia can be found by the formula, bending moment = moment of resistance. Care must be taken to use the maximum bending moment on the beam, which will be at the point of application of the load from the lower beam, at R, Figure 9. The following design is calculated from the tables given in Carnegie's "Pocket Companion" for 1893, page 99. All I-beams are steel.

I at $P_1 = 438$, use one 15-inch 41-pound beam.

I at $P_2 = 1{,}131$, use two 15-inch 60-pound beams.

I at $P_3 = 408$, use one 15-inch 41-pound beam.

I at $P_4 = 419$, use one 15-inch 41-pound beam.
I at $P_5 = 353$, use one 15-inch 41-pound beam.

Since the general equations are based upon the condition that no bending occurs in this direction, the amount of deflection which will result from this design when the steel and concrete act together, must be investigated to insure that it does not exceed ⅛ inch. The following is the general formula for the maximum deflection of a beam loaded similarly to these beams:

$$EIy = wl^3 \, [4 \, (3 \, r - r^3) - 5] \div 24$$

where W is the total distributed load on the beam; l is the length of the beam, see Figure 9; and r is the ratio of the distance from the end of the beam to the point of support, to the length of the beam.

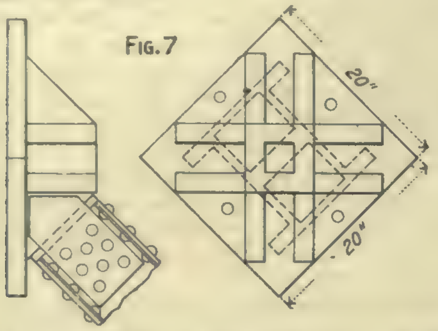
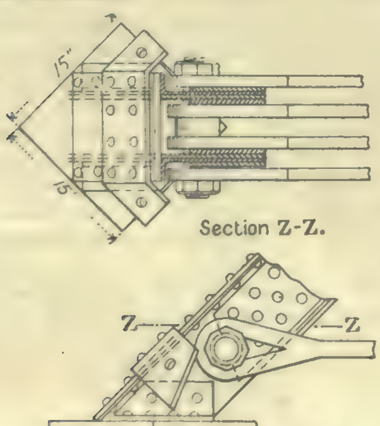


FIG. 7

In the following, the subscripts of the ys indicate that the deflection is for the beam, which is under the reaction P with a like subscript. The resisting area of the concrete section can be considered as made up of two parts, one a section of the base course only, and the second a section which extends through both courses. Where the intermediate steel beams are composed of two I-beams, the first part of the concrete area in the problem at hand is 12 inches wide and 14 inches deep, and the second part is 12 inches wide and 29 inches deep; but when one beam is used in the intermediate course, the first section is 6 x 14 inches, and the second is 18 x 29 inches. Let $U = EI$. Then

$$U = 29000000 \times I_s + 1380000 \times \tfrac{1}{12} \, [29^3 \times v + 14^3 \, (24 - v)]$$

where v = width of the two course section. Substituting in the formula, the deflections are as follows: $y_1 = 0.045$ inch, $y_2 = 0.102$ inch, $y_3 = .042$ inch, $y_4 = 0.044$ inch, and $y_5 = 0.037$ inch. Therefore the beams as designed meet the requirements as this method gives results on the safe side.



Section Z-Z.

FIG. 8

For calculating the deflection in the direction of the lower steel course, equation (e^1), page 355, can be used. This gives the maximum deflection as 0.176 inch for:

$$E_1 I_1 y_5 = l^3 \, [11 \, R - 11 \, P_2 - 40 \, P_3 - 81 \, P_4 - 128 \, P_5]$$

The total weight of steel required by this design is 5120 pounds in the third course, 8432 in the second and 182 in the first.

To design a footing to meet these same requirements by the method of figuring in present practice in order that a comparison of economy in steel may be made between the two methods it will be necessary to change the dimensions of the column stool to 4½ feet square, because the number of steel beams now required for the third course will make the total width of the course 4½ feet under the minimum allowable spacing. By using the maximum moments on each course the following moments of inertia are found for the upper and lower steel courses respectively, assuming the depth of the top, which corresponds to the third course in the previous discussion, to be 20 inches, and the lower, which corresponds to the previous intermediate, to be 15 inches; 8625 biquad. inches and 6456 biquad. inches. Required six 20-inch 80-pound steel I-beams for the upper, and sixteen 15-inch 41-pound steel I-beams for the lower, all 16 feet long. The total weight of steel in this case is 18,176 pounds. Hence by using the former method, a saving of 25 per cent. in the steel work is obtained.

The column base which will distribute the column load according to the conditions upon which this new method is based, will require a design very different from that in present use. Undoubtedly the best design for this purpose from a theoretical standpoint, would be two girders placed at right angles to the beams of the third course and carrying a third, upon whose center the column is supported; for the equal distribution of loads between the four given points will be assured by this design. But this method, besides being uneconomical, is undesirable on account of the space it would occupy above the basement floor. The following design, as illustrated by Figures 7 and 8, is not wholly satisfactory, but it is believed that from a practical standpoint it will satisfy the conditions better than the method just mentioned, or that of the cast-iron stool of present practice. The benefits to be attained by employing this design are to be attributed to the advantages gained from using a framed structure, for in brief the column may be said to be supported upon the apexes of two king-post trusses. An objection to the design can be raised from the theoretical standpoint, however, on the ground that the distribution of loading between the two trusses is indeterminate, depending upon the comparative lengths of the tie rods in the two cases. But since the tension members of both trusses will have the same cross-section and length, and can be provided with turn-buckles, they can be brought to carry equal loads by sound tests after the column has received its full dead load, if their concrete protection is omitted until near the completion of the building.

The calculations for the design of a stool of this description for the footing, which has just been figured, are as follows: Referring to Figures 7 and 8, the height of the stool was so chosen that the struts would be inclined to the vertical at an angle of 45 degrees. The stress in each will therefore be 282,850 pounds, assuming that each truss carries half the load. Allowing 16,000 pounds per square inch for the working load of the steel, the required cross section will be 17.68 square inches. Two latticed channels with plates riveted to their webs will form a section well fitted to the requirements of the case. The design of the cast-iron plate which transfers the column load to the struts is shown in Figure 7, and upon its design depends the depth of channel that can be used. The struts for this case are composed of two 8-inch 22-pound steel channels with two 8 x 13/16-inch steel plates riveted to them and one 7 x 8 x ⅞-inch bearing plate tap-bolted to the end of the struts which bears against the cast-iron plate. It will be noted in Figure 8, that a connection is provided for tying adjacent struts together, this being necessary to prevent the possibility of the points of support being deranged. The steel part of this design will weigh in the neighborhood of 1,700 pounds, and the cast-iron plate will weigh about 400 pounds, while a cast-iron stool now in use in Chicago to carry a column load of 826,000 pounds weighs about 2,500 pounds, which shows that the steel stool is at a slight economical disadvantage, depending upon the relative cost of cast-iron and steel.

In regard to the construction of the footing proper, the ends of the steel tension rods in the concrete base must be fastened to a cross bar of steel, not only for the purpose of producing a better bond between them and the concrete, but also for facilitating the work of setting them during construction; and in the intermediate course the beams must be tied together with ¾-inch or ⅞-inch tie rods to prevent their becoming displaced during the laying of the concrete filling.

No doubt many will object to using the complex theory of the continuous girder for the basis of a footing design, but it is interesting to see how many of the objections that Mr. Chas. Bender makes to its use in bridge work are applicable, and what importance they can be said to have in the present case. These can be found in the "Transactions" of the American Society of Civil Engineers for May, 1876. In the first place, only his first, second, third, sixth and fifteenth points can be applied here, as the remainder are upon points of construction which apply to bridges only. His first point is that "the theoretical calculations of curves of moments without consideration of proportions and details is fallacious," but both are considered in this case. Second, "this fallacy will be greater if the theory stands upon false premises." The reasons for believing that the conditions upon which this design is based are well founded, have already been discussed. Third, "the theory of continuity is fallacious and unreliable, because it supposes the coefficient of elasticity constant." Professor Merriman says in regard to this point: "The values of E, from which it is concluded that the laws of flexure are fallacious, were in fact found by the theory itself from the measured deflections of beams, and it is hence more than fallacious to regard them as condemning the theory." Sixth, "the calculations of a continuous girder are exceedingly tedious." This is certainly true, but if a saving of over 20 per cent. is accomplished by using it, it matters little if some extra time is required for the figuring. The general formulas cannot, however, be said to be complex and in use they are of such a character that the calculations can be greatly facilitated by the use of slide rules or logarithms. Fifteenth, "continuous bridges deflect as much as single spans." This everyone knows to be untrue, if the two are similarly loaded and of the same depth and span. This is of little consequence in the present case. In regard to the second and sixth points, they may be made to every new proposed construction in engineering.

On the other hand the advantages of employing this method over that in present use, are: First, a saving in steel amounting to about 20 per cent.; and, second, a design dependent upon an interior distribution of loads, which is based upon the conditions governing the action of the external forces and not assumed.

There are many cases, however, where this method cannot be applied on account of the complex condition of the loads to be supported; but in cases where two columns must be supported on a single footing, it is of the greatest importance that the effect of bending be taken account of in the designing.

The set of equations given in this discussion cannot be used to the best advantage in many cases, which will arise in practice, as a more economical design for footings carrying light loads will be found to result from using either five or seven beams in the intermediate course. But with the exception of the values of the numerical coefficients, the general equations for these cases will be the same as those given above for nine beams, and little difficulty in obtaining them will be found, if the given demonstration be closely followed.

NOTES.

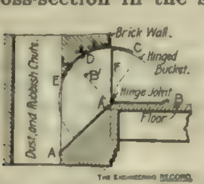
Electric Welded Wire Fence has recently been placed on the market by the Clinton Wire Cloth Company, of New York. In the old style of fence the wires were twisted at the intersection. This weakened them, as well as required more material than is needed where they merely cross at right angles. The weld at each crossing in a sample sent "The Engineering Record" is stronger than any force which can be applied to it by hand.

The Specifications for Steel Roofs and Buildings prepared by Mr. Charles Evans Fowler, M. Am. Soc. C. E., have recently been revised. The new edition, the fourth, contains tables for facilitating the calculation of Pratt roof trusses of four, six, eight, ten and twelve panels, supplementing the former tables for Fink and fan trusses. There are also tables of unit strains in steel columns and of rivet values which are convenient for general use. The specifications are used by the classes of several schools.

Compressed Air for Cleaning Purposes is being used in some of the taller office buildings in New York City. Many of the buildings have their elevator wells partially hidden behind more or less decorative grill work. It is frequently of bronze, and of such design that the dust of a week detracts much from its appearance. To remove the dust, which always lodges in the smallest cracks, a jet of compressed air is directed upon it. In the Dun Building in New York, such a plant was installed by Mr. John W. Ferguson, of New York, and consists essentially of a system of pipe lines throughout the building with outlets wherever desirable. Short flexible-hose connections are attached to these, and a nozzle at the other end of the hose may be carried about at will.

A Chimney was Damaged by Lightning in Wakefield, Mass., recently. It was a brick structure, 152 feet high, built in two shells, with the customary annular air-space, and surmounted by an iron cap weighing about a ton. The lightning knocked away the bricks forming the outer shell to within about 70 feet of the ground, leaving intact the inner shell of 8 inches of brickwork. From the top of the chimney there was left hanging about 8 feet of the outer brickwork. The Heywood Brothers & Wakefield Company, the owners of the chimney, write: "The bolt of lightning seems to have gotten into the air-space between the core and the outer shell of the chimney and exploded the gas, which, we presume, had accumulated there, thus tearing away the bricks of the outer shell."

An Automatic Dust Chute Bucket for buildings has been designed by Mr. Richard E. Schmidt, of Chicago, which is fireproof and always ready to discharge rubbish without scattering it, raising a dust, or involving its removal down stairways or elevators. Its capacity is practically unlimited, and it is designed so as always to close the opening from the room into the chute and prevent the possibility of a back draft. The device consists of a sheet-iron triangular bucket or double flap, shown in cross-section in the sketch. It is normally set with one side horizontal and the other vertical, and placed in the angle between floor and walls at an entrance to the vertical shaft or duct which forms a dust chute to the bin in the cellar. The bucket is hinged at the angle so as to revolve on a horizontal axis, and the top of the wall opening is provided with a sheet-iron hood as long as the bucket, and bent to a cylindrical surface with its axis coincident with that of the bucket.



The refuse may be swept into the bucket when it is in the position shown, and then it is revolved toward the left so as to carry it inside the wall, when it drops down on the inclined seat AA and discharges its contents into the chute. The bottom B meanwhile engages the hood D at its projection C before the back of the bucket F has been released at E. The bottom of the bucket B can revolve only so far as B^1, where it closes the chute opening and may be left, entirely withdrawn from the room, until it is used again. If the wall is thick enough to contain the bucket, or if the hood is extended at E, its projection at C may be dispensed with, so that there is no obstruction whatever in the room when the bucket is not in service. This device is in use at the Montgomery Ward & Company's building, Chicago, with a chute 110 feet high, buckets 44 inches long, and of a proportionate diameter.

Inventors' fads are readily discovered from the quarterly index to patents issued by the Government. Those in touch with the work of the office very quickly learn to separate most patented inventions into four classes. In the first are grouped the devices which are called out by some strong hobby of the public generally, such as bicycling, which now has the most patents every quarter of all the subjects in the index. In the second class are the machines or processes developed for carrying on the business of a firm or corporation, such as eight patents recently taken out by one man for pyroxylin. In the third class are the articles patented to protect the manufacturer who places them on the market, while in the fourth are the great variety of mechanisms and combinations which seem to have come into existence merely to gratify a desire to invent something, regardless of its utility or practicability. For example, a patent was taken out a few years ago for hash, an article of food which, in any of its protean forms, it seems nearly incredible could be made a short-time monopoly on the ground of novelty. Just at present there are two marked new fads—rotary engines and acetylene gas apparatus. The last quarterly index credits each with about 30 patents. The old joys of the amateur inventor are by no means neglected, moreover. Patents were issued during the quarter for twelve air-brakes, the same number of non-refillable bottles, 26 car couplings, 16 car fenders, 11 cash registers, 24 filters, 27 nut locks and 25 sewing machines, all favorite subjects for many years. The rural patentee has kept his record a creditable one in point of numbers, also, for applications were granted for 25 cultivators, 33 fences or fence-making tools, 22 gates, 17 harrows, 23 planters and 20 plows. The largest number of patents granted to any one individual during the quarter was 29, of which 25 were for weighing machines. The next largest number, 16, is to the credit of another inventor of the same town, Hartford, Conn.

An Interesting Account of repairs to a large sewer at New Haven, Conn., was given recently before the Connecticut Civil Engineers' Association by Mr. L. W. Burt, who was engineer in charge of the work. The repairs were made on a large outfall sewer on a point of land extending into the harbor and where the level of the foundation was 6 feet below high tide. The sewer had been built in two sections, working in opposite directions. About a week after the junction was made and the trench refilled, it was discovered that a section of the invert about 15 feet long and 3 to 4 feet wide had been forced up by the pressure of the water, which flowed in through the break and found an outlet through the completed sewer to the harbor. Access to the break was afforded through a manhole about 40 feet away. Bags of sand were lowered and with them dams were constructed, enclosing the broken portion. An Edson diaphragm pump was placed in the sewer, and by means of this and vigorous bailing the inrush of water was controlled and all of the loose brick, mortar and concrete was removed. A large number of cheese-cloth bags about 8 x 12 inches in size had been prepared, and a quantity of wooden forms and lagging with struts and wedges to hold them in place. Roman and Portland cement were then mixed in equal proportions and worked with hot water into a stiff paste. The bags were quickly filled and compactly placed in each vacant space, forming a barrier to the rush of water and ultimately became a substantial part of the structure. On the foundation thus prepared the 4-inch brick invert was turned. As the work proceeded the force of the concentrated stream of water increased and an opening about 1 x 2 feet was left in the center. The lagging strips were then placed over the invert, the wooden forms over these and the whole was braced from the top. These were removed at the end of three weeks and the invert was found to be firm and of correct form. The 2 x 1-foot space was then repaired in a similar manner and no further trouble was experienced.

PERSONAL AND OBITUARY NOTES.

Mr. Samuel Ryan has been re-elected superintendent of the water-works of Bellefonte, Pa.

Mr. Timothy Woodruff has been re-elected superintendent of the Bridgeton, N. J., water-works.

Mr. H. D. Bush, M. Am. Soc. C. E., of Springfield, Mass., is recovering from a severe attack of pneumonia.

Mr. Rodney A. Swift has been elected city engineer of Auburn, Me., and Mr. E. S. Paul water commissioner.

Mr. J. S. Humphrey, of Findlay, Ohio, has been elected city engineer of Alexandria, Ind., where extensive paving and sewerage undertakings are contemplatd.

Mr. John Birkinbine has been elected engineer-in-chief of mechanical and electrical construction and sanitary engineering of the proposed Philadelphia exposition.

Mr. I. M. Wolverton, Assoc. M. Am. Soc. C. E., has been appointed chief engineer of the Mt. Vernon Bridge Works and will have charge of the shops and construction at Mt. Vernon, Ohio.

Mr. Charles I. Brown, formerly city engineer of Mankato, Minn., and later connected with the municipal engineering staff of St. Louis, Mo., died at Mankato on March 23 of rheumatism of the heart.

Mr. R. B. C. Bement, M. Am. Soc. C. E., of St. Paul, recently a major of volunteer engineers in the service of the United States, has been elected acting general manager of the Superior Water, Light & Power Company, of Superior, Wis.

Mr. Robert H. Moth has been elected city engineer of Kenosha, succeeding Mr. J. B. Davidson, whose resignation of the office was noted in these columns recently. Mr. Moth has been connected with the department for several years.

Mr. Frank T. Oakley, Assoc. M. Am. Soc. C. E., has resigned the position of first assistant city engineer of Toledo, Ohio, which he has held for the past four years, to open an office for private practice in the Spitzer Building in the same city.

Mr. R. H. Brown, chief engineer of the Delaware & Hudson Canal Company, died in Albany, N. Y., from typhoid fever on March 26. He had been connected with the engineering department of the company from his boyhood, advancing in the course of 20 years of faithful service from the position of chainman to the head of the engineering department.

CONTRACTING NEWS

OF SPECIAL INTEREST TO

CONTRACTORS, BUILDERS, ENGINEERS, AND MANUFACTURERS

OF ENGINEERING AND BUILDING SUPPLIES.

For Proposals see pages xi, xii and 416.

WATER.

Tullahoma, Tenn.—Bills have passed the House authorizing the issue of water-works bonds, $6,000 electric light bonds and $25,000 sewer bonds.

Spencer, W. Va.—It has been voted to issue bonds for the construction of water-works.

Watervliet, N. Y.—The Governor has signed the bill granting the Water Commissioners power to use the $250,000 recently voted for the purpose of securing a water supply.

Bermidji, Minn.—Bids are wanted April 10 for a system of water-works.

Chicago, Ill.—Bids are wanted April 7 for furnishing and delivering at the site of the Kedzie Ave. tunnel 14 36-in. flanged cast-iron water pipe specials, with channel beams, plates and bolts. L. E. McGann, Commr. Pub. Wks.

Camden, N. J.—Bids are wanted April 4 for erecting a feed water heater at the pumping station at Morris Station. John S. Roberts, Chmn. Water Com.

Goshen, Ind.—See "Paving and Roadmaking."

Montgomery, Ala.—Bids are wanted April 20 for the exchanging of present air cylinders upon the city's compressor for larger ones and for the application of air lift to three new artesian wells. R. H. Sommerville, City Treas.

Newark, N. J.—The Street and Water Commissioners have decided to advertise for bids for an auxiliary water supply from driven wells at Belleville.

Pittsburg, Pa.—Bids are wanted April 7 for constructing gate house on effluent chamber, Highland reservoir No. 2; furnishing and placing boiler in Garfield pumping station; furnishing special cast-iron sleeves for making connections to pipe lines with tapping machines, etc. Bids are also asked until April 7 for a large amount of pipe laying and relaying. Edward M. Bigelow, Dir. Dept. of Pub. Wks.

Canton, N. Y.—It is stated that bids are wanted April 12 for laying 2,288 ft. of water pipe, setting hydrants, etc. J. H. McIntosh, Supt.

Camden, N. J.—Local press reports state that bids are wanted by the Water Committee of the City Council April 18 for meters from 1½ to 10 inches.

Milford, Ind.—Press reports state that bids are wanted April 4 by the Town Board for a water and light plant.

Walker, Minn.—Bids are wanted April 10 for a system of water-works. Chas. Kinkele, Village Pres.

Louisville, Ky.—Bids are wanted April 5 for the construction of several wells with wrought-iron pipe. Charles F. Grainger, Chmn. Bd. Pub. Wks.

Sibley, Ia.—H. Newell, City Clk., writes that it was voted on March 27 to construct water-works.

East St. Louis, Ill.—The Duquoin Water-Works Co. has been incorporated, with a capital stock of $58,500. Incorporators: George Gascogne, Fred E. Shilling and George P. Merrick.

Salt Lake City, Utah.—The Committee on Water-Works has decided to recommend an expenditure of $17,500 for the betterment of the system in the eastern part of the city.

Sioux Falls, S. D.—Press reports state that the Water-Works Co. will put in a 5,000,000 gal. pump, dig wells and make other improvements, at a cost of about $20,000.

Grand Junction, Colo.—The Court of Appeals has handed down a decision to the effect that the city of Grand Junction has the right to purchase, operate and own its water-works.

Manti, Utah.—The Manti Irrigation Co. has filed articles of incorporation; capital stock, $12,500. The officers are: A. H. Christensen, Pres.; G. B. Fox, Vice-Pres.; E. V. Hardy, Sec'y and Treas.

Pratt City, Ala.—Mayor E. J. Hudnall writes that it was voted March 25 to issue bonds for water-works construction.

Elizabethtown, Ky.—It is stated that bids are wanted April 5 for a standpipe. R. L. Wintersmith, Mayor.

Valparaiso, Ind.—D. F. Skinner, Pres. of the First Nat. Bank of Porter Co., is stated to have offered $10,000 for a franchise to build and operate a water-works system.

Manchester, N. H.—The Water Commissioners will relay about 2,000 ft. of 24-in. main this season.

Leadville, Colo.—A vote of the taxpayers will be taken on the proposition to purchase the plant of the Leadville Water Co., at a cost of $300,000.

Marblehead, Mass.—At a recent town meeting an appropriation of $9,300 was made to extend the water system.

Goldhill, Ore.—Press reports state that it is proposed to issue bonds for the construction of water-works.

Montreal, P. Q.—Local press reports state that of the $81,500 appropriation received by the Water Committee $15,000 will be spent for mains, $20,000 for new services and $36,000 for reservoirs.

Colorado Springs, Colo.—Water bonds to the amount of $135,000 are stated to have been sold.

Greenport (L. I.), N. Y.—It has been voted to issue $22,000 bonds for the purchase of the Greenpoint Water Company's plant and $5,000 bonds for the purchase of the electric light plant.

Tinleypark, Ill.—Bids are wanted April 15 for a system of water-works. Wm. Funk, Village Clk.

Lakeport, Cal.—Bids are wanted April 17 for constructing and completing a system of municipal water-works, as advertised in "The Engineering Record."

Allegheny, Pa.—Director Robt. McAfee, of the Dept. of Pub. Wks., in his annual report recommends the introduction of the meter system, also the construction of new reservoirs on Troy Hill of sufficient size to hold at least 150,000,000 gallons.

Erie, Pa.—The Water Commissioners in their annual report state that it is intended to extend the 24-in. main in South Erie to a special standpipe which is to be erected.

Elkpoint, S. D.—A vote will be taken April 3 on the issue of $12,000 bonds for constructing a water-works system.

Bastrop, La.—J. B. Levy, Chmn. Water Com., writes that an election has been ordered to vote on the issue of bonds for water-works, electric lights and a school.

Sherman, Tex.—E. M. Kearney, City Secy., writes that the city contemplates increasing the water supply, extending water mains and purchasing new machinery for the water-works station.

Brownsville, Tenn.—A committee has been appointed to investigate the cost of putting the town water-works system in good condition.

Shiner, Tex.—The City Council has granted a 20-year franchise to Charles Welhausen, M. E. Wolters and others, for the purpose of erecting and operating a system of water-works.

San Luis Obispo, Cal.—A vote will be taken April 20 on the proposition to issue $80,000 water bonds and $36,000 sewer bonds.

Washington, D. C.—Bids are wanted April 26 for water and sewer systems and 2 dormitories at Fort Peck Agency, Mont. W. A. Jones, Commr. of Indian Affairs, Dept. of the Interior.

Greenville, Cal.—Bids are wanted April 20 for a water and sewer system. W. A. Jones, Commr. of Indian Affairs, Dept. of the Interior, Washington, D. C.

Hintonburgh, Ont.—Bids are wanted April 15 for a system of water-works. W. A. Mason, Village Clk.

Verdun, Ont.—See "Sewerage and Sewage Disposal."

Cullman, Ala.—Bids are wanted May 1 for a system of water-works and electric lights. John F. Beyer, Mayor.

Pendleton, Ind.—The City Council has granted a franchise to the Pendleton Water-Works and Electric Light Co. to put in water-works and an electric light plant. Estimated cost, $34,900.

Titusville, Pa.—The City Council has decided to purchase a 5,000,000-gal. pump.

Atlantic City, N. J.—Mayor Thompson in his annual message recommends laying an additional 24-in. water main and other improvements to cost about $110,000.

Lasalle, Ill.—G. Walker, Supt. of Water-Works, writes that about 12,000 ft. of 24-in. cast-iron pipe will be required this season.

Irvington, N. J.—The Senate has passed the bill authorizing Irvington to establish water-works.

Fayetteville, Tenn.—The lowest bid received for the construction of water-works was from Guild & Co., of Chattanooga, at $34,500.

Morton, Minn.—It has been recently voted to construct water-works.

Lexington, Ky.—Mayor Simrall has approved the resolution to appoint a committee to investigate and report upon the advisability of the city purchasing the water-works.

Reading, Pa.—Emil L. Nuebling, Supt. and Engr. of the water-works, writes that contracts have been awarded as follows for supplies for the fiscal year, 1899-1900: To the Reading Foundry Co. (Ltd.), Reading, Pa., for cast-iron pipe and specials at $26,688, and for cast-iron gate boxes at $1,110; to the Rensselaer Mfg. Co., Troy, N. Y., for water gates at $4,865, and for fire hydrants at $1,104; to H. Muller Mfg. Co., Decatur, Ill., for corporation cocks at $291.33; to Howard E. Ahrens & Bro., Reading, for pipe laying, at $4,306.

Boston, Mass.—The contract for furnishing small iron castings to the amount of 1,125,000 pounds No. 1 and 225,000 pounds No. 2 has been awarded to Sessions Foundry Co., Bristol, R. I., for $24,637. The same firm received the contract for furnishing heavy iron castings from March 15, 1899, to Feb. 1, 1900, at $1.10.

Bloomington, Ind.—James D. Showers, Secy. of the Water-Works Co., writes that the following bids were received March 23 for reconstructing and extending the water-works: J. P. Miller & Co., Chicago, Ill., $20,979; Joseph H. Campbell, Bloomington, Ind., $19,916.50; F. H. Beeman, Louisville, Ky., *$16,617.60.
*Contract awarded.

St. Louis, Mo.—The following bids for 3 vertical triple-expansion crank and flywheel condensing pumping engines at Bissell's Point pumping station were opened March 21: Lake Erie Engine Wks., Buffalo, N. Y., $330,000; Holly Mfg. Co., Lockport, N. Y., $318,655; Edward P. Allis Co., Milwaukee, Wis., $272,000; Southwark Foundry and Machine Co., Philadelphia, Pa., $350,000.

SEWERAGE AND SEWAGE DISPOSAL.

Ann Arbor, Mich.—The Council has voted to build storm sewers in two districts at an estimated cost of $8,000.

Wilkesbarre, Pa.—A vote will be taken May 9 on the proposition to issue $100,000 bonds, to be used as follows: $60,000 for sewers, $30,000 for streets, and $10,000 for the Fire Department.

Medford, Ore.—It is stated that bids are wanted May 15 by the City Recorder for furnishing sewer pipe and constructing a sewer.

Washington, D. C.—Bids are wanted April 8 for sewers. John B. Wight, Chmn. Commrs., D. C.

Spokane, Wash.—Otto Weihle, City Engr., is stated to have completed plans for the proposed sewers in the 4th Ward. The plans call for a total of 2¼ miles of 8 to 21-in. pipe. Estimated cost, $26,000.

Ottawa, Ont.—Local press reports state that bids are wanted by the Main Drainage Committee April 14 for sections 1 and 2 of the sewerage system.

Neenah, Wis.—The following bids are stated to have been received for the construction of a sewer: J. H. Green, of Appleton, $2.84 per lin. ft. for 42-in. tile and $2.64 for 36-in. tile; the Hackworthy Construction Co., $3.13 for 42-in. tile and $2.97 for 36-in. tile.

Jersey City, N. J.—Bids are wanted April 12 for a main sewer in Hudson City district, consisting of 2,479 lin. ft. of 30 and 36-in. brick sewer, 3,618 lin. ft. of vitrified and cast-iron pipe, etc. Geo. T. Bouton, Clk. Bd. Street & Water Commrs.

Seattle, Wash.—Local press reports state that the contract for constructing a sewer system on East Denny Way and several streets has been awarded to F. McLellan for $37,223.

North Braddock, Pa.—Bids are wanted April 13 for the construction of brick and pipe sewers, with manholes, flush-tanks, etc., as advertised in "The Engineering Record."

Terre Haute, Ind.—Bids are wanted April 4 for a pipe sewer in 9th St. Wm. Hamilton, City Clk.

Bayonne, N. J.—Local press reports state that bids are wanted April 18 by the City Clerk for a trunk sewer in Centreville section.

New Brighton, Pa.—Plans have been ordered prepared for a sewerage system. P. D. Hall, S. F. Jackson, G. W. and J. D. Martsolf have been appointed a committee to secure bids, etc.

Independence, Mo.—Bids are wanted April 14 for the construction of sewers, approximately 709 ft. 18-in., 5,682 ft. of 15-in., 3,940 ft. of 12-in., 8,171 ft. of 10-in. and 18,620 ft. of 8-in. pipe, as advertised in "The Engineering Record."

Guthrie, Okla.—According to estimates prepared by H. B. Abercrombie, the proposed sewerage system will cost about $38,910.

New Britain, Conn.—The Senate has passed a bill authorizing the issue of $150,000 sewer bonds.

Chillicothe, O.—City Engineer Redd has reported that the total estimated cost of constructing three storm sewers is $9,060.

Saratoga Springs, N. Y.—Prof. Olin H. Landreth, in his preliminary report upon the matter of sewage disposal, estimates that the separation of sewage from storm water, the construction of a trunk sewer to the disposal territory, the option on land ultimately needed for filtration, the purchase of land needed for preliminary experimental work and the cost of one year's experimental work will cost not more than $75,000.

Brookfield, Mo.—Hiram Phillips, of St. Louis, has been employed as consulting engineer for the proposed sewer system.

Westboro, Mass.—F. W. Bullard, Town Clk., writes the matter of sewage disposal has been referred to the Sewer Commissioners to consider and report on same at the next town meeting.

Cambridge, O.—A vote will be taken April 3 to decide the question of issuing $17,000 sewer bonds.

Rochester, N. Y.—The City Engineer estimates the cost of constructing a vitrified pipe sewer in Bethlehem and Masseth Parks at $4,900.

Champaign, Ill.—The Council has passed an ordinance providing for a 60-in. brick sewer estimated to cost $15,000.

Washington, D. C.—See "Water."

St. Paul, Minn.—Bids are wanted April 3 for sewers in Short St. and Pennsylvania Ave. C. H. Bronson, Clk. Bd. Pub. Wks.

Indianapolis, Ind.—The Board of Works has adopted resolutions for a Fall creek intercepting sewer, also for a sewer to be known as the Michigan St. sewer.

St. Paul, Minn.—The order for the Hamline sewer system is said to have been passed. The proposed system is 5½ miles in length, and estimated to cost $37,000.

Carrollton, Mo.—It is stated that bids are wanted April 15 for constructing the proposed sewerage system and for paving, for which $50,000 bonds have been voted. Hiram Phillips, Consulting Engr., 525 Lincoln Trust Bldg., St. Louis, Mo.

Greenville, Cal.—See "Water."

Collingwood, O.—Bids are wanted April 10 for a 24-in. tile drain in St. Clair St. L. A. Wilson, Village Clk.

Akron, O.—Bids are wanted April 15 for a main trunk sewer in Districts 3, 4, 5 and 10. Charles H. Isbell, City Clk.

Middleboro, Mass.—Freeman Coffin, of Boston, will submit his report, on the matter of sewage disposal, at the town meeting to be held April 29.

San Luis Obispo, Cal.—See "Water."

Verdun, Ont.—Bids are wanted April 4 for brick and tile sewers, also for water mains. Geo. A. Ward, Secy.-Treas. of Council.

Cleveland, O.—The contract with Bramley & Gribben for the construction of the fourth section of Walworth Run sewer has been approved by the Council.

Jersey City, N. J.—Bids are wanted April 4 for sewers in Delaware Ave. and Jackson Place. Geo. T. Bouton, Clk. Bd. Street and Water Commrs.

Buffalo, N. Y.—Bids are wanted April 15 for brick and tile sewers in Hopkins St. and South Park Ave. R. G. Parsons, Secy. Bd. Pub. Wks.

Tullahoma, Tenn.—See "Water."

Larchmont Manor, N. Y.—It has been voted to spend not more than $27,000 for a new outlet sewer to the Sound.

Goshen, Ind.—Local press reports state that bids are wanted April 17 for 7,332 ft. of 10 to 30-in. pipe sewers. I. D. Wolfe, City Clk.

Irvington, N. Y.—Bids are wanted April 3 for extending the sewer system on Broadway. T. W. Crisfield, Clk. Sewer Commrs.

Sauk Centre, Minn.—Bids are wanted May 3 for the construction of all or any part of a sewer system. J. F. Cooper, City Clk.

Baltimore, Md.—Bids are wanted April 12 for 850 ft. of 30-in. sewer pipe. W. W. Varney, City Commr.

Concord, Mass.—Bids are wanted April 10 for a sewerage system, as advertised in "The Engineering Record."

Pittston, Pa.—Ordinances have been passed to construct sewers in several streets.

Akron, O.—An ordinance has been passed providing for the preparation of plans for sewers in the southerly portion of sewer districts 8 and 9. Chas. H. Isbell, City Clk.

Washington, D. C.—Local press reports state that the following bids were received for furnishing the District with 50,000 vitrified invert sewer brick: J. H. Guise, Williamsport, Pa., at $25 per 1,000, and Savage Fire Brick Co., of Keystone Junction, Pa., at *$23.50 per 1,000.

* Contract awarded.

Buffalo, N. Y.—The following bids were opened March 22 for 8,990 ft. of 8-ft. to 3-ft. brick sewer and 45 manholes, the trench is expected to average 12 ft. in depth and will be excavated 6 ft. in rock: Christopher Smith, $113,343; Busch Bros., $104,807; Wm. Franklin, Jr., $101,000; John Harrer, $101,000; P. B. McNaughton, $99,793; Brown, Stobell & Griffiths, $98,544; John Mumm, $92,000; W. F. Boyson, $85,300; Thos. T. Moore, *$84,900. Bidders all of Buffalo.

*Contract awarded.

Boston, Mass.—The following bids were opened March 21 by the Metropolitan Water Board for continuing and completing Section 2 of the Clinton Sewerage System. The work to be done includes about 3,600 ft. of 20, 24 and 30-in. intercepting sewer, the completion of a masonry reservoir having a capacity of 600,000 gals., and the foundations for a pumping station, as advertised in "The Engineering Record": Charles N. Taylor, Natick, Mass., *$15,642; Baker & Judson, Gloversville, N. Y., $16,281; E. R. Patterson Construction Co., New York, N. Y., $16,546.45; M. Murphy & Co., Clinton, Mass., $17,921.50; Coleman Bros., Charlestown, Mass., $18,888; Chas. G. Craib, Winthrop, Mass., $19,119.50; P. F. Brennan, New York, N. Y., $19,234; Ethan R. Cheney & Orren A. Trumbull, Chelsea and Reading, Mass., $19,241.50; Jos. D. Gennaro, Boston, Mass., $19,299; C. E. Trumbull & Co., Boston, Mass., $19,581.50; Newell & Snowling Construction Co., Uxbridge, Mass., $20,261.85; Moulton & O'Mahoney, Boston, Mass., $21,078.75; George M. Bacon, W. Medford, Mass., $21,113.10; Bruno & Salomone, E. Boston, Mass., $21,912.25; Long & Little, Leominster, Mass., $22,916.

*Contract awarded.

BRIDGES.

Bethany, Mo.—C. F. Snyder, Co. Engr., writes that a 100-ft. steel span is to be built 2 miles northwest of Bethany.

Rossville, Kan.—B. F. Pankey is the engineer in charge of constructing a $9,000 bridge across Kansas River.

Towanda, Pa.—Hiram E. Bull, Co. Surveyor, writes that 3 county bridges, estimated to cost $7,000, are in contemplation. The construction has not yet been approved by the Court and County Commissioners. David A. Keefe, Athens, Pa., designing engineer of superstructures, and Hiram E. Bull, designing engineer of substructures.

Terre Haute, Ind.—Engineer Paige reports the Macksville trestle in a dangerous condition.

Petersborough, Ont.—E. Pearse, Co. Clk., writes that it is proposed to replace the Mud Lake bridge, which is a floating structure about 4,000 ft. in length, with a new and similar bridge estimated to cost $12,000. John E. Belcher, Co. Engr.

Providence, R. I.—Bids are wanted April 12 for furnishing and erecting a steel highway bridge over the Moshassuck River at Mill St., as advertised in "The Engineering Record."

Georgetown, D. C.—See "Government Work."

Crescent, Ill.—Bids are wanted April 15 for taking down and replacing the 4 metal tubes under the south end of the Fidler bridge over the Vermilion River, 5 miles northeast of this city. B. H. Skeels, Chmn. Com.

Ottumwa, Ia.—The Board of Supervisors has been petitioned to construct a viaduct over the Des Moines River at or near Cliffland, probable cost $20,000.

Jacksonville, Fla.—Local press reports state that authority has been given to the Atlantic, Valdosta & Western Ry. to construct a viaduct over Duval St.

Toronto, Ont.—Specifications have been submitted by the City Engineer, for Eastern Ave. bridge over the Don.

Buffalo, N. Y.—Plans have been accepted by the Grade Crossing Commissioners for a viaduct at Albott Road, over the Nickel Plate, Western N. Y. and Pa. & Buffalo Creek R. R. tracks.

Chatham, Ont.—It is stated that bids are wanted April 8 for 2 masonry abutments for a bridge over the Thames River. J. C. Fleming, Co. Clk.

Oakland, Cal.—It is stated that bids are wanted April 10 for a trestle bridge over Arroyo Macho Creek. Frank C. Jordan, Clk. Bd. Supervisors.

Providence, R. I.—Bids are wanted April 7 for removing old bridge, constructing new river walls and extending pier northerly from Exchange Bridge; also for constructing new abutments at site of Mill St. Bridge and a river wall southerly from Stevens St. Bridge along Charles St., as advertised in "The Engineering Record."

Huntington, W. Va.—Bids are wanted April 24 for two iron bridges over Cabell and Tyler's Creek. F. L. Doolittle, Co. Clk.

Woonsocket, R. I.—The rebuilding of the west arch of the Globe Bridge and the widening of South Main St., at a probable cost of $30,000, are being considered.

Boston, Mass.—A bill passed the House providing for the rebuilding by the city of Boston of the Malden Bridge.

St. Paul, Minn.—Preliminary drawings for the proposed rebuilding of the south end of the Wabasha St. Bridge have been submitted to the City Council. Estimated cost, $110,000.

Bradford, Pa.—The City Engineer has submitted plans, estimates, etc., for a steel bridge at Forman St., to cost $3,032.09; also for a steel bridge on Washington St. extension to cost $5,016.19.

North Braddock, Pa.—The Borough Council has accepted the plans submitted by the Monongahela Traction Co. for a 200-ft. steel bridge over the Sixth St. hollow.

Buford, Ga.—The iron bridge across the Chattahoochee River between this place and Cumming has been washed away.

Paterson, N. J.—Plans are about to be prepared for a bridge to be built across the tracks of the Erie R. R. at Sixth Ave.

Syracuse, N. Y.—Plans, specifications and estimates submitted by the State Engineer and Surveyor for building a lift bridge over Erie Canal at Catherine and Almond Sts. have been accepted by the Canal Board.

Beaverfalls, Minn.—It has been voted to build a steel bridge across Beaver Creek, on the road to Morton.

Bergen, Minn.—At an election held March 14 the people decided to construct an iron bridge in place of the wooden structure crossing Crow River at Seefeldt Place.

Milwaukee, Wis.—Local press reports state that plans are being prepared for a folding drawbridge across the Milwaukee River at Broadway.

Stillwater, Minn.—The construction of a railroad bridge across the lake, to be used jointly by the Wisconsin Central R. R. and the Lowry Goodrich Street Railway and Interurban electric line, is stated to be under consideration.

Boston, Mass.—The Committee on Metropolitan Affairs has been petitioned to authorize the Metropolitan Park Commissioners to construct a bridge across the Mystic River between Somerville and Wellington, at an expense of $150,000.

Edgerton, Kan.—Press reports state that the County Commissioners have under consideration the construction of a bridge across the Kaw River at Lenape. Cost, $10,000.

Sellersville, Pa.—A portion of the wall of the county bridge crossing the Branch Creek has collapsed. The entire structure will have to be rebuilt, according to local press reports.

Kansas City, Mo.—City Engineer Wise has approved plans for a steel bridge at Woodland Ave., over the Belt Line tracks; cost about $4,000.

Tuscaloosa, Ala.—The Southern Bridge Co., Birmingham, Ala., is stated to have received the contract for constructing a draw bridge across Warrior River at $33,250.

Bayonne, N. J.—Local press reports state that the Central Railroad Co. has been requested by the Common Council to construct a wagon bridge over its tracks at 30th St.

Watertown, N. Y.—Press reports state that City Engineer Macomb has been instructed to make specifications, and solicit plans and estimates for a bridge at Pearl St.

Winton Place, O.—The construction of an iron bridge over Ross Run on Paddock road, is stated to be under consideration.

Bermidji, Minn.—Local press reports state that 2 viaducts will be constructed across the tracks of the Great Northern Railroad at American and Irvine Aves.

Sandusky, O.—Press reports state that the Lake Shore & Sandusky and Interurban Railroads have had plans prepared for a wagon bridge at State Cut, to cost about $8,000.

Troy, N. Y.—A bill has passed the Senate authorizing the Albany Railway to construct a bridge over the Hudson River, between Troy and Watervliet.

Lima, O.—Plans and specifications for the proposed bridges at Elm and Metcalf Sts., estimated to cost $9,660, have been submitted to the City Council.

Boston, Mass.—City Engineer Jackson opened the following bids March 27, for building a retractile draw for Malden bridge over Mystic River: Massillon Bridge Co., Massillon, O., $11,210; Pittsburg Bridge Co., Pittsburg, Pa., $10,949; Wrought Iron Bridge Co., Canton, O., $11,100; Boston Bridge Wks., Boston, Mass., $11,400; New England Structural Co., Boston, Mass., $11,432; New Jersey Steel & Iron Co., Trenton, N. J., $11,680; Toledo Bridge Co., Toledo, O., $11,312; King Bridge Co., Cleveland, O., $11,265; Youngstown Bridge Co., Youngstown, O., $11,050; New Columbus Bridge Co., Columbus, O., $12,120; Canton Bridge Co., Canton, O., $11,800; Groton Bridge Co., Groton, N. Y., $11,500; Penn Bridge Co., Beaver Falls, Pa., $11,189. Taken under advisement, awaiting action of the Legislature on bill for a new bridge between Boston and Everett.

Boston, Mass.—The following bids were opened March 24 by Benj. W. Wells, Supt. of Streets, for furnishing and placing the steel superstructure of the Charlesgate West bridge over Ipswich St., as advertised in "The Engineering Record": Edge Moor Bridge Co., Wilmington, Del., $14,200; Boston Bridge Wks., Boston, Mass., $14,141; Pittsburg Bridge Co., Pittsburg, Pa., $13,900; Groton Bridge Co., Groton, N. Y., $14,400; Youngstown Bridge Co., Youngstown, O., $14,030; New Columbus Bridge Co., Columbus, O., $14,140; King Bridge Co., Cleveland, O., *$13,050; Canton Bridge Co., Canton, O., $15,700; Wrought Iron Bridge Co., Canton, O., $14,710; New England Structural Co., Boston, Mass., $15,471; Mace Moulton, Springfield, Mass., $13,945; Massillon Bridge Co., Massillon, O., $13,999.

*Contract awarded.

Akron, O.—The City Engineer has been instructed to prepare plans and estimates for a viaduct at Mill St.

Buffalo, N. Y.—Local press reports state that the contract for the superstructure of the iron bridge at Elk St. and Abbott Road has been awarded to the Elmira Bridge Co., their bid being $193,128, and without labor clause, $191,668. The lowest bid received for the sub-structure was from Henry P. Burgard, at $132,055. New bids will be asked for the sub-structure.

PAVING AND ROADMAKING.

Greeneville, Tenn.—A bill has passed the House authorizing Greene County to issue $100,000 road improvement bonds.

Decatur, Ala.—Morgan County has been authorized to issue $250,000 bonds for road construction. Judge W. E. Skeggs, Commr.

Hartford, Conn.—Contracts for sheet asphalt paving in six streets have been awarded to the Southern New England Paving Co., at $2.55, $2.56 and $2.59 per sq. yd.

Scottsburg, Ind.—It is stated that 20 miles of road will be built in Lexington township and 15 miles in Jennings township.

Shamokin, Pa.—Local press reports state that the contract for paving Market (12,255 sq. yds.) and Spruce Sts. with Montella brick has been awarded to the Alcatraz Paving Co., at $1.56½ per sq. yd.

Scarsdale, N. Y.—The Town Board has voted to raise $35,000 for road improvements.

Rockport, Ind.—Ohio Township has voted to expend $43,000 in building 36 miles of macadam roads.

Windfall, Ind.—Press reports state that the contract for building brick streets has been awarded to Minich, Gaddes & Dingle, of New Castle, for $16,000.

Jersey City, N. J.—Bids are wanted April 4 for 5,410 sq. yds. asphalt and 9,605 sq. yds. Belgian pavement and 420 sq. yds. repaving, etc., on four streets. Geo. T. Bouton, Clk. Bd. Street and Water Commrs.

Goshen, Ind.—Local press reports state that bids are wanted April 17 for paving four streets; also for extending water mains. I. D. Wolfe, City Clk.

Crownpoint, Ind.—Bids are wanted April 13 for constructing about 45 miles of macadam and 22 miles of gravel roads. Michael Grimmer, Co. Aud.

Brooklyn, N. Y.—Bids are wanted April 4 for asphalt pavement on Pacific St. Wm. N. Shannon, Deputy and Acting Commr. of Highways.

Brooklyn, N. Y.—Bids are wanted April 6 for telford pavement on Bay Ridge parkway terminus, for furnishing 3,950 cu. yds. crushed trap rock, sizes 1½ and 2½; 3,050 cu. yds. crushed blue limestone, 65,800 compressed Trinidad asphalt paving tiles, etc. George C. Clausen, Chmn. Commrs. of Parks, New York City.

Philadelphia, Pa.—The Common Council has passed the bill designating streets to be paved out of the $2,000,000 appropriation.

Montreal, P. Q.—An appropriation of $73,000 has been received by the Road Commitee; of this sum $30,000 is for Craig St. paving and $30,000 for sidewalks.

Kokomo, Ind.—Chas. R. Ford, City Clk., writes that the contract for 12,000 sq. yds. of brick pavement has been awarded to Yager & Dickerson, of Danville, Ill., for $20,049.

Jamestown, N. Y.—The Common Council has been petitioned to pave two streets with brick.

Rochester, N. Y.—An ordinance has been passed providing for the paving of Thrush St. with asphalt, at an estimated cost of $26,000.

Erie, Pa.—About 7,100 sq. yds. of vitrified brick pavement will be laid this spring on Holland St.

A petition is being considered for 8,800 sq. yds. of sheet asphalt pavement on Sassafras St.

Pawtucket, R. I.—A resolution has been passed by the City Council appropriating $22,000 to pay for the improvement of Main St., after the obstructions are removed, and including the widening of the bridge.

Scranton, Pa.—An ordinance has been passed for paving Providence Road and North Main Ave. with asphalt.

Pittsburg, Pa.—Bids are wanted April 8 for one or more horse-power road rollers, weighing from 5 to 10 tons. W. E. Thompson, Co. Controller.

Carrollton, Mo.—See "Sewerage and Sewage Disposal."

St. Paul, Minn.—Bids are wanted April 6 for improving and boulevarding Portland and Summit Aves. C. H. Bronson, Clk. Bd. Pub. Wks.

Charleston, S. C.—Bids are wanted April 5 for paving the county roadway. Wm. P. Cantwell, Co. Supervisor.

Bond Hill, O.—Bids are wanted April 25 for improving Paddock Road. A. J. Kiphart, Village Clk.

Evanston, Ill.—Ordinances have been passed for paving Wesley Ave. and Crain St.

Buffalo, N. Y.—Bids are wanted April 5 for Trinidad Lake asphalt pavement on 4 streets. R. G. Parsons, Secy. Bd. Pub. Wks.

Sharpsburg, Ky.—Bids are wanted April 8 for repairs to several roads. C. S. Ratliff, Commr. for Turnpike and Gravel Roads for Sharpsburg Magisterial Dist.

Omaha, Neb.—The City Council has passed ordinances providing for the paving of Capital Ave.

Colden, N. Y.—It is stated that bids are wanted April 15 for constructing 1,800 lin. ft. of highway and a new channel for the west branch of Cazenovia Creek. W. E. Hoyt, Ch. Engr., Buffalo, Rochester & Pittsburg Ry. Co.

Joliet, Ill.—Bids are wanted April 3 for improving a portion of Wilcox St. Sebastian Lagger, Pres. Bd. Local Improvements.

Camden, N. J.—Press reports state that bids are wanted April 6 by the Treasurer of the Finance Committee for $50,000 paving bonds.

Wabash, Ind.—It is stated that bids are wanted April 10 for asphalt pavement on 3 streets. Fremont McLees, City Clk.

New Orleans, La.—Bids are wanted April 3 for asphalt pavement on Burgundy St. W. S. Douglass, Compt.

Shamokin, Pa.—It is stated that bids are wanted April 15 for about 17,000 sq. yds. brick paving on 2 streets.

Morristown, N. J.—Bids are wanted April 10 for macadamizing a portion of the public road in Rockaway and Hanover Townships. Merritt B. Linn, Dir. Bd. Chosen Freeholders.

Petersburg, Va.—Bids are wanted April 15 for laying about 2,500 sq. yds. of granite block and 12,300 sq. yds. of brick, as advertised in "The Engineering Record."

Mt. Vernon, N. Y.—Bids are wanted April 18 for brick pavement on Mt. Vernon Ave. Wm. N. Hoyt, City Clk.

Barbourville, Ky.—The question of issuing $10,000 street improvement bonds will probably soon be voted upon.

Van Wert, O.—It is proposed to pave the main business streets with brick. F. C. Manship, City Clk.

Chicago, Ill.—The following bids were opened March 15 by the Sanitary District of Chicago for two bridges across the Desplaines River in Joliet, as advertised in "The Engineering Record": For Jefferson St. bridge: A, lump sum for deviating pipes onto temporary structure; B, price per cu. yd. for the removal of 2,880 cu. yds. of old masonry; C, price per cu. yd. for 3,000 cu. yds. of earth excavation; D, price per cu. yd. for 104 cu. yds. of rock excavation; E, price per 1,000 ft. B. M. for 116,000 ft. B. M. of timber in temporary structure; F, price per cu. yd for 1,151 cu. yds. of P. C. concrete; G, price per cu. yd. for 91 cu. yds. of masonry; H, price per sq. yd. for 260 sq. yds. of pavement; I, lump sum superstructure; J, price per lb. for extra medium or soft steel; K, price per lb. for extra cast iron; L, price per 1,000 ft. B. M. for extra lumber:

Name and Address of Bidder.	A	B	C	D	E	F	G	H	I	J cts.	K cts.	L	Total.
J. G. Wagner & Co., Milwaukee, Wis	$500	$2.00	$0.60	$4.00	$50	$5.75	$13.00	$1.50	$23,160	3.5	3	$28	$45,627.25
Toledo Bridge Co., Toledo, O	375	.85	.50	1.00	23	5.60	11.00	1.20	31,200	3.6	3	28	46,053.60
Chicago Bridge & Iron Co., Chicago, Ill.	300	2.10	.42	1.10	30	7.62	12.60	3.00	24,834	3.75	2.75	35	46,733.62

For Cass St. bridge bids were as follows: A, lump sum for the removal of old superstructure; B, price per cu. yd. for the removal of 560 cu. yds. of old masonry; C, price per cu. yd. for 2,850 cu. yds. of earth excavation; D, price per cu. yd. for 52 cu. yds. of rock excavation; E, price per 1,000 ft. B. M. for 3,000 ft. B. M. of timber in temporary structure; F, price per cu. yd. for 665 cu. yds. of P. C. concrete; G, price per cu. yd. for 31 cu. yds. of masonry; H, price per sq. yd. for 250 sq. yds. of pavement; I, lump sum, superstructure; J, price per lb. for extra medium or soft steel; K, price per lb. for extra cast-iron; L, price per 1,000 ft. B. M. for extra lumber:

Name and Address of Bidders.	A	B	C	D	E	F	G	H	I	J cts.	K cts.	L	Total.
Toledo Bridge Co.	$50	$0.85	$0.50	$1.00	$20	$5.60	$11	$1.20	$25,000	3.6	3	$28	$31,428.00
J. G. Wagner Co	500	2.00	.60	4.00	50	5.75	13	1.50	29,976	3.5	3	28	38,265.75
Chicago Bridge & Iron Co	500	1.60	.42	.90	27	7.35	19	3.00	30,732	3.75	2.75	35	30,679.55

Sedalia, Mo.—It is stated that bids are about to be asked for the purchase of a stone crusher.

Louisville, Ky.—L. R. Figg is stated to have received the contract for paving four alleys with brick at $12.50 per square of 100 sq. ft.

Sioux City, Ia.—J. M. Lewis, Acting City Engr., writes that the following bids for paving were opened March 21: For 7,500 sq. yds. of asphalt on 6-in. concrete base, B. Sheppard & Co., of Kansas City, Mo., bid $2.31½ per sq. yd., and the Barber Asphalt Paving Co., of N. Y. City, bid *$2.24 per sq. yd. For 19,000 sq. yds. of brick on 6-in. concrete base with sand filler, E. J. Hanlon, of Sioux City, bid $1.69; M. L. Flinn, of Sioux City,* $1.59½, and Hanson Bros., of Sioux City, $1.69¼. The prices given do not include extra grading, concrete, gravel and sand, nor the resetting of old curb, setting new curb, drain tile, etc.
*Contract awarded.

Joliet, Ill.—Geo. W. Brown, City Clk., writes that the following bids were opened March 20 for 55,700 sq. yds. of asphalt pavement, to be laid on a 6-in. concrete foundation and binder in five streets: Warren-Scharf Asphalt Paving Co., N. Y. City, at $1.75 for 4 streets and $1.70 for 1 street, total, $122,105; R. F. Conway Co., Chicago, Ill., at $1.51 for 4 streets and $1.50 for 1 street, total, *$104,930. Indiana Bermudez Asphalt Paving Co., Indianapolis, Ind., at $1.87 for 3 streets and $1,89 for 2 streets, total, $124,-216; James A. Sackley, Chicago, Ill., at $1.64, $1.67, 1.68½ and $1.69, total, $109,379; Bermudez Asphalt Paving Co., Chicago, Ill., $1.92 for 4 streets and $1.91 for 1 street, total, $137,115.
*Contract awarded.

POWER PLANTS GAS AND ELECTRICITY.

Elmhurst, N. Y.—The Long Island Gas & Electric Light Co. of the 2d Ward, Borough of Queens, has been incorporated to do a general gas and electric light business in the 2d Ward; capital, $50,000. Incorporators: Joseph Bermel, of Middle Village; Geo. S. Jervis, of Maspeth, and others.

Mankato, Minn.—See "Electric Railways."

Broken Bow, Neb.—The question of constructing an electric light plant is under consideration here.

Greenport (L. I.), N. Y.—See "Water."

Augusta, Ga.—Judge C. O. French, of Sandusky, O., is reported to be organizing a company with a capital of $100,000, to establish a gas plant.

New Britain, Conn.—The question of placing the wires on the main streets underground is said to be under consideration.

West Hoboken, N. J.—The North River Heat, Light & Power Co. is stated to have secured a franchise to erect poles and string wires.

Evanston, Ill.—The Yaryan Hot Water Construction Co. of Toledo is stated to have received a franchise to construct a heating and electric light system.

Pittsfield, Me.—The Pittsfield Electric Light & Power Co. has been organized to generate and distribute power in Somerset County; capital, $50,000. Arthur B. Lake, Pres., Old Town, Me.; Frank L. Smith, Treas., Pittsfield, Me.

Tullahoma, Tenn.—See "Water."

Emporia, Va.—It is reported that Col. C. P. E. Burgwyn has made surveys and investigations with a view to developing water power at Emporia.

Genoa, Neb.—Bids are wanted April 20 for an electric lighting system at Genoa Indian School. W. A. Jones, Commr. of Indian Affairs, Dept. of the Interior, Washington, D. C.

Pendleton, Ind.—See "Water."

Port Louis, Mauritius.—Bids are wanted April 23 for the right to establish and maintain one or more central stations, etc., and to fix in the streets of the town, suburbs and neighborhood, overhead mains or underground conduits for the purpose of lighting the town by electricity, and supplying requirements of both public and private service. Maurice Ulcoq., Gen. Agt., 9 Idol Lane, London, E. C.

Cullman, Ala.—See "Water."

Columbus, O.—The Tuscarawas Oil & Gas Co. has been incorporated; capital, $10,000. Incorporators: Geo. B. Kauffman, Fred W. Herbst, Lewis C. Hopp and others.

San Francisco, Cal.—The Independent Electric Light & Power Co. is reported to have been incorporated, to construct an electric light plant here; capital, $10,000,000. Directors: Claus Spreckels, Chas. E. Hume and others.

St. Michaels, Md.—The Town Commissioners are said to be considering the matter of constructing an electric light plant.

Port Chester, N. Y.—The Port Chester Gas & Coke Co. has been incorporated to furnish gas for public and private use; capital, $50,000. Directors: Wm. L. Ward, Addison Johnson and Geo. C. Blakeslee.

Santa Ana, Cal.—Belmont Perry, of Santa Ana, and B. H. Dyer, of Los Angeles, are stated to have petitioned for a franchise for an electric light plant.
It is stated that bids for an electric light franchise will be received May 1. Edw. Tedford, City Clk.

Milford, Ind.—See "Water."

Seymour, Ia.—R. F. Greer, Town Clk., writes that it was voted on March 27 to issue bonds for the construction of an electric light plant.

Warren, O.—The Warren Light Co. is said to be preparing to build a new plant to cost about $40,000.

Ukiah, Cal.—The committee appointed to investigate the cost of constructing an electric light plant is stated to have recommended that an election be called to vote on issuing $18,000 bonds. R. L. Crane, Chmn. Com.

Danville, Pa.—It is stated that an election will be held April 25, to vote on issuing $15,000 bonds for an electric light plant.

Bastrop, La.—See "Water."

Peoria, Ill.—The People's Gas & Electric Co. has been incorporated; capital, $500,000. Incorporators: O. J. Bailey, P. Miles and S. R. Clark.

Holmesville, Neb.—It is stated that it is proposed to put in an electric light plant here, to furnish light for Blue Springs and Wymore.

Brockton, Mass.—Bids are wanted April 8 for lighting the streets with electricity. Geo. H. Ackerman, Clk. Com. on Fuel & St. Lights.

Carthage, Mo.—Bids are wanted April 18 for furnishing and constructing an electric light plant, as advertised in "The Engineering Record."

Brooklyn, Ia.—The citizens will probably be asked to vote on a proposition to establish and maintain an electric light plant.

Crawfordsville, Ind.—See "Public Buildings."

Waterport, N. Y.—There is talk of constructing a dam here to produce water power sufficient to develop 6,000 h. p. to be transmitted to Albion and other towns for electric lighting and power purposes.

ELECTRIC RAILWAYS.

South Bethlehem, Pa.—The Bethlehem & Nazareth Ry. Co. is stated to have petitioned for a franchise.

Southington, Conn.—It is stated that work will soon commence on the trolley line which the Central Ry. & Electric Co. proposes to construct from Plainville to this place. F. G. Platt, Gen. Mgr.

St. Louis, Mo.—The Mayor is reported to have signed a bill authorizing the St. Louis Ry. Co. to change the motive power of the Broadway cable system to electricity.

Natick, Mass.—It is stated that the Natick & Cochituate St. Ry. Co. will build about 3 miles of new road this spring. F. P. Quackenbush, Asst. Supt.

Scottdale, Pa.—It is stated that bids will soon be received for about 28 miles of electric railroad to be built by the Mt. Pleasant, Scottdale & Connellsville Ry. Co. Principal office at this place. W. E. Tustin, Pres., Allegheny; G. S. Lewis, Secy., Crafton.

Fresno, Cal.—It is stated that the Fresno R. R. Co. has been incorporated, to build a standard gauge electric railroad in Fresno County; capital, $500,000. Directors: Alexander Gordon, W. M. Wyatt and others.

Atlanta, Ga.—The Atlanta Consolidated St. Ry. Co. is said to be considering the matter of extending its line to Marietta, a distance of about 17 miles. Ernest Woodruff, Pres.

Berlin, Conn.—The officials of the Consolidated Road are said to be considering the matter of erecting a power plant here to operate a third rail line from Hartford to New Haven.

Minneapolis, Minn.—The Twin City Rapid Transit Co. will build a power house and extend its line from St. Paul to Stillwater, Minn., a distance of 20 miles.

Rome, N. Y.—The Rome City St. Ry. Co. is stated to have received a franchise to extend its line.

Stillwater, Minn.—Thos. Lowry and C. G. Goodrich, of Minneapolis, are stated to have received a franchise.

Ottumwa, Ia.—The Ottumwa Electric & Steam Co. is reported to have been incorporated, with a capital of $200,000, to build an electric or steam railroad in this city and vicinity. J. H. Merrill, Pres.; J. B. Sax, Secy., both of Ottumwa.

Mankato, Minn.—A. E. Clark has petitioned the Council for a franchise for an electric street car and lighting plant.

Hennepin, Ill.—Thos. Dore, C. C. Greiner and others are stated to be interested in the construction of an electric railway to Streator, a distance of 35 miles.

Chicago, Ill.—It is reported that the Chicago City Ry. Co. will make immediate arrangements to substitute electricity for horse-power on its line.

Akron, O.—The Akron Traction & Electric Co. has been incorporated; capital, $100,000. Incorporators: Aaron Wagoner, Frank A. Seigerling, L. C. Miles and others.

Tacoma, Wash.—C. S. Barlow has petitioned the Council for a franchise; the proposed road is estimated to cost $100,000.

Lewistown, Pa.—Wm. Schwarz and Geo. H. Sargeant of Baltimore, H. M. Vanzandt of Harrisburg, and others, are said to be stockholders of an electric railway to be constructed from Lewistown to Yeagertown, a distance of 4 miles. It is stated that work on the road will be commenced at once.

Cedar Falls, Ia.—The Cedar Falls & Normal Ry. Co. is reported to have been incorporated with a capital of $25,000, to build an electric railway about 25 miles long. Incorporators: C. W. McElyea and Jennie E. Beyer, of Nevada, Ia.

Chesterfield, Va.—The Richmond & Petersburg Electric Ry. Co. on March 27 received a franchise through Chesterfield County.

East Lyme, Ct.—Mayor Cyrus G. Beckwith, of New London; Calvin S. Davis, of Niantic; Joseph T. Crittenden, of Norwich, and others are stated to be interested in the construction of an electric railway from Niantic to Crescent Beach, Black Point, Flanders and Oswegatchie.

Montgomery, Ala.—Barrie L. Holt, W. B. Davidson and associates have received a franchise to construct a railway to be operated by electricity or cable.

Westerly, R. I.—The Sea View Electric Ry. Co. is stated to have received a franchise.

Frankfort, Ind.—The Clinton Traction Co. is stated to have applied to the County Commissioners for a franchise through Clinton County.

East St. Louis, Ill.—The Collinsville, Caseyville & East St. Louis Electric R. R. Co., has been incorporated with a capital of $20,000, to build an electric road from Collinsville to East St. Louis. Incorporators: Wm. G. Burroughs, Collinsville; W. H. Huckel, Caseyville; D. M. Browning, East St. Louis, and others.

Edgartown, Mass.—The Marthas Vineyard St. R. R. Co. is stated to have received a franchise for the construction of an electric railway to connect this place and Cottage City.

Kansas City, Mo.—The Metropolitan St. Ry. Co. is stated to have awarded the following contracts: To the Electrical Installation Co., of Chicago, for the overhead work, and the Faulk Co., of Milwaukee, for the track work. The two contracts said to amount to $250,000.

Racine, Wis.—It is stated that the street railway company will expend $100,000 in improvements.

Detroit, Mich.—The following electric railways are stated to have been incorporated: The Detroit, Mt. Clemens & Marine City R. R. Co., which is to include the Rapid Railway and the road from Mt. Clemens to Marine City; capital, $600,000. Stockholders: C. J. Reilly, F. W. Brooks and C. M. Swift.
The Detroit-Northwestern R. R. Co., with a capital of $800,000, to build a line from this city to Pontiac. Stockholders: E. W. Voigt, Hoyt Post, Jas. A. Randall and others.
The Detroit & Lake Orion R. R. Co.; capital, $300,000. Stockholders: John Winter, F. C. Andrews, O. H. Lau and others.

RAILROADS.

Weiser, Idaho.—The Pacific & Idaho Northern R. R. Co. has been incorporated, to build a road from Weiser to Lewiston, with several branch lines; capital, $8,000,000. Directors: Thos. W. Bates, Mart Patrie, George S. Glover and others.

Indianapolis, Ind.—The Indianapolis & Louisville Ry. Co. has been incorporated, with a capital of $100,000, to construct a line about 100 miles long. Directors: E. R. Thomas, B. E. Taylor, John Greenough and others.

Buffalo, N. Y.—It is reported that the Buffalo St. Ry. Co. will expend about $500,000 on improvements. W. Caryl Ely, Pres.

PUBLIC BUILDINGS.

(See also Schools and Government Work.)

Los Angeles, Cal.—Plans prepared by Austin & Skilling, of Los Angeles, have been adopted by trustees of the M. E. Church for a $40,000 church to be erected on 6th and Hill Sts.

Boston, Mass.—The plans of McKim, Mead & White, of New York City, have been accepted for the new music hall.

Jersey City, N. J.—Bids are wanted April 10 (change of date) for a public library. L. J. Gordon, Pres. Trus. Free Public Library.

Atlanta, Ga.—The Public Buildings Committee of the County Board at a meeting March 27 decided to recommend to the Board that the architects of Atlanta and suburbs be asked to submit plans and specifications for an annex to the Court House; estimated cost, $100,000.

Pullman, Wash.—Plans and sketches are wanted April 5 for 2 halls. Address Pres. Bryan, Bd. of Regents of the Washington Agricultural College and School of Science.

North Braddock, Pa.—Bids are wanted April 17 for a municipal building. J. M. Reese, Clk.; F. C. Sauer, Archt., Pittsburg.

Camden, Ark.—Bids are wanted April 20 for a jail to cost about $12,000. W. F. Avera, Chmn. Commrs.

Manti, Utah.—Bids are wanted April 4 by the County Clerk for a jail.

Evanston, Ill.—Henry J. Schlacks, 109 Randolph St., Chicago, is said to be preparing plans for a $33,000 edifice for St. Nicholas R. C. Church at South Evanston. Rev. P. J. Biermann, Pastor.

Clarion, Pa.—The County Commissioners are stated to have accepted plans for a $40,000 county home.

Kokomo. Ind.—It is stated that A. A. Small and others have been appointed as a committee to secure plans for a $35,000 M. E. Church.

Memphis, Tenn.—The Council will petition the Legislature for permission to issue $300,000 bonds for a city hall.

Lowville, N. Y.—The citizens are stated to have decided to erect a $20,000 town hall.

Peru, Ind.—Bids are wanted April 22 for a sheriff's residence and jail. Jesse W. Miller, Chmn. Co. Commrs.

Chicago, Ill.—Henry J. Schlacks, 109 Randolph St., is said to be preparing plans for a $45,000 church, to be erected at North Wood and Clybourn Place. Rev. F. Gordon, Pastor.

Detroit, Mich.—The Board of Supervisors on March 23 instructed the Building Committee to let additional contracts for the new county building as follows: Davidson Bros., of Chicago, for marble and scagliola work, $155,000; for mason, iron and steel work, Henry Carew & Co., of Detroit, $54,499.

Selma, Ala.—The congregation of the First Methodist Church is stated to have decided to erect a $25,000 edifice.

Batavia, N. Y.—Bids are wanted April 12 for an exhibition hall. Albert E. Brown, Secy. Genesee Co. Agricultural Society.

Little Rock, Ark.—The Senate passed a bill March 20 for a new capitol, the cost not to exceed $1,000,000.

Elwood, Ind.—The M. E. Society is stated to have decided to erect a $25,000 church. Rev. L. M. Krider, Pastor.

Springfield, Mass.—It is stated that the Belmont Ave. Baptist Society proposes to erect a $25,000 church. Rev. W. E. Waterbury, Pastor.

Pittsburg, Pa.—It is stated that a $40,000 addition will be erected to the Bellefield Presbyterian Church. Dr. Henry T. McClelland, Pastor.

Leavenworth, Kan.—An $18,000 orphan asylum is to be built.

Vincennes, Ind.—The Christian Society is stated to have decided to erect an $85,000 church.

NEW YORK CITY.

A permit has been issued for a $45,000 home for idiots, to be erected on Randall's Island. Horgan & Slattery, Archts., 60 W. 58th St.

BUSINESS BUILDINGS.

Osage, Ia.—It is stated that bids are wanted April 15 for a store and apartment building for B. M. & S. E. Cleveland. Netcott & Donnan, Archts., Independence, Ia.

Newport News, Va.—The Newport News Abattoir Co. is about to build an abattoir in the vicinity of Point Breeze; cost, $1,500,000. T. B. Henley, of Newport News, is interested.

Reading, Pa.—A. L. Ketz is about to erect 4 stone buildings at a cost of $19,000. Smith Bros., Archts.

Elyria, O.—The Mussey Building Co. is said to be preparing to erect a 7-story office building.

Fargo, N. D.—It is stated that a $25,000 masonic temple will be erected.

Fitchburg, Mass.—Crocker, Burbank & Co. are about to build a $15,000 addition to their brick paper mill on Westminster St.

Des Moines, Ia.—Plans are being prepared by Liebbe, Nourse & Rasmussen for a $50,000 addition to the Savery Hotel.

Cincinnati, O.—It is stated that B. H. Kroger will erect a 6-story warehouse on Hunt St., to cost about $60,000.

Chicago, Ill.—Wm. J. Van Keuren, 84 La Salle St., is stated to have prepared plans for a $75,000 hotel for the People's Institute Hotel Co.

A permit was issued March 23 for a 10-story store and office building to be erected on Clark and Adams Sts., for Marshall Field & Co., to cost about $700,000. The same firm also received a permit for a $45,000 addition to its wholesale building on Adams and Franklin Sts.

Louisville, Ky.—Samuel Ouerbacker and C. W. Inman will build a cold storage and ice plant, to cost $50,000.

Marshall, Mich.—It is stated that a $20,000 opera house will be erected. F. A. Stuart is said to be interested.

Brockton, Mass.—White & Belcher propose to erect a 3-story brick mercantile building on Centre St. J. W. Beal, Archt., Boston.

Denver, Col.—A bill is stated to have been passed in the Legislature authorizing this city to issue $400,000 bonds to erect an auditorium.

Boston, Mass.—Cabot, Everett & Mead, 60 Devonshire St., have prepared plans for an 11-story building, to be erected for Lewis F. Perry on Province St., near Bosworth St. Estimated cost, $75,000.

Philadelphia, Pa.—Henry R. Hallowell & Son are stated to have decided to construct an 18-story office building at 111 and 113 South Broad St.

New York City.—Plans have been filed by Cauldwell & Morgan, Archts., for a $250,000 hotel for Francis Kinney, to be erected on 56th St. and Madison Ave.

Plans were also filed by Stein, Cohen & Roth for an 11-story apartment hotel, to cost $650,000, to be erected on 70th St. and Central Park West.

Watertown, N. Y.—Bids are wanted April 10 for a factory for H. H. Babcock Co. John W. Griffin, Archt., Watertown.

Frankton, Ind.—John Meckel, of Anderson, is stated to have prepared plans for rebuilding the Commercial block. Estimated cost, $20,000.

Washington, D. C.—It is reported that the Southern Ry Co. will erect a 7-story, fireproof building. Frank S. Gannon, Gen. Mgr.

New Orleans, La.—The Texas & Pacific Ry. Co. is said to be considering the matter of erecting a $200,000 depot. B. S. Wathen, Chf. Engr., Dallas, Tex.

Crawfordsville, Ind.—John G. Thurtle, of Indianapolis, is stated to have prepared plans for a $50,000 hotel for C. M. Crawford; it will be provided with an electric plant.

NEW YORK CITY.

Permits for the following buildings have been issued; o, signifies owner; a, architect; b, builder, and c, contractor.

632 and 634 Broadway, br store and lofts; cost, $375,000; o, Henry Korn; a, Robert Maynicke.

139 Eldridge, br store and tenem't; cost $28,-000; o, Farbush Libman; a, G F Pelham.

60 and 62 Suffolk st, br stores and tenem'ts; cost, $30,000; o, Harry Fischel; a, Samuel Sass.

Ave D and 9th st, br stores and flat; cost, $28,000; o, Livingston & Kotzen; a, M. Bernstein.

10 and 12 Elizabeth st, br stores and tenem'ts; cost, $30,000; o, Barnett Gery; a, C B Meyers.

273 to 281 Madison st, 4 br stores and flats; cost, $115,000 all; o, Louis J Levy; a, Horenburger & Straub.

183 to 187 Ave C, 2 br stores and flats; cost, $75,000 all; o, Baker & Fine; a, Fredk Ebeling.

113 to 117 W 41st st, 112 and 114 W 42d st, br stores and lofts; cost, $325,000; o, E Wm Wagner; a, J K Thompson.

577 and 579 2d ave, 2 br stores and flats; cost, $56,000 all; o, Jacob Hassewitz; a, G F Pelham.

420 E 119th st, br store and flat; cost, $20,000; o, John T Brady; a, Jas W Cole.

225 E 105th st, br stores and flat; cost, $28,000; o, P J Herter; a, P Herter & Son.

537 to 551 E 69th st, br factory; cost, $50,000; o, The Hammond Typewriter Co; a, L C Holden.

5th ave and 133d st, 2 br stores and flats; cost, $60,000 all; o and b, T J Jenkins; a, Ward Cunningham.

Railroad ave and 158th st, br stores and flat; cost, $20,000; o, Schmuck & Montag; a, Edw Wenz.

Central Park West and 100th st, 2 br stores and flats; cost, $55,000 all; o, Peter Doelger; a, Chas Stegmayer.

DWELLINGS.

Boston, Mass.—McKim, Mead & White, 160 5th Ave., N. Y. City, are said to be preparing plans for a $50,000 dwelling for E. C. Swift, to be erected on Beacon and Hereford Sts.

NEW YORK CITY.

Permits for the following buildings have been issued; o, signifies owner; a, architect; b, builder, and c, contractor.

323-329 E 12th st, 3 br flats; cost, $85,000; o, Gerson Hyman; a, Schneider & Herter.

22 and 24 W 53d st, br. dwell'g; cost, $40,000; o, F R Halsey; a, W W Smith.

88th st and Madison ave, 5 br flats; cost, $100,-000 all; o, John McLaughlin; a, Chas. Stegmayer.

Central Park West and 70th st, br flat; cost, $650,000; o, T G Stein; a, Stein, Cohen & Roth.

124th st and Amsterdam ave, 2 br flats; cost, $48,000 all; o, G F Quinlan; a, F Wolfgang; b, Francis Mitchell.

124th st and Amsterdam ave, 3 br flats; cost, $72,000 all; o, Arthur Gorsch; a, F Wolfgang.

112th st and 8th ave, br flat; cost, $75,000; o, Elbert D Howes, Jr; a, S B Ogden & Co.

Central Park West and 92d st, br flat; cost, $120,000; o, Samuel Quincy; a, G F Pelham.

103d st and West End ave, 6 br dwell'gs; cost, $108,000 all; o, Robt Wallace; a, G F Pelham.

111th st and 7th ave, br bachelor apartments; cost, $100,000; o, Ida F. Moore; a, C A Millner; b, H M Moore.

129th st and 8th ave, br flat; cost, $45,000; o, Jere Flanagan; a, Henry Andersen.

169th st and Clinton ave, 4 br flats; cost, $85,-000 all; o, Margarette Strese; a, W C Dickerson.

138th st and Willis ave, br flat; cost, $30,000; o, Hy Muller; a, Harry T Howell.

Brook ave and St Paul's pl, br flat; cost, $20,-000; o, S & M Guidera; a, G F Pelham.

BROOKLYN, N. Y.

Clinton and Greene aves, br flat; cost, $60,000; o, James Burke; a, J L Young.

NEW INDUSTRIAL PLANTS.

The Express Refrigerator Car Co., Gainsville, Fla., expects to rebuild its ice plant during the present year, and will probably put in a 25-ton machine.

The Union Malleable Iron Co., Moline, Ill., has adopted plans for a new plant. The works will include a 408x150-ft. foundry, a 50x80-ft. mill room, a 40x50-ft. assorting room, a 100x225-ft. annealing room, a soft mill room 50 ft. square, a shipping room 60x204 ft., a 50x128-ft. machine shop, a 50x80-ft. carpenter shop, a core room of the same dimensions, 50x50-ft. engine room and a boiler room of the same size. A tract of land has been set aside for the producers for the gas used in annealing, and there will be other buildings for storage and administration purposes. The power plant will have a capacity of about 200 H.-P.

A 2-story, 48x24-ft. machine shop, run by water power, will be put up at Fontana, Wis., by Walter Vrooman.

Mr. A. Turner, Sangamon and Fourteenth place, Chicago, will make extensive additions and alterations in his wood moulding plant.

The York Mfg. Co., York, Pa., will soon begin the erection of a 40x63 ft. foundry building for making charcoal iron and gun metal castings. A malleable iron shop will also be constructed. The usual foundry apparatus, including a traveling crane, will be required, and about $100,000 will be spent on the improvements.

The Wood Specialty Mfg. Co., Urichsville, Ohio, has placed a contract for erecting a 2-story and basement 42x60 ft. building, and will need a 70 H.-P. engine, with two 50 H.-P. boilers.

T. J. Mowry, Rome, N. Y., will put up an 84x40-ft. excelsior mill and a 20x30-ft. power house, which will contain a 70-H.-P. boiler and 60-H.-P. engine.

The American Insulating Material Mfg. Co., 213 N. Third St., St. Louis, Mo., has placed contracts for a new plant, having a 290x60 ft. main building and a separate office building. A 70 H.-P. engine and three boilers of 150 H.-P. will be needed.

The Shreveport Ice & Refrigerating Co., Shreveport, La., will erect a 50-ton ice plant and is figuring on a fruit storage plant.

BUSINESS NOTES.

The Judson A. Goodrich Co., dealers in steam specialties, have moved their offices from 120 to 105 Beekman St., New York City.

The Buffalo Forge Co., Buffalo, N. Y., announces that its New York office will be at 114 and 115 Taylor Building, 39 and 41 Cortlandt St., and not at the address given last week.

PROPOSALS OPEN.

Bids Close — See Eng. Record

WATER-WORKS.

Apr. 1. Fire hydrants, Washington, D. C...Mar. 11
Adv., Eng. Record, Mar. 11.
Apr. 3. Lockport, N. Y. ...Mar. 18
Apr. 3. Engine, Winnipeg, Man...Feb. 4
Adv., Eng. Record, Feb. 4 to 18.
Apr. 3. Supplies, Winnipeg, Man...Mar. 11
Adv., Eng. Record, Mar. 11 to 25.
Apr. 3. Baird, Tex ...Mar. 25
Apr. 4. Albany, N. Y...Mar. 25
Apr. 4. Berea, O...Mar. 25
Apr. 4. Pipe, Boston, Mass. ...Mar. 18
Adv., Eng. Record, Mar. 18.
Apr. 4. Verdun, Ont ...Apr. 1
Apr. 4. Milford, Ind. ...Apr. 1
Apr. 4. Water heater, Camden, N. J. ...Apr. 1
Apr. 5. Stand-pipe, Elizabethtown, Ky...Apr. 1
Apr. 5. Wells, Louisville, Ky. ...Apr. 1
Apr. 5. Boiler, Newport, Ky...Mar. 25
Apr. 5. Mayville, N. D...Mar. 25
Apr. 5. Pipe, Yonkers, N. Y...Mar. 25
Apr. 7. Austin, Minn...Mar. 25
Adv., Eng. Record, Mar. 25.
Apr. 7. Pittsburg, Pa. ...Apr. 1
Apr. 7. Chicago, Ill. ...Apr. 1
Apr. 8. Ontario, Cal...Mar. 25
Apr. 8. Fort McPherson, Ga...Mar. 18
Apr. 10. Boilers, Montgomery, Ala...Mar. 18
Apr. 10. Tank, Washington, D. C...Mar. 11
Apr. 10. Walker, Minn...Apr. 1
Apr. 10. Bermidji, Minn. ...Apr. 1
Apr. 11. Philadelphia, Pa...Mar. 11
Apr. 12. Seattle, Wash ...Mar. 18
Adv., Eng. Record, Mar. 18, 25.
Apr. 12. Mankato, Kan...Mar. 25
Apr. 12. Iron pipe, etc., Cincinnati, O. ...Mar. 25
Apr. 12 Canton, N Y...Apr. 1
Apr. 15. Golden, Colo...Mar. 18
Apr. 15. Forestport, N. Y ...Mar. 4
Apr. 15. Pumping engine, Montgomery, Ala. Mar. 25
Apr. 15. Tinley Park, Ill ...Apr. 1
Apr. 15. Hintonburgh, Ont ...Apr. 1
Apr. 17. Lakeport, Cal...Mar. 25
Adv. Eng. Record, Apr. 1.
Apr. 17. Goshen, Ind. ...Apr. 1
Apr. 18. San Carlos, Ariz ...Mar. 25
Apr. 18. Meters, Camden, N. J. ...Apr. 1
Apr. 19. Butte, Mont ...Mar. 18
Adv., Eng. Record, Mar. 18, 25.
Apr. 20. Greenville, Cal ...Apr. 1
Apr. 20. Air cyl'ders, etc, Montgomery, Ala. Apr. 1
Apr. 26. Washington, D. C...Apr. 1
Apr. 28. Cincinnati, O ...Mar. 25
Adv., Eng. Record, Mar. 25, Apr. 1.
May 1. Cullman, Ala. ...Apr. 1
—— Napoleonville, La ...Mar. 25
—— Corinth, Miss...Mar. 25

SEWERAGE AND SEWAGE DISPOSAL.

Apr. 1. Havana, Ill ...Mar. 11
Adv., Eng. Record, Mar. 11.
Apr. 1. Athens, Ga ...Mar. 18
Adv., Eng Record, Mar. 18.
Apr. 3. Lockport, N. Y...Mar. 18
Apr. 3. Plainfield, N. J...Mar. 18
Apr. 3. Whiting, Ind ...Mar. 18
Apr. 3. Albany, N. Y. ...Mar. 25
Apr. 3. Toledo, O...Mar. 25
Apr. 3. St. Paul, Minn...Apr. 1
Apr. 3. Irvington, N. Y. ...Apr. 1
Apr. 4. Jersey City, N. J...Apr. 1
Apr. 4. East Liverpool, O...Mar. 18
Apr. 4. Verdun, Ont...Apr. 1
Apr. 4. Terre Haute, Ind...Apr. 1
Apr. 5. Buffalo, N. Y...Apr. 1
Apr. 6. Submerged sewer, New London, Conn ...Mar. 11
Adv., Eng. Record, Mar. 11.
Apr. 6. Vitrified pipe, New London, Conn. .Mar. 11
Adv., Eng. Record, Mar. 11.
Apr. 8. Washington, D. C ...Apr. 1
Apr. 10. Collinwood, O. ...Apr. 1
Apr. 10. Concord, Mass...Apr. 1
Adv., Eng. Record, Apr. 1.
Apr. 12. Salem, O...Mar. 18
Apr. 12. Jersey City, N. J...Apr. 1
Apr. 12. Pipe, Baltimore, Md...Apr. 1
Apr. 13. North Braddock, Pa ...Apr. 1
Adv, Eng. Record, Apr. 1.
Apr. 14. Independence, Mo...Apr. 1
Adv., Eng. Record, Apr. 1.
Apr. 14. Ottawa, Ont ...Apr. 1
Apr. 15. Akron, O...Apr. 1
Apr. 15. Carrollton, Mo ...Apr. 1
Apr. 15. Honolulu, H. I...Feb. 25
Adv., Eng. Record, Feb. 25, Mar. 4.
Apr. 17. Goshen, Ind. ...Apr. 1
Apr. 18. Bayonne, N. J. ...Apr. 1
Apr. 20. Greenville, Cal ...Apr. 1
Apr. 26. Washington, D. C. ...Apr. 1
Apr. 18. San Carlos, Ariz...Mar. 25
May 3. Sauk Centre, Minn...Apr. 1
May 15. Medford, Ore...Apr. 1

BRIDGES.

Apr. 3. Ellensburg, Wash...Mar. 25
Apr. 3. Mitchell, S D ...Mar. 25
Apr. 3. Kalama, Wash...Mar. 18
Apr. 3. Grand Forks, N. D ...Mar 18
Apr. 4. Somerville, N. J...Mar. 25
Apr. 4. Superstructure, Sidney, O...Mar. 18
Apr. 5. Columbus, O...Mar. 11
Apr. 5. Dakotah, Ia...Mar. 25
Apr. 5. Goldbeach, Ore. ...Mar. 25
Apr. 7. Superstructure, Cleveland, O...Mar 18
Apr. 7. Providence, R. I. ...Apr. 1
Adv., Eng. Record, Apr. 1.
Apr. 8. Columbus, O ...Mar. 18
Apr. 8. Chatham, Ont ...Apr. 1
Apr. 10. Oakland, Cal...Apr. 1
Apr. 10. Chicago, Ill. ...Feb. 18
Adv., Eng. Record, Feb. 18.
Apr. 12. Columbus, O...Mar. 18
Apr. 12. Batavia, O...Mar. 25
Apr. 12. Providence, R. I...Apr. 1
Adv., Eng. Record, Apr. 1.
Apr. 15. Crescent, Ill. ...Apr. 1
Apr. 15. Hartford, Conn. ...Mar. 25
Adv., Eng. Record, Mar. 25.
Apr. 15. Gainesville, N. Y...Mar. 25
Apr. 23. Raleigh, N. C...Mar. 18
Apr. 24. Huntington, W. Va ...Apr. 1
Apr. 27. Georgetown, D. C. ...Apr. 1
Adv., Eng. Record, Apr. 1.
May 10. Chicago, Ill...Mar. 18
Adv., Eng. Record, Mar. 25.
—— Quincy, Ill...Feb. 25
Adv., Eng. Record, Feb. 25.

PAVING AND ROADMAKING.

Apr. 1. Athens, Ga ...Mar. 18
Adv., Eng. Record, Mar. 18, 25.
Apr. 3. Boston, Mass...Mar. 25
Apr. 3. Union City, Pa ...Mar. 18
Adv., Eng. Record, Mar. 18, 25.
Apr. 3. Albany, N. Y...Mar. 25
Apr. 3. Paterson, N. J...Mar. 25
Adv., Eng. Record, Mar. 25.
Apr. 3. New Orleans, La...Apr. 1
Apr. 3. Joliet, Ill...Apr. 1
Apr. 4. Jersey City, N. J...Apr. 1
Apr. 4. Brooklyn, N. Y. ...Apr. 1
Apr. 4. Road machines, Colfax, Wash. ...Mar. 25
Apr. 5. Trenton, N. J...Mar. 25
Apr. 5. Asphalt, Winnipeg, Man. ...Mar. 11
Adv., Eng. Record, Mar. 11 to 25.
Apr. 5. Charleston, S. C...Apr. 1
Apr. 5. Buffalo, N. Y. ...Apr. 1
Apr. 6. Brooklyn, N. Y. ...Apr. 1
Apr. 6. St. Paul, Minn...Apr. 1
Apr. 8. Bedford, Ind...Mar. 25
Apr. 8. Sharpsburg, Ky. ...Apr. 1
Apr. 8. Road rollers, Pittsburg, Pa...Apr. 1
Apr. 10. Morristown, N. J...Apr. 1
Apr. 10. Wabash, Ind ...Apr. 1
Apr. 10. Lafayette, Ind...Mar. 18
Adv., Eng. Record, Mar. 18, 25.
Apr. 10. South Bend, Ind ...Mar. 25
Apr. 10. Bedford, Ind ...Mar. 25
Apr. 10. Des Moines, Ia...Mar. 25
Apr. 10. Wabash, Ind ...Apr. 1
Apr. 11. Schenectady, N. Y...Mar. 25
Apr. 11. Huntington, Ind...Mar. 11
Apr. 12. Salem, O...Mar. 18
Apr. 14. Waukesha, Wis. ...Mar. 25
Apr. 15. Akron, O...Mar. 25
Apr. 15. Colden, N. Y ...Apr. 1
Apr. 15 Shamokin, Pa...Apr. 1
Apr. 15. Carrollton, Mo ...Apr. 1
Apr. 15. Petersburg, Va. ...Apr. 1
Adv., Eng. Record, Apr. 1.
Apr. 17. Portland, Ind...Mar. 25
Apr. 17. Risingsun, Ind...Mar. 25
Apr. 17. Bridgeport, O. ...Mar. 25
Apr. 17. Toledo, O...Mar. 25
Apr. 17. Goshen, Ind. ...Apr. 1
Apr. 18. Mt. Vernon, N. Y...Apr. 1
Apr. 25. Bond Hill, O ...Apr. 1
Apr. 28. Bellefontaine, O ...Mar. 25

POWER, GAS AND ELECTRICITY.

Apr. 3. Forsyth, Ga. ...Mar. 25
Apr. 4. Picton, Ont...Mar. 18
Apr. 4. New York, N. Y...Mar. 11
Apr. 4. Transmission line, Benica, Cal...Mar. 11
Apr. 4. Milford, Ind. ...Apr. 1
Apr. 5. Mayville, N. D...Mar. 25
Apr. 5. Indianapolis, Ind...Mar. 25
Apr. 8. Norfolk, Va ...Mar. 11
Apr. 8. Brockton, Mass ...Apr. 1
Apr. 10. Dayton, O...Mar. 4
Adv., Eng. Record, Mar. 4, 11.
Apr 18. San Carlos, Ariz ...Mar. 25
Apr. 18. Carthage, Mo...Apr. 1
Adv., Eng. Record, Apr. 1.
Apr. 20. Genoa, Neb...Apr. 1
Apr. 23. Port Louis, Mauritius ...Apr. 1
May 1. Franchise, Santa Ana, Cal...Apr. 1
May 1. Cullman, Ala...Apr. 1
May 1. Franchise, Fairfield, Cal. ...Mar. 25
—— Pleasantville, O...Dec. 24

GOVERNMENT WORK.

Apr. 1. Rock Island, Ill ...Mar. 11
Adv., Eng. Record, Mar. 11 to 25.
Apr. 5. Vicksburg, Miss...Mar. 4
Adv., Eng. Record, Mar. 4 to 25.
Apr. 6. New Orleans, La...Feb. 11
Adv., Eng. Record, Feb. 11 to 25.
Apr. 6. Wilmington, Del...Mar. 11
Adv., Eng. Record, Mar. 11 to Apr. 1.
Apr. 8. Norfolk, Va. ...Mar. 11
Apr. 10. Tank, Washington, D. C. ...Mar. 11
Apr. 10. Kansas City, Mo...Mar. 11
Adv., Eng. Record, Mar. 11.
Apr. 13. St. Paul, Minn...Mar. 18
Adv., Eng. Record, Mar. 18, 25.
Apr. 13. Steam heating plant, Grand Junction, Colo ...Mar. 25
Apr. 14. Louisville, Ky. ...Mar. 11
Apr. 17. San Francisco, Cal ...Mar. 11
Adv., Eng. Record, Mar. 11.
Apr. 17. Cement, etc., Duluth, Mich...Mar. 25
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Apr. 6. Electric Ry., Addyston, O...Mar. 25
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SCHOOLS.

Epworth, O.—Bids are wanted April 20 for a school in Dist. No. 6, Willis Township. E. A. Clingan.

Grand Junction, Colo.—Bids are wanted April 12 for a steam heating plant at the Indian Industrial School. W. A. Jones, Commr. Indian Affairs, Dept. of Interior, Washington, D. C.

Dayton, O.—Bids are wanted April 24 for a school in North Dayton. Wm. G. Haeussler, Clk. Bd. of Educ.

Waterbury, Conn.—Bids are wanted April 5 for ventilating, heating, plumbing, etc., in an addition to East Main St. School. Augustus I. Goodrich, Chmn. Dist. Com.

Washington, D. C.—See "Water."

New York, N. Y.—Bids are wanted April 10 for alterations in, and an addition to, School No. 5, Borough of Brooklyn. Richard H. Adams, Chmn. Com. on Bldgs., Bd. of Educ.

Poughkeepsie, N. Y.—An election will be held April 18 to vote on expending $59,300 for new schools.

Mt. Vernon, N. Y.—It is stated that bids are wanted April 3 (change of date) by the Board of Education for 2 schools. Joseph S. Wood, Pres.

Lagrande, Ore.—The citizens are stated to have voted to issue $20,000 bonds to erect a school.

Washington, D. C.—The plans of Henry Ives Cobb of Chicago have been accepted for the new Manual Training School, to cost about $100,000.

Evanston, Ill.—The citizens are stated to have voted on March 25 to issue $60,000 bonds for improving the high school.

Detroit, Mich.—Malcomson & Higginbotham, 53 Moffat Bldg., are said to be preparing plans for 2 schools, to cost $35,000 each.

Cambridge, Mass. — The Harvard Grammar School, recently destroyed by fire, is to be rebuilt, at a probable cost of $30,000.

Gloucester, Mass.—The Council has passed a resolution authorizing the issue of $30,000 bonds for a school in Ward 6.

Bastrop, La.—See "Water."

Chicago, Ill.—The Council is stated to have appropriated $2,000,000 for new schools.

Roselle, N. J.—The citizens are stated to have voted to erect a $30,000 school.

Brockton, Mass.—One or more schoolhouses will probably be built this spring.

Portland, Me.—The School Board is said to be considering the matter of erecting a $50,000 school.

Murray, Utah.—The citizens are stated to have voted to erect a $15,000 school.

Warrensburg, N. Y.—The citizens have voted to erect a $20,000 school.

Suttons Bay, Mich.—It is stated that the St. Michaels Catholic Society will build a $26,000 school. Address Rev. Alex. Zugelder, Provemont, Mich.

Hortonville, Wis.—The citizens are stated to have voted to erect a $10,000 school.

Piermont, N. Y.—Bids are wanted April 6 for a school. Chas. Haring, Clk. Bd. Educ.

Odebolt, Ia.—It is stated that an $18,000 school will be erected.

Easton, Pa.—The Board of Control has passed a resolution to construct a school to cost about $20,000. J. W. H. Knerr, Secy.

Pittsburg, Pa.—Bids are wanted April 7 for the enlargement and remodeling of the Oakland sub-district school. Probable cost, $50,000. U. J. L. Peoples, Archt.

Carlisle, Pa.—Miller & Co., of Harrisburg, are stated to have prepared plans for a $25,000 school for the 3d Ward.

Chicago, Ill.—Bids are wanted April 7 by the Business Manager of the Board of Education for an addition to Pullman school, including ventilating, heating, plumbing and gas fitting. W. B. Mundie, Archt., Bd. of Educ.

New York City.—The following bids were opened March 27, for the erection of a school on 101st and 102d Sts., between Columbus and Amsterdam Aves.: Mapes-Reeve Construction Co., 150 Nassau St., $308,000; Harry McNally, 287 4th Ave., $296,975; P. J. Walsh, 503 5th Ave., $303,000; P. Gallagher, 150 5th Ave., $308,900; Thos. Cockerill & Son, 550 W. 51st St., $314,900; Murphy Bros., 407 E. 101st St., $301,000. Bids were received as follows for alterations and additions to school No. 70, Borough of Brooklyn: K. A. Murphy, 96 Linwood St., Brooklyn, $45,700; Jas. I. Newman, $47,875; Hartman & Horgan, $47,883; L. W. Seaman, Sr., & Son, 133 Grand Ave., Brooklyn, $43,000; John Thatcher, 54 Park Ave., Brooklyn, $46,000; F. J. Kelly & Son, $47,120. All bids rejected for addition to school No. 70.

Bids are wanted April 6 for School No. 181. Richard H. Adams, Chmn. Com. on Bldgs., Bd. of Educ.

STREET CLEANING AND GARBAGE DISPOSAL.

Lowell, Mass.—The Board of Health has under consideration a proposition from John F. Murphy, Mgr. of the Lowell Garbage and Reduction Co., to collect and dispose of all garbage, ashes, etc., for a term of 5 years, at $27,000 per year.

Westfield, Mass.—It is stated that bids are wanted April 4 by the Board of Health for the collection of garbage.

Washington, D. C.—Bids are wanted April 10 to clean improved alleys and unimproved streets and alleys; also to sprinkle, sweep and clean, by hand, improved streets and avenues designated by the Commissioners; also to sprinkle, sweep and clean, by machine, improved streets and avenues designated by the Commissioners, as advertised in "The Engineering Record."

Binghamton, N. Y.—The Common Council has accepted the bill recently passed by the Legislature authorizing the city to contract for the collection and disposal of garbage and appropriate $15,000 annually for that purpose.

Savannah, Ga.—Director of Public Works Gadsden has been directed to confer with manufacturers with a view to obtaining a garbage crematory plant.

Houston, Tex. — Separate bids are wanted April 10 for 3 small crematories. S. H. Brashear, Mayor.

Watertown, Mass.—Bids are wanted April 3 for the collection of garbage. Walter C. Stone, Clk. Bd. of Health.

GOVERNMENT WORK.

Boston, Mass.—The following bids are stated to have been received for constructing a new roof and making alterations in building No. 42 in the Boston Navy Yard; the first bid is for the main machine shop portion and the second bid is for what is known as a crystal palace: L. K. Marston, $25,933, $55,036; W. A. & H. A. Root, total, $82,253; Conners Bros., $32,123, $57,381; William H. Keys, $23,560, $55,856; F. G. Coburn & Co., $21,221, $51,750; Woodbury & Leighton, $22,500, $54,500; Norcross Bros., $20,548, $53,504. Bidders all of Boston.

Georgetown, D. C.—Bids are wanted April 27 for reconstructing pier No. 4 of aqueduct bridge across Potomac River, as advertised in "The Engineering Record."

New York, N. Y.—Bids are wanted April 26 at the U. S. Engineer Office for dredging in Bay Ridge and Red Hook Channels, N. Y. Harbor, as advertised in "The Engineering Record."

New York City, N. Y.—Bids are wanted April 28 for the purchase and removal of 235,000 cu. yds. of broken stone, owned by the United States and stored near Spuyten Duyvil, as advertised in "The Engineering Record."

New York, N. Y.—Bids are wanted April 24 at the U. S. Engineer Office for dredging East Channel, N. Y. Harbor, as advertised in "The Engineering Record."

Duluth, Minn.—Bids are wanted May 1 at the U. S. Engineer Office for riprap embankment at Agate Bay, Minn., as advertised in "The Engineering Record."

Allenhurst, N. J.—It is stated that Benjamin A. Van Brunt has secured a contract for the construction of 1,600 ft. of bulkhead and a 30-ft. wide steel walk along the ocean front. Cost, about $25,000.

Annapolis, Md.—P. J. Carlin & Co., of Brooklyn, have received a $920,000 contract for the construction of a sea wall, power house, armory and boat house at the Annapolis Naval Academy. Ernest Flagg, 15 B'way, N. Y. City, Archt.

Cleveland, O.—Bids are wanted April 26 for dredging in Cleveland Harbor. Col. Jared A. Smith, Corps of Engrs., U. S. A.

Fort Leavenworth, Kan.—Plans are being prepared for a $100,000 hospital; also for artillery barracks, to cost $50,000.

Kansas City, Mo.—The following bids were opened March 28 by the Superv. Archt., Treas. Dept., Washington, D. C., for electric wires and conduit for the U. S. Court House and Post Office: Arthur Frantzen & Co., Chicago, Ill., $6,797; B. R. Electric Co., Kansas City, $6,600; W. T. Osborn, Kansas City, Mo., $5,275; Hodge, Walsh & Lonny, Kansas City, Mo., $8,000, $8,150, $8,350 and $8,500; J. F. Dalton, Savannah, $6,177; J. F. Buchanan & Co., Philadelphia, Pa., $5,888; F. E. Newberry & Co., St. Louis, $5,847; National Electric Supply Co., Washington, D. C., $7,054; Kingsbury, Samuel & Co., Baltimore, $5,979.74.

MISCELLANEOUS.

Springfield, Ill.—Plans have been prepared for subways under the Wabash Railroad tracks at 10th and Cook Sts., and under the Chicago & Alton Railroad tracks at 8th St. and Eastman Ave.

Philadelphia, Pa.—The Common Council has passed the bill appropriating $900,000 for the elevation of the Pennsylvania Railroad tracks on Trenton Ave.

Providence, R. I.—See "Bridges."

Baltimore, Md.—William Skinner & Sons' Shipbuilding and Dry Dock Co. has been incorporated with a capital stock of $300,000. The incorporators are: Henry Williams, president of the Weems Steamboat Co.; Decatur H. Miller, Jr., port captain of the Merchants' and Miners' Transportation Co.; Robert Ramsay and others.

WHILE THE ENGINEERING RECORD maintains a costly organization for the collection and verification of the advance contracting intelligence published each week in its columns, we are always glad to receive from our readers information of projected public and private engineering and building work of which they may have any knowledge or with which they are professionally connected. Such service is of mutual benefit and is always greatly appreciated by us.

When sending information, please be sure to give post-office address of any person mentioned.

New York, N. Y.—Bids are wante April 7 for dredging at the Rutgers se tion on the East River. J. Sergear Cram, Chmn. Commrs. of Docks.

Los Angeles, Cal.—Bids are wante April 10 for a submerged concrete da in the San Gabriel River. San Gabri Electirc Co., 254 South Los Angeles St.

PROPOSALS.

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The Engineering Record.

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TABLE OF LEADING ARTICLES.

The Engineering Record, conducted by Henry C. Meyer, is published every Saturday at 100 William Street, New York. Its opinions on technical subjects are either prepared or revised by specialists.

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THE REVERSAL OF THE DANVILLE WATER-WORKS DECISION.

Several years ago Chief Justice Phillips of the Supreme Court of Illinois rendered a decision in the suit brought by the Danville Water Company against the City of Danville to compel it to pay for hydrant rental on terms mutually determined by the two parties. The full text of that opinion was printed in "The Engineering Record" of November 20, 1897, and has generally been regarded since it was rendered as protecting the interests of investors in the securities of water-works companies operating in that state. This important decision has recently been reversed practically, although not in so many words, by an opinion of the same court written by Mr. Justice Magruder, who also wrote the opinion in the Rogers Park case which is printed elsewhere in this issue. In view of the important effect these two decisions, particularly that in the Danville case, will have on all water-works undertakings in Illinois, it is desirable to review in this place the history of the Danville litigation. The Danville Water Company was organized under the General Incorporation Act of Illinois of 1872. Section 9 of that act provides that: "The General Assembly shall at all times have power to prescribe such regulations and provisions as it may deem advisable, which regulations and provisions shall be binding on any and all corporations formed under the provisions of this act." On November 9, 1882, an ordinance was passed by the City Council of Danville giving the Danville Water Company a right to construct a system of works and contracting for 100 fire hydrants for the term of thirty years at an annual rate of $75 each and for an indefinite additional number of hydrants at lower rates. In June, 1894, it was mutually agreed between the parties to make a considerable reduction in the rental of these additional hydrants.

Meanwhile, on June 6, 1891, the State Legislature passed an act of one section containing the following provision: "That the corporate authorities of any city now or hereafter incorporated under any general or special law of this State in which any individual, company or corporation has been or hereafter may be authorized by such city to supply water to such city and the inhabitants thereof, be and are hereby empowered to prescribe by ordinance maximum rates and charges for the supply of water furnished by such individual, company or corporation to such city and the inhabitants thereof, such rates and charges to be just and reasonable. And in case the corporate authorities of any such city shall fix unjust and unreasonable rates and charges, the same may be reviewed and determined by the circuit court of the county in which such city may be." The city of Danville took advantage of this act by passing on January 17, 1895, an ordinance declaring the rates hitherto charged to be excessive and prescribing lower rates, declared to be reasonable, which were to be put in force May 1, 1895. A certified copy of this ordinance was delivered to the officers of the water company. The company continued to furnish water and on the expiration of the quarter ending on the last day of July presented a bill for hydrant rental at the rate previously paid. The amount was $2,630.62; of this amount, the city offered to pay $1,930, the sum computed from its new schedule of rates. The litigation which has been in progress since then has had for its aim the determination of the legality or want of legality of the ordinance of January 17, 1895.

The previous decision of the Supreme Court held that the old rates were just and the new rates were not binding. The opinion then rendered was that under the provisions of an act passed by the State Legislature on April 9, 1872, giving cities the right to contract with incorporated companies for a supply of water for public use for a period not exceeding thirty years, the City of Danville had ample power to make the agreement which it did. That agreement having been made, it was held illegal to annul or render it invalid by any legislative act.

The recent decision by Judge Magruder holds that this construction of the laws of the State is true to a certain extent. It holds that the two parties made a binding contract for the supply of water by the one to the other. But the new interpretation of the authority "to contract for a supply of water for public use for a period not exceeding thirty years" is that the power does not imply that the price of the supply should be fixed for the entire period. "The supply could be made for the entire term, but the price is to be determined from time to time, and the rates to be settled by the rules of common law." It is held that under section 9 of the General Incorporation Act, previously quoted, the water company is controlled much more closely by legislative acts than is the case of companies incorporated under the acts of some other states. Moreover, this act and the act passed in the same year allowing cities to contract for water supply, "cannot be construed as authorizing the City of Danville to make a contract to pay a fixed rate for a supply of water to the city for a period of thirty years without violating the principle that a legislative body like a common council, whose members are elected only for two years, cannot restrict and curtail the legislative powers of succeeding common councils, and without violating the further principle that the Legislature has the right to regulate and control the rates of charges made by a corporation whose business is impressed with a public use." The effect of this decision is that a contract between a water company and a city in Illinois, under the conditions briefly outlined, binds the water company to furnish the city with a public supply at practically any rate which may be fixed by the city council and upheld by the courts as just and reasonable. The fact that the original franchise of the company prescribes different rates has little or no effect on the powers of the council.

Three of the judges of the Supreme Court dissent from any such interpretation of the law, and express their views in an opinion written by Chief Justice Phillips, who says: "The right is granted * * * to contract for the supply of water for a period of thirty years, and the right to contract for a supply necessarily authorizes the right to fix the rate at which the supply shall be furnished. By the provisions above quoted the State invested the municipality with power to make and contract for a supply of water for a period of thirty years, and it would be difficult to comprehend the meaning of terms authorizing a contract to be made for a supply of water to be furnished without including therein the right to fix the price at which it should be furnished. This power conferred by the Legislature sanctions a particular act and authorizes it to be done. Where a contract is made to accomplish that act thus sanctioned, it must be held valid. The power of the State in regulating, governing and conferring power on municipalities is supreme, but where it confers a power with reference to a contract and that power is once exercised, it is subject like other legislative powers to the authority of the State and Federal Constitutions; and when it invests a corporation which derives its powers from the State with the power to make a contract and that power is exercised, the Legislature is thereafter concluded from annulling or rendering invalid such a contract. Such a contract is only subject to judicial construction and is sacred from interference by the legislative power. Such a contract, made by a municipality under the power conferred by a State Legislature, cannot be impaired, and has thrown around it positive restrictions of the Federal and State Constitutions." If this dissenting opinion of three of the members of the Supreme Court is carefully studied it seems to indicate a possibility of obtaining a reversal of Judge Magruder's decision if the case is carried into the Federal Courts. It is to be hoped that this will be done for the interpretation now placed upon municipal contracts makes it extremely hazardous to engage in any semi-public undertaking in Illinois.

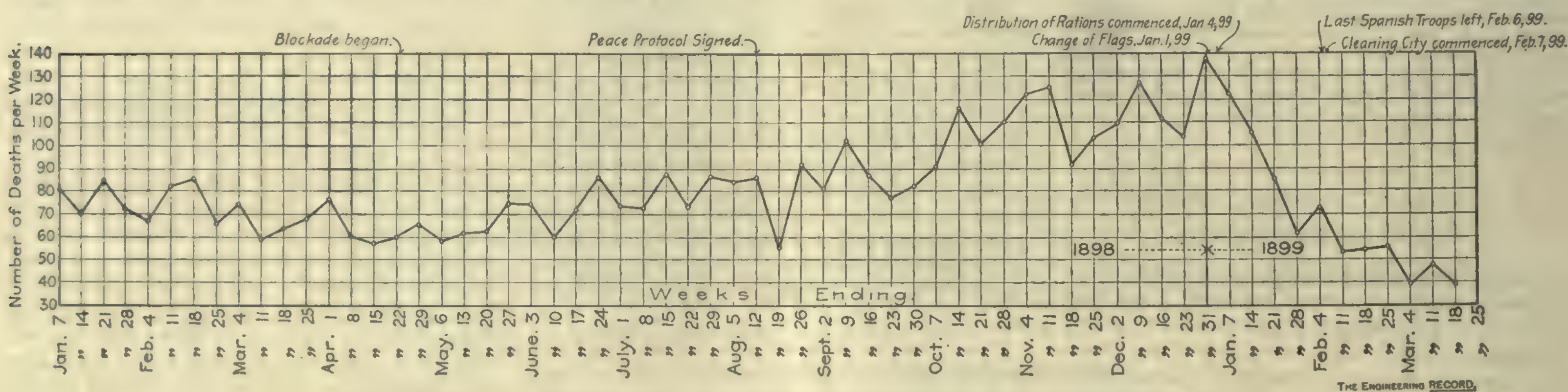
THE TYPHOID FEVER OUTBREAK IN PHILADELPHIA.

The death rate from typhoid fever in Philadelphia is beginning to awaken the people of this city to the knowledge that if they had paid more attention to the warnings of the Bureau of Water and less to the words of veiled scorn with which the reports of that office were discussed in the local press, they would not now be in the grasp of an epidemic as certain to follow Councils' recent proceedings as the sun is to rise. If the people of a community prefer to accept the engineering advice of newspaper editorials to that of men of professional training and experience, they need expect no sympathy when they are reaping the result of their foolishness. If they prefer to have typhoid fever to being in good health, that is largely their own outlook. In the present situation in which the citizens of Philadelphia find themselves they will receive no sympathy from outsiders, and if they wish to vent their disgust at affairs generally on some one they will do well to visit the offices of the local press, which has shown itself more than usually blind to the importance of the situation and rabidly unwilling to learn from the experience of other cities. As for the political features of the situation, for it has been controlled very largely the last two years by politics, that is a matter which it is unnecessary to discuss in this place. If a community is willing to allow itself to be governed solely for the benefit of the men who run the machine, they cannot be prevented from doing so. If

these men wish to cripple the Bureau of Water in order to foster schemes in which they are interested, such a thing as the safety of the public will not deter them a moment.

The present situation in Philadelphia is this: Since the beginning of the year there have been 4,864 cases of typhoid fever and 485 deaths due to it in a population of about 1,200,000. One person in every 2,000 in one of the wards of the city was stricken with the disease last week, and in another ward the figure was one in every 3,000. The trouble is unquestionably due to the impure water supply. Why that supply is defective is pointed out in the address by Professor Marburg, printed in another column. It has been explained regularly for several years in the annual reports of the Bureau of Water, and that explanation has been as regularly ridiculed by the public press, from which most of the citizens imbibe their opinions of public policy. If the men who purvey editorial opinions in that city have any real regard for their subscribers, they will pay attention hereafter to the recommendations they have derided heretofore, and endeavor to obtain proper treatment for the Bureau of Water at the hands of Councils and the Director of Public Works.

Typhoid fever will be a standing menace to Philadelphia so long as it uses unfiltered river water. The cost of filtering water is considerable, and the best method of purification to follow in Philadelphia is not known. It will take a number of months of experimenting by trained sanitary engineers to determine what is the best system, but the expense of such a study will be far less than the cost of works built hastily and found unsatisfactory when put in service. Louisville, Pittsburg, Cincinnati and Albany are instances of cities which have found it advisable to follow this course in the last few years. While these experiments are going on some steps should be taken to locate the sources of the waste of water in the city. The supply is now more than twice what it should be, and if the water is to be purified and the works built for a sum within reason, then the waste must be stopped. The people of Philadelphia believe firmly that the universal introduction of meters will result in water becoming as dear as attar of rose. The press of the city has led them to consider that the experience of all other cities will not be their experience; that there is something so inherently vicious in a meter when it is worked by the diluted filth served to Philadelphians as water, that its indices will scorch around the dials and pile up a registration against the consumer which will reduce the affluent to penury in a short time. All this is, of course, untrue, and tends to delay the introduction of the necessary reduction of waste which must precede the planning of filtration works. But the situation must be confronted, and the method adopted by some of the engineers of Philadelphia to meet it does not appeal to "The Engineering Record" as particularly tactful. The people of the city regard the meter with great aversion, and instead of thrusting one of these instruments down the throat of every consumer, whether he wants it or not, and whether he is careful or not in the use of water, it would be a much better plan to extend the district system with Venturi, Deacon or Kennedy meters, and give warning that all pipes detected in a leaking condition by this means more than twice in three months will have meters put on them. This method of introducing the system will probably prove effective for it means that no meter will be attached to any service unless the people supplied by that service have been warned they are wasting water. It is doubtful if any serious objection will be raised to this system of control, which can be introduced rapidly and carried on systematically without subjecting anybody to a change of present conditions, who has not been twice detected wasting the public supply. The examination may also show that some of the large loss of water in the city is due to defects in street mains, for such things have been known to occur elsewhere. The pith of the matter is that it is the duty of the officials, as far as they are able, to reduce the waste of water, and if the local feeling will not allow meters to be applied to every service, and the works put on a true business basis in that way, their duty is to spread the use of the district meter system and obtain authority to put meters on leaking services in the manner indicated. In this way the first meters will be put where they are of most good, and, unless all precedents fail, the experience of the people who are thus forced to pay for water by measurement will be so satisfactory that the popular prejudice will soon be overcome.



WHAT AMERICAN ADMINISTRATION HAS DONE FOR PUBLIC HEALTH IN CIENFUEGOS, CUBA.

The curve in this diagram shows the number of deaths per week in Cienfuegos since January 1, 1898, exclusive of the deaths of Spanish soldiers. The American troops arrived January 3, 1899, and the fall in the death rate since that date reflects great credit on the chief engineer of the department, Col. D. D. Gaillard, Third Regiment, U. S. Volunteer Engineers.

THE OFFICIAL EXPLANATION OF THE LIQUID AIR PROBLEM.

About five weeks ago that part of the scientific world which reads "McClure's Magazine" was treated to a new theory of physics. It appeared in an article on liquid air and was stated very concisely in the following caption to one of the illustrations: "About three gallons of liquid air, used in the engine shown on the opposite page, will produce ten gallons of liquid air from the liquifier, a surplusage of seven gallons, produced without expense." There was more to the same effect in the article, but no explanation of the manner in which the inventor of the apparatus, Mr. Charles E. Tripler, was thus able to set at naught the law of the conservation of energy and other fundamental principles of physics and engineering. Ever since that remarkable article appeared, much curiosity was evinced as to the startling theory which was thus thrust on an unprepared community. That explanation has at last been given, however, by Mr. Tripler himself; it was presented at a meeting of the younger members of the American Society of Mechanical Engineers at the club house on April 4, and, as taken down by a stenographer, was as follows:

"There was a remark made in a paper that has troubled the scientists, and I have got more letters and more people have talked to me about it from all over the country, than you would readily believe. The remark was that I can make ten gallons out of three gallons. I am talking here before an intelligent audience composed largely of engineers, and I can say that not only can I make three gallons, but I can make five hundred gallons. Three gallons is enough to run an engine. These young gentlemen here this evening have shown you that you can condense this air the same as you can water. It is only a matter of temperature. Liquid air is simply the air in this room with the heat taken out of it. If I can find something that will take the heat out of this room, I have got liquid air. It is not necessary to have ponderous engines to make cold. Nature does not use any ponderous condensing engines, but she makes more cold than we know anything about. This stuff in Nature's laboratory would be solid. All we have got to do is to go twenty miles up in the air, and take that with us, if we could, and that would be solid. I can take that in my laboratory and freeze it solid. I can take the air in this room and condense it and run it down in a stream. Now, if we take our three gallons of air and charge a suitable piece of machinery and use that three gallons over and over again, I see no reason why we should not make ten gallons or a hundred gallons, as long as we use that power for making liquid air. I use steam at present for making liquid air. We take 100 pounds of ammonia in an ice machine and we use the ammonia over and over again, and we make ice, make cold. Now, if we wanted to condense ammonia instead of making ice, you would not think anything if I told you I could condense five hundred gallons or pounds of ammonia, because you know of it, but you do not know anything about this thing; that is the trouble."

After this lucid explanation was finished, the chairman announced that further discussion of the subject and questions were in order, which led Mr. Tripler to round off his previous address as follows:

"I think you better not ask me any questions. I think the three gallons and the seven gallons and the five gallons and the ten gallons, you know—I think that is enough for any one to think of in one night. Much obliged to you." (Applause.)

After a careful study of this new theory, "The Engineering Record" is inclined to doubt if the late Mr. Keely ever produced anything better in the course of his long career. The fundamental principle "you do not know anything about this thing, that is the trouble," is a novelty in technical argument which may satisfy some people; others may see in it the importance to the speaker of an elementary technical education

before he again addresses an audience of people acquainted with the main facts o. thermodynamics.

THE SOULANGES CANAL.

This noted Canadian canal connects Lakes St. Louis and St. Francis and will surmount the Cascades, Split Rock, Cedars and Coteau Rapids in the St. Lawrence River. It was between these lakes that the earliest attempts were made to improve the navigation of the river by the construction of small canals on the north shore at the heaviest pitches of the stream. These were built by the Royal Engineers. The first series, built as far back as 1779, were only capable of passing batteaux or canoes drawing about 30 inches. The locks were enlarged from time to time, so that in 1817 there were canals at the Cascades, Split Rock and Coteau Rapids, with locks 120x12 feet, and deep enough to pass boats drawing 4 feet of water. These canals remained the chief aids to navigation until the completion of the Beauharnois Canal in 1845, which is situated on the south side of the river and is still in use. The locks are 200x45 feet, with 9 feet on the mitre sills.

The Soulanges Canal is on the north shore. It is 14 miles long from Coteau Landing, at the foot of Lake St. Francis, to the Vaudreuil branch of the Ottawa River at Cascades Point, a short distance from its junction with the St. Lawrence. The canal has only two curves in its entire length, each of very large radius, so that for all practical purposes of navigation it is a straight line. It will pass vessels of over 2,000 tons burden on a draught of 14 feet. There are four locks, with an aggregate lift of 82½ feet, which is 45 per cent. of the total rise between Montreal and Lake Ontario. Three of these, each having a lift of 23 1/3 feet, are located within the first mile from the lower end of the canal, and climb the bluff forming the right bank of the Vaudreuil branch above referred to. The fourth is situated about three miles from the lower entrance, and has a lift varying from 12½ to 14½ feet, according to the level of Lake St. Francis. About 1,000 feet above the fourth lock a pair of guard gates are built to insure the safety of the lower locks. The summit level is 10½ miles long, and reaches from Lock 4 to the upper entrance at Coteau Landing, where a guard lock is built which will only be used as a lift during periods of high water in Lake St. Francis.

The locks are built chiefly of concrete, faced with cut stone. The use of timber in the floor has been abolished. They are 270x45 feet in the chamber, with a total length of about 350 feet. The side walls are 20 to 25 feet thick at the base, and in these there are tunnels for filling or emptying, the water passing from the tunnels to the chamber through 30-inch cast-iron pipes, ten on each side. Each lock will be filled in five or six minutes.

The water necessary for the supply of the canal and the generation of electrical power is passed into the upper entrance from Lake St. Francis through a weir having four 10x9-foot openings, provided with gates on the Stoney principle. This weir discharges into a raceway of large dimensions, which is carried along the south side of the guard lock for about 650 feet, where it joins the main canal.

About five miles from the upper entrance, or halfway down the summit reach, a weir of large dimensions has been constructed in the south bank, through which this level will be regulated or entirely emptied if so desired. At this point a power house is being built, the water for this purpose being drawn from the canal and discharged into the River a la Graisse, a short distance from its junction with the St. Lawrence. The head is from 18 to 20 feet. The water is passed through wheels of the latest type and coupled directly to the generators. It is proposed to place 2,000 candle-power arc lamps about 500 feet apart on the north side of the canal throughout its entire length. The locks, bridges, etc., will also be efficiently lighted so that the canal can be safely and expeditiously navigated by night. All the structures will be operated by electrical power.

To the south of the guard gates above Lock 4 the supply will be passed by two Stoney sluices, each 20x22 feet in size. Behind Locks 4, 3, 2 and 1 this will be effected by double culverts constructed in the dividing embankments between the various reaches, furnished with sluices by which the volume passing down can be regulated automatically if so desired. All these gates are submerged and no water is passed over breast walls as in the other canals.

The canal is 100 feet wide at the bottom, with side slopes of 2 to 1. There will be about 7,000,000 cubic yards of excavation, varying in character from quicksand to solid rock, of which latter there are 300,000 cubic yards. A great deal of trouble occurred from slides in the soft blue clay of the drift formation, which in some places is of great depth and saturated with water.

The sides of the canal are protected from the wash of vessels, etc., by a riprap lining, having a surface width of 18 feet measured on the face of the slope. The base of this is 3 feet thick, tapering to about 1 foot at the top. It lies in a notch cut out of the earthwork to receive it. The space between the top of this protection lining and the edge of the prism is carefully sodded throughout.

There are seven highway bridges and one railway bridge across the canal. The latter carries the Canada Atlantic Railway over the lower wings of the guard lock at Coteau Landing. Two of the highway bridges cross at locks, while the other five traverse the canal at its full width. The pivot pier of these, instead of being placed as usual in the center of the canal, is put on the south side with its face in line with the toe of the slope. The face of the north abutment is in line with the north slope, so that the clear water opening of the bridge is equal to the bottom width of the canal. These structures are almost wholly of concrete.

There are three streams which cross the line of the canal. The largest of these is the River Delisle, which is met with about 2 miles from the upper entrance. This drains an area of about 180 square miles, and its flow during spring freshets is over 200,000 cubic feet per minute. It is carried under the canal in four lines of cast-iron pipe 300 feet long and 10 feet in diameter, laid in a trench excavated in the solid rock and filled with concrete. There is a clearance of about 2 feet between the top of the pipes and the bottom of the prism. The ends of the culverts are provided with wells of cut stone masonry of large dimensions. About a mile further down the stream is the crossing of the River Rouge. The discharge of this stream is almost half that of the Delisle, and it is passed under the canal in two lines of 10-foot tubes, embedded in concrete on a foundation of boulder clay. The third crossing is that of the River a la Graisse, which is of small dimensions and is carried under the canal in a single line of 10-foot pipes resting on a pile foundation. It is this stream that serves the purpose of a tail race at the power house previously alluded to.

The Soulange Canal is divided into 13 sections, all of which were under contract in May, 1893. The work has been delayed from various causes, but it is now rapidly approaching completion and will be opened for navigation during the season of 1899. When it is brought into use the Beauharnois Canal will be almost entirely available for the development of additional water power.

The total cost of the canal will be about $5,250,000. The chief engineer is Mr. Thomas Monro, M. Inst. C. E., Past-President Can. Soc. C. E. The bridges were designed by Mr. George H. Duggan, M. Can. Soc. C. E., chief engineer of the Dominion Bridge Company, who also worked out the details of the Stoney sluices and operating gear for the locks, weirs, etc. The hydraulic development for electric power was intrusted to Mr. A. H. Rice of Canton, Ohio, and the electrical appliances were designed by the Royal Electric Company of Montreal. The drawings of the lock gates were made by Mr. J. B. Spence, M. Can. Soc. C. E.

NOTES ON MUNICIPAL WORKS.

About two years ago Mr. A. D. Thompson, city engineer of Peoria, Ill., reported that the sudden and extreme changes in temperature common in that locality were found to present a serious obstacle to the construction of a durable asphalt pavement. A mixture which best suited the demands of traffic became defaced with numerous irregular cracks after two or three winters, while a mixture sufficiently elastic to resist rupture from contraction became uneven during warm weather from the expansion which then took place. In the report for 1898 of the same engineer. there is some further information concerning the subject, which will be of general interest. This report covers the experience during a period of unusually cold weather, which is held to demonstrate beyond question the necessity of some provision for allowing for this expansion and contraction. On one street in the city there is a continuous sheet of asphalt pavement 6,600 feet long where no provision is made for these changes in length. It is assumed that the asphalt mixture has the same coefficient of expansion as steel, about 0.000006389. Assuming the asphalt has a temperature of about 100 degrees Fahrenheit when compacted, and that the extreme cold of winter is 22 degrees below zero, there is a variation in temperature of 122 degrees. Under these conditions it is estimated that the pavement in question would contract more than 5 feet if allowed to move freely. Mr. Thompson states that a small portion of this contractive force is exerted in overcoming the friction of the asphalt on the concrete, but the greatest part is exerted in a tendency to rupture the pavement and the mixture must have an enormous cohesive strength to prevent cracking. Experiments made on another street with expansion cracks constructed intentionally every 50 feet were not entirely successful. The cracks opened from an eighth to a half of an inch at the crown of the street and narrowed to a fine line at the curbing, thus indicating a greater strain at the center. "The variation in the width of these cracks, as noticed with changes of temperature, would indicate that they have partially fulfilled their object, while the fineness of the lines of the ruptures would show that the cracking would have been much worse without these reliefs. The results encourage a continuation of the experiment."

The cost of laying service pipes in Bay City, Mich., is paid entirely by the consumers, and, on account of the location of the mains at one side of the street, half the abutting property can be connected at a lower cost than the other. This subject has been referred to in the report for 1898 of Mr. E. L. Dunbar, superintendent of the works, as follows: "Under the ordinance now in force, consumers are required to pay all the expenses of connecting their service pipes with the main without reference to its location. As nearly all of the main pipes are on one side of the street, this renders it much more expensive for the property one side of the street to secure a supply of water than on the other. This is certainly an injustice, and there appears to be but one way to overcome it. The city should put in all services to the property line, charging a uniform price, sufficient to cover the cost from the center of the street. While this would increase the work of tne department somewhat, and render it necessary for the city to carry a stock of lead pipe, stop-cocks and stop-cock boxes, the actual expense would be borne by the consumer, and the result would

be more uniformity in the location of the stop boxes, and as the work would not be open to competitive bids, but would be done by direct employees of the city, it would be our own fault if the workmanship and material were not of the best possible to procure."

The value of good machinery is shown by the experience of Rockford, Ill., with a new stone crushing plant built during 1898. The crusher itself is of the Gates type, with a hopper 8 feet in diameter. The stone is caught in an elevator, which lifts it to a screen. Here it is separated into three sizes, if necessary, and then run through shutes into bins, from which it is discharged as wanted into the wagons. The drilling at the quarry has also been done during the past year by Ingersoll-Sergeant steam drills in place of the hand work done before, which cost about 25 cents per foot of hole, exclusive of repairs. During the year over 15,000 feet of holes are driven, so the reduction of the cost to 4 cents a foot, including repairs, which the power drills effected, amounts to a considerable sum. The amount of stone crushed by the new plant was 17,880 yards, and the cost of the work averaged 29 cents. Heretofore the lowest estimate for crushing was 65 cents a yard. Mr. Edwin Main, city engineer, estimates that the saving which has followed the installation of the improved machinery not only paid for the entire plant during the year, but also left the city more than $650 better off than it would have been under the old system.

A description of one of the sewage treatment plants at Hamilton, Ont., was printed in these columns on April 10, 1897. These works have been in operation so successfully since they were opened, about the time the article was printed, that a second plant was built on practically the same lines about a year later. In the annual report of Mr. E. G. Barrow, city engineer, for 1898, there are some interesting figures concerning the details of the management of the older plant during that year. The total quantity of sewage received was 343,342,000 imperial gallons. The amount of crude sludge was 26,100 tons, from which 580 tons of sludge cake was produced, although, as will be mentioned later, all of it was not pressed. The precipitation was effected by 128,460 pounds of lime and 36,340 pounds of alum, and 1,000 pounds of chloride of lime were used about the works. The sludge has been readily taken by farmers, market gardeners and fruit growers, and is growing so much in favor that several offers of a dollar a ton have been made, provided the contract would be given for several years. Some of the gardeners took away the raw sludge, which had not been pressed, but the amount was small, and only for use in adjacent localities.

The number of services in Ware, Mass., according to the annual report of the superintendent of the water-works, Mr. Thomas C. Gleason, is 692, of which all but one are metered. All the water for the town is pumped, and the quantity, as shown by the pump counters, was 92,000,000 gallons during the past year. The amount registered by the meters was but 45,280,000 gallons, leaving more than half the nominal supply unaccounted for. The total amount of private and public pipe in the works is a trifle over 12 miles. These figures are interesting when compared with somewhat similar returns for Fall River, Mass., which were printed in the issue of March 4.

A pump duty of over 163,000,000 foot-pounds per million heat units has probably been developed by the vertical quadruple-expansion flywheel pumping engine recently erected by the Nordberg Manufacturing Company, Milwaukee, Wis., for the Pennsylvania Water Company, of Pittsburg, Pa., of which Mr. James H. Harlow, M. Am. Soc. C. E., is engineer and president. The test was conducted by Prof. R. C. Carpenter, who has not yet finished the final calculations, but expects the result will be as stated. The pump has a capacity of 6,000,000 gallons, but as it works against a head of over 600 feet the steam end is much larger than usual.

Water rates in Wilmington, Del., will not be reduced by State legislation, if the Governor can prevent it. He has announced that he will not approve a bill making a 40 per cent. reduction, and gives the following reasons for his action: "The people of Wilmington are blessed with one of the finest water systems, and even the advocates of this bill admitted that the system was practically unsurpassed, and that it was well managed. Had the situation been otherwise, I might have given more favorable consideration, but, being thus, there was no course open but to disapprove the bill. The principle of coming to a Legislature for a compulsory reduction of the taxes by which the city's water system is so well maintained, is very wrong. The people of Wilmington are satisfied with their water system in itself, and are only divided as to its cost. That, therefore, is purely a local issue, and certainly can be decided by the people themselves, who have full redress in the election of their mayor and council."

The water-works of St. Paul are fortunate enough to be provided with means for measuring the entire supply of the city, and on this account it is possible to study the distribution of the water with a fair degree of accuracy. The amounts furnished from two stations are measured by two Venturi meters, and that from a third is estimated by plunger displacement checked by weir gaugings. For several years City Engineer L. W. Rundlett and Secretary John Caulfield have been working together to determine where all the water goes, and the last annual report of the water commissioners contains some interesting figures on the subject. These gentlemen have made an effort to ascertain the actual amount of water per service and per capita used in the residence districts, and to obtain an idea of the general use and waste of water throughout the city from these figures and the records of the supply to each of the districts into which the distribution system is divided. To obtain these results a record of 1,585 metered services in different sections of the residence district was tabulated and a census taken of the number of inhabitants to each tap. It was found that the consumption varied according to the section in which the houses were situated, a fact that had been noticed previously in less extensive measurements.

It was found that on these 1,585 services there were 5,884 people. The average daily consumption per service was 140 gallons, or about 28.22 gallons per capita. In the entire district in which the measurements were made there were 8,626 services, and the average amount of water delivered daily was 462½ gallons per service. Assuming that the consumption for each domestic service is the same figure, 140 gallons daily, as found from the meter measurements, it follows that more than half the total supply to this district must be wasted, for the use of water for public purposes in this territory is apparently not far from 46 gallons when estimated on the number of services. The supply to both high and low-service districts was furnished through 13,971 service pipes, and averaged 572.6 gallons per service. Of this amount 54 gallons is estimated to be used for public purposes. In discussing these figures Mr. Rundlett states that they are presented as approximations only, although they agree closely with others obtained by an entirely different method in 1894. "It is hard to estimate," he states, "how large a proportion of this waste is due to leakage in the distribution mains and how much in the service pipes, but the detailed tables of the metered services show a considerable number of leaks increasing the consumption from four to thirty-five times the normal. These are, of course, repaired as soon as made apparent by the increase in the amount of the water bill, but in unmetered services they are left to run unless discovered by the inspector or they increase to such an extent as to become a nuisance. * * * The results of the above tabulation seem to show conclusively that a large amount of waste still exists, that meters are the best check on waste, and that the proper and most equitable method of making water rates is by meter measurement, where the consumer pays for what he actually uses, and is made responsible for the condition of his service pipes and plumbing."

The construction of private streets of impracticable grades and improper location has caused so much inconvenience in Haverhill, Mass., that the city council recently passed an ordinance which will discourage building such poor streets. According to the report of the city engineer, Mr. Robert E. Evans, no petition for the acceptance of a private street will hereafter be considered unless the grade is under 12 per cent. and a plan and profile of the road has been signed by the city engineer and filed among his records. The street must be brought to the line and grade shown on the drawings before an application is presented to the city council. "Although this ordinance," his report runs, "does not prevent land owners from opening up streets in such locations as to benefit their own land solely, without regard to public convenience, and oftentimes of unnecessarily steep grades, still it is hoped that the extra inducements which land owners who have availed themselves of the provisions of this ordinance can offer to prospective customers, and the protection to lot owners from heavy cuts and fills when the street is accepted by the city, will cause projectors of new streets to submit plans for the same for approval, and will tend to discourage the opening up of new streets, which are undesirable for lot owners and expensive of maintenance when they become public streets."

In the annual report of the commissioners of the Attleboro, Mass., water-works, of which Mr. L. Z. Carpenter is superintendent, there are two sections which are of more than local interest. The first relates to the complaints made during the warm months concerning rust in the water. Some of these came from localities where there was a constant flow in the street mains, and the trouble could not be due to accumulations of foul material in dead ends. After some unsatisfactory study of the problem by the local authorities, the assistance of the State Board of Health was requested. The Board made examinations of the water, and found it to be a soft, clear, nearly colorless, practically odorless supply, containing little organic matter and of excellent quality for domestic purposes, except for the iron. Since there was but an insignificant amount of this iron in the water, as it came from the well, it was evidently taken up in the distribution mains. "Further examination of the water of the well has shown that it contains carbonic acid gas in large quantities and a considerable quantity of dissolved oxygen. Our investigation of this and other water supplies," the Board of Health reported, "and experiments conducted in the laboratory have shown that some waters in which these substances are present will attack the metal of pipes, through which the water is conveyed, and it is probable that the corrosive action of the Attleboro water on the pipes through which it is conveyed is caused by the presence of one or both of these substances. Various means of preventing the water from attacking the pipes have been tried, one of which was to remove the carbonic acid gas by aeration, but the quantity of oxygen that remained in the water was such as to cause the water to attack the pipes. The effect of adding lime to the water has also been tried, but our experiments have not been car-

ried far enough to determine definitely what results can be obtained in this way." The studies were still being carried on at the date of the report, and the Board advised the local authorities to drive tube wells around their large well and endeavor in this way to trace the carbonic acid gas to its source.

A second interesting feature of this report is the account of a method of piping a stand-pipe. "During the summer a check valve was placed on the connection to the stand-pipe in a by-pass so that in case of fire the gate in the pipe which supplied the tank can be closed at once while the pressure from the tank is maintained through the by-pass. As soon as the pumps at the pumping station are started, however, the check valve closes automatically and the pressure runs up to such a height as may be desirous. In case of a break in the pump, so that the pressure begins to fail, the check valve again opens from the tank pressure and the supply at the tank is in use again. This has proved to be an excellent safeguard, besides saving time in closing the gate and putting direct pressure on the pipes, as it was impossible heretofore to close the gate to the tank without first telephoning or receiving a signal from the engineer at the pumping station, as in case the pumps were not running there would have been no pressure."

ATCHAFALAYA RIVER BRIDGE PIERS.

The Atchafalaya River in Louisiana is a swiftly-flowing stream, traversing an alluvial country. It is subject to fluctuations of level reaching 37 feet, and has reached a flood volume of 500,000 cubic feet per second. The line of the Texas & Pacific Railway Company crosses this stream near West Melville, La., by a five-span bridge about 1,300 feet long. The bridge substructure consists of concrete-filled cylindrical iron piers. Two of these piers had been broken off by the sliding of the inclined strata forming the river bottom, and in 1894 a contract was let for replacing the broken cylinders, building a new pier and erecting a new 250-foot span. In the execution of the enterprise some interesting caisson work was done by Mr. C. H. Chamberlin, and he contributed a description of it to the Louisiana Engineering Society. From the publication of this paper in the "Journal" of the Association of Engineering Societies, the following abstract has been made:

Test borings were made close to the pier sites, and showed that from the surface of the ground to minus 30 feet was ordinary river deposit, with quantities of brush and logs; from minus 30 to minus 60 was a blue mud or clay, soft near the top but very firm farther down; from minus 60 to minus 100 was pure sand, fine near the top but getting coarser as it was penetrated, and having in it occasional pebbles. These borings were verified while the pier work was in progress. All the sliding of the bank at this point had taken place in the deposit above the stratum of clay. This was proved by the fact that in sinking Pier II, as soon as the ordinary deposit was passed through and the mud stratum entered, the lower sections of the original piers put down in 1882 were encountered, and had to be broken up and brought out through the air locks. They had moved but little if any after they were first crushed. A machinery barge was used for the work, equipped with boilers, air compressors, pumps and an electric-light plant. Old rails were furnished to add weight to the cylinders in sinking. These, when used, were stood on end on the inside of the inner cylinder, just above the air lock; and some also were cross-piled on a frame resting on top of the cylinder.

Each pier consists of a pair of 8-foot steel cylinders filled with concrete and braced together at the top by a stiffened web plate or diaphragm about 20 feet high, as shown in Figure 3. Each cylinder has a concentric 5-foot inner cylinder, as shown in Figures 1 and 2, with a conical section uniting it to the cutting edge and closing the lower end of the annular space. There are four stiff webs riveted to both cylinders to connect them and keep them concentric. The inside cylinders extend above the bottom of the river, but terminate about 22½ feet below the top of the outer cylinders. These have a total length of over 135 feet, and are made with 5-foot rings erected in 10-foot sections, which were successively riveted on the tops of the cylinders with single lap splice plates, as indicated in Figure 3. The working chambers were 25 feet high, roofed by a 2-foot oak diaphragm made of four thicknesses of timber with a 2-foot circular hole closed by a heavy cast-iron door. Eight feet above this deck a similar diaphragm formed the roof of the air lock. Besides the small pipes for regulating the lock pressure the diaphragms were pierced by a 3-inch air supply pipe and two 4-inch pipes for water supply and discharge from the sand pump. Access to the working chamber was by a ladder, although an elevator was provided to work above the air lock. The lower part of one of the cylinders is shown in Figure 1, with the annular space filled with concrete, which was deposited to promote sinking as fast as the sections were added. In this figure all but one of the large pipes are omitted to avoid confusion, and in the corresponding section, Figure 2, the pipes shown in Figure 1 are omitted, only the jet pipes being shown. In this figure the working chamber is shown sealed and the concrete filling begun above the lower diaphragm. Figure 3 is a view of a complete pier with the front of one of the outer cylinders removed. This drawing shows the pipes for water and sand, and together with Figures 1 and 2 gives all the pipes used in a cylinder, none that appears in one figure being repeated in any other. The details of the sand pump are shown in Figure 4.

Four feet above the cutting edge there was made a horizontal row of holes through the outer shell around the cylinder, and 35 feet higher was a similar row. All these holes were for hydraulic jets to decrease skin friction and diminish resistance to sinking. All, or only a part, of these jets could be worked at once, as judgment might dictate, except that in this case there was only pump power sufficient to work one full set at a time. Separate pipes with suitable valves led to each quadrant of a set, so that any part could be operated independently of the other. The position of the cutting edge and of the working top of the cylinder was accurately determined every morning or as often as was necessary; and if it was intended to move the cylinder in any horizontal direction the jets on that side would be operated the longer time. It would also often be necessary during a settle to assist the jets and force the top out of position by wedging against a framework built around the cylinder above ground. In this way the cylinder would be temporarily inclined out of its vertical position to be straightened up during some subsequent settle. Of course, as the piers went deeper into the ground they were the more difficult to control, and as the cutting edge was expected to stop at last somewhat out of position, the greater care during the final settle was given to getting the tops in their true

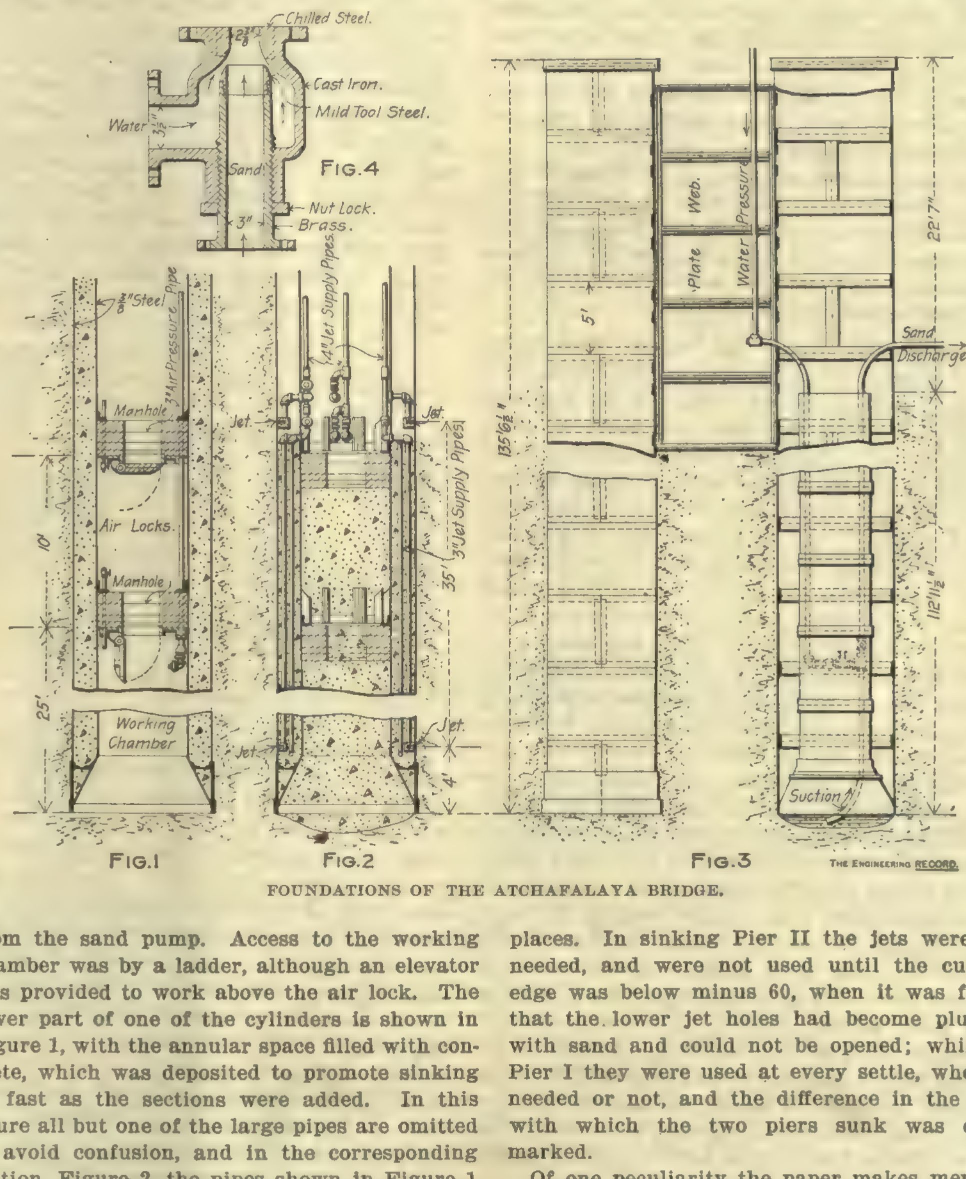


FIG.1 FIG.2 FIG.3

FOUNDATIONS OF THE ATCHAFALAYA BRIDGE.

places. In sinking Pier II the jets were not needed, and were not used until the cutting edge was below minus 60, when it was found that the lower jet holes had become plugged with sand and could not be opened; while at Pier I they were used at every settle, whether needed or not, and the difference in the ease with which the two piers sunk was quite marked.

Of one peculiarity the paper makes mention as follows: "The air pressure required to keep the water from rising in the working chamber was always equal to or slightly in excess of the weight of the river water displaced, when the cylinders were well on their way down. This goes without saying at Pier II, which was located in the river water; but around Pier I there was always a hole of water varying from 2 to 6 feet in depth, the surface of which was from 9 to 15 feet above the river, while the work was progressing, and yet the stage of the river governed the air pressure."

In making a settle the material would ordinarily be pumped out of the working chamber nearly to the cutting edge. Then the pressure gang, consisting of three men, would come outside. The jets would be operated two minutes and then when the air was suddenly reduced to two-thirds or one-half of the working pressure the cylinder would sink. The working cham-

ber would be found partly filled with the material encountered, which would be pumped out and sinking resumed. After the cylinder had been stationary for 24 hours or more, the first settle would be only a few inches, but subsequent ones, made without delays for concreting, etc., would amount to 2 or 3 feet each. Sometimes the operation of the jets alone, without reducing the air pressure in the working chamber, would sink the cylinder several inches. The amount of material excavated was probably three or four times greater than the actual displacement of the cylinder. This was due to drawing material down from the out-
due to drawing mateiial down from the outside.

When the cylinder reached its final resting place the pump pipes and the jet pipes above the locks were removed and the operation of sealing begun. Concrete was taken through the air locks in sacks into the working chamber, and was handled and tamped there by the pressure men. In this way all of the space was filled, except just where the lock door swung, and this space was filled with grout after the door was closed. From the lower door to the top of the shaft there was nothing to interfere with rapid concreting, and the work was continuous till finished.

This work was executed by the Missouri Valley Bridge and Iron Works, of Leavenworth, Kan., Mr. A. J. Tullock, M. Am. Soc. C. E., proprietor. Mr. Alfred Noble, M. Am. Soc. C. E., of Chicago, was consulting engineer, and Mr. M. A. Waldo was resident engineer.

RECONSTRUCTION OF THE PENROSE FERRY BRIDGE, PHILADELPHIA.

The Penrose Ferry bridge is a highway structure across the Schuylkill River about a mile above its junction with the Delaware. The original wooden bridge was purchased by the city in 1862. As rebuilt in 1877, it consisted of a 411-foot iron draw span and approaches 18 feet wide and 569 feet in total length between the earth embankments. There were stone piers for the draw span and the shore ends of two 55-foot Howe truss spans adjacent to it, one at each end, and the remainder of the approach was a timber trestle with bents about 18 feet apart, and resting on small surface footings. The annual appropriation of scarcely one per cent. of its valuation was inadequate for its maintenance, and it finally became so dilapidated that it was pronounced unsafe and plans were made for renewing the entire structure except the draw span. The alignment of the approaches was changed slightly through the center of the pivot pier, their grade diminished, and their total length reduced to 518.25 feet. The superstructure was to consist of plate girder viaduct spans of alternate lengths of about 27.5 and 55 feet, supported on steel towers, except for the four masonry piers under the ends of the spans adjacent to the draw. The masonry piers and the small stone piers under the viaduct towers were founded on concrete footings supported on piles. The width of the viaduct roadway was increased to 26 feet and an 8-foot sidewalk was cantilevered out on each side. As the appropriation made was not sufficient to execute the whole of the work, only a part of it has as yet been accomplished. A thorough investigation and survey of the old structure has been made, new designs prepared, the substructure rebuilt and a temporary wooden viaduct erected to serve until one of steel can be built.

It was found that the masonry pivot and fender piers rested on stone-filled cribs sunk 30 feet below water level to a gravel bottom. The two main piers each side of the river were of coursed rock-faced ashlar with rubble backing laid in lime mortar and carried on timber platforms resting on piles. The wooden trestle bents in the approaches were supported on small rubble masonry piers carried on timber platforms resting in the mud.

The timber was rotten and the trestle piers were undermined. In the large piers the pile foundations were good, and much of the masonry bad. The gravel stratum is close to the surface at one end of the bridge, about 30 feet below water level at the middle, and could not be reached by a 75-foot boring at the other end. Above the gravel is a deposit of river mud, fine silt and sand, which was stiff enough to be removed in cubical chunks by spades. The proposed viaduct was estimated to weigh 3,000 pounds per lineal foot, and to carry 100 pounds live load per square foot of floor surface. On account of the limited appropriation it was decided to build the new piers and towers on pile foundations, using the old piles where they satisfactorily endured the pile-driver-hammer test. The old piles were from 10 to 12 inches in diameter, and carried from 5½ to 11 tons of dead load each. In order to determine the proper loads for the old and new piles, test piles nominally 14 inches in diameter at the butt and 9 inches at the point were driven from 30 to 48 feet into the ground, and then platforms were built on top of them, and each loaded with from 17 to 25 tons of pig iron. The piles were of yellow pine, most of them barked and sharpened to a point 4 inches square. The butt end of each was hooped with an iron ring and they were driven with a hammer weighing 1,930 pounds. The surface of the ground was about 8 inches above mean high tide and the piles were driven in the line of the north approach in September and October, 1897. The test record is as follows:

Diameter. Inches.		Total Penetration.		Fall of Hammer.	Average Penetration for each of last few blows.	Number of Blows Averaged.	Loads.	Settlement.		Calculated Working Load.	
Butt.	Point.	Feet.	Inches.	Feet.	Inches.		Tons.	Inches.	Days.	Tons.	Mark.
14	8.5	45	6	16	5.25	4	....	....	......	[illegible]	B
13.5	10.5	33	8	21.3	4	5	....	....	......	8.2	C
14	8	40	3.75	25	5 05	5	....	....	......	8.1	D
15.5	8 5	36	0	22.5	6.9	9	15 4 16 7	1/16 5/32	1 6	6	E
15.5	10	36	3	22.5	5.18	4	11 20 25 25	1/16 5/32 1/4 9/16	5	7.1	F
15	13 75	36	6	25	7.7	[illegible]	10 15.5 17 17	3/32 5/32 7/32 1/4	6	5.6	G

Pile B was driven between high and low water.
Pile E was not pointed.
Pile F was not pointed or barked.
Pile B was driven with a 3,500-pound hammer.

In 1872 Mr. Chas. E. Davis, Superintendent of the Girard Point Storage Company, made similar tests in the same kind of ground half a mile away. Thirty-two piles were driven by a 2,100-pound hammer falling 10 feet and gave results approximately alike. One pile was 55 feet long, 12 inches in diameter at the butt and 5½ inches at the point. It penetrated 14 feet under its own weight and that of the hammer, 10 feet farther under the first blow, 6 feet the second, 5 feet the third, 4½ feet the fourth, 2½ feet the fifth, 1 foot each on the sixth and seventh, 7 inches the eighth, 4 inches each the ninth to the fifteenth, inclusive, and 3 inches each on the sixteenth to the twentieth, inclusive, making a total of 48 feet 2 inches. Platforms were built and loaded on single piles and clusters of piles. One pile loaded with 6½ tons settled 1.5 inches in 24 hours. Two piles capped and together loaded 16 tons settled 1.25 inches in 25 hours. Four piles capped and loaded with 35 tons settled 1 inch in 24 hours. Eight piles capped and loaded with 100 tons settled 0.5 in 24 hours. Sixteen piles driven 30 inches apart, capped and loaded with 208 tons did not settle at all in six days. The character of the soil penetrated by these piles was shown to be uniform by a number of test wells. The strata encountered in one well were as follows: Water at half tide, 12 feet; alluvial deposit, 15 feet; soft mud, 7 feet; hard mud, 16 feet; coarse sand, 5 feet; hard gravel and small pebbles, 10 feet; 2-inch stones and gravel, 8 feet.

From the results of these tests it was decided to allow loads of 6 tons each for friction piles and 9 tons each for bearing piles, amounts which correspond closely with those obtained by the Wellington formula used in the calculations, viz., $P = 2\ wh \div (s + 1)$, where P is the safe load in pounds, w is the weight of the hammer in pounds, s is the penetration in inches under the last blow, and h is the fall of hammer in feet.

The work was let to one bidder under three contracts, for the substructure and embankments of the north and south approaches, and for the wooden superstructures.

The masonry consisted of two abutments or retaining walls at the ends of the earth embankments, and of 20 large and small piers. The essential features of their construction are shown in Figures 1, 2 and 3, which are typical of all. Figure 1 is one of the end piers of the draw span; the other two tall piers under the opposite ends of the adjacent approach spans are similar in construction. All the stones are laid alternate headers and stretchers, the headers extending through from face to face where the thickness of the pier is 6 feet or less. All of the face stones up to the corbel are of regular coursed ashlar, the first three courses rock-faced and the upper ones rough-pointed. The cap stones and corbel course are of fine-pointed granite with a pean-hammered upper surface. Both courses are dowelled with 1-inch galvanized iron pins leaded in the lower stone and projecting 2½ inches into each course. The bridge seats are tied together with two iron clamps to each joint. The concrete foundations were built inside of 4-inch tongued and grooved yellow pine sheathing driven 5 feet below the bottom of the footing and left in place after the completion of the work. Two pairs of tower piers most exposed to floods were connected by a timber frame work, as shown in Figure 2, constructed to prevent injury by floating logs, ice, etc., to the steel brace, which will connect transversely the feet of the tower columns. The other small piers were each separate and were substantially like one of the pair in Figure 2. Two 1½-inch upset anchor bolts 8 feet 9 inches long were built into each pier and took bearing on 8 x 14 x 1-inch plates with cast-iron washers. The north abutment consisted of a concrete platform 16 feet 9 inches wide by 48 feet 6 inches long, with front and side masonry walls, as shown in Figure 3. The rear extension of the platform and the spur piles in front were designed to prevent possible lateral displacement from the horizontal thrust of the embankment by frictional resistance and oblique bracing, respectively. The south abutment was much lower and lighter than the north one, and consisted merely of a straight retaining wall, as shown in Figure 4. In this abutment and some of the tower piers on the same side of the river the foundations were carried down to the gravel stratum without the use of piles or timber, and without the expanded metal binder sheet, which was a special feature elsewhere in the concrete. The old piles in the main piers, 9, 10, 11 and 12, were tested and allowed to remain; those in piers 10 and 11 being reinforced by additional new ones driven around three sides of the original base, so as to extend the footing, as shown in Figure 1. Eight of the tower piers were built wholly of concrete, and eight were built of rough pointed

ashlar on concrete footings; the remainder were built as already described.

The expanded metal in the foundation is of the size known as 6-inch mesh, No. 4 gauge steel, annealed after expansion. The metal was bright and free from paint, grease or rust when set. The sheets were as large as practicable and each overlapped the adjoining one by at least one full mesh, and was fastened to it with No. 14 steel wire. The metal was also fastened to the tops of piles by steel staples one-quarter inch in diameter and 6 inches long. At 5 inches inside the face of the foundation the metal binder was bent up vertically 9 inches. The concrete was thoroughly tamped around the piles and the binder, care being taken that the latter was nowhere exposed. Pointing was done with mortar made of two parts slow-setting Portland cement and three parts sand, all other mortar was made of one part Portland cement to three of sand or one part of natural cement to two of sand. Grout was made of one part Portland cement and two parts sand for dry foundations, and two parts Portland cement and three parts sand for wet foundations. When natural cement was used for grout, these proportions were reduced to two to three and one to one respectively. Concrete was made of one part Portland cement, three parts clean coarse sand or gravel not over ¼ inch in diameter, and six parts of hard two-inch broken stone. The sand and cement were mixed dry, wet to mortar and spread on top of a 6-inch layer of wet stone and the whole mass turned over repeatedly by hand. The piles were driven with a 2,000-pound hammer falling 15 feet and were cut off at 45 feet penetration unless they had come to refusal sooner. The contractor selected his own methods of executing the work, and experienced little difficulty with it except at piers 10 and 11, which are the largest ones and support the ends of the draw-span. Pier 10 was built in a cofferdam made of a single thickness of yellow pine 6x10-inch sheet piles, jointed by 2x2-inch spruce splines nailed on their edges. This dam was poorly constructed and leaked badly.

The soft spots around the piles caused by leaks were filled with riprap and 18 inches of riprap was laid over the whole bottom and received the concrete. The head of water in the dam was 24½ feet at high tide and 18½ feet at low tide. The coffer dam sheeting was left in place and cut off at the mud line. In view of the experience with this single-sheeting coffer dam and the facts that at Pier 11 the bottom of the sheeet piles would be in gravel and not in mud and that considerable riprap and some cribwork were encountered, the contractor was requested to build either a crib dam or double-row sheet-pile dam with clay puddle at Pier 11. The contractor refused to do this and built a coffer dam with a single thickness of sheet piling without puddle. When pumped out and partly excavated this dam was lifted and crushed in by the water outside.

Many efforts to make the dam tight enough to work in failed utterly, and consumed valuable time. A double-sheeting puddled dam was finally built and the pier constructed in it. Even with the puddled dam many leaks formed under and along the piles, through the gravel, and it was necessary to lay the concrete in from 8 to 12 inches of water. The proportions were consequently changed from one cement, three sand and six stone to one, two and four respectively. The concrete laid under water was mixed dry, the stone only being wet. It was dumped from an ordinary iron hoisting bucket, the fall being about 12 inches. The stone from the old piers was used as riprap around the bases of pier 10 and 11, also for slope paving at the north abutment and for the base of the macadam paving on the earth-fill approaches. The ashlar is Stockton sandstone from New Jersey and the bridge seats Port Deposit granite. The contractor's plant consisted of a land pile driver, a floating pile driver, a steam dredge, a large centrifugal pump and one small plunger pump driven by steam from the pile driver or dredge, and several derricks.

As the Councils failed to appropriate money for the new superstructure it was necessary to built new temporary wooden approach viaducts. The principal features of interest in this work were the A-shaped arch spans, the use of pile ends as mud sills and the use of the old wooden Howe trusses as shown in Figure 5. The end panels of the lower chords of these trusses were cut off and two 6x12-inch pieces bolted on to form inclined end posts, and the trusses were suspended from the upper chords instead of being supported, as is usual, on the lower chord. The trusses were reinforced with 1-inch iron rods removed from the old bridge.

The work on the substructure began April 1, 1898, and under the contract was to have been completed in four months, but it was not actually finished for over seven months. The total contract price of the reconstruction was $48,347, $41,406 of which was for the piers and the remaining $6,941 for the wooden approaches. The work was done for the Bureau of Highways of the city of Philadelphia. Mr. Wm. H. Brooks, chief of bureau, and the late Carl A. Trik, superintendent of bridges. The investigation of the old structure was made in 1897 by Assistant Superintendent of Bridges Harrison Souder, who made topographical surveys, borings, soundings and inspection of the whole structure, including that of the foundations in submarine armor. Mr. Souder also sunk the test wells, conducted the pile tests, prepared the design of the new steel viaducts and supervised the reconstruction work, and acknowledgment is made to him for the preparation of data for this description. The American Artificial Stone Pavement & Construction Company was the contractor for the new substructure and present timber viaduct.

Military Bridge Repairs in Cuba were made during the recent war in a hasty but serviceable manner on a railway structure near Gibara under the direction of officers of the Corps of Engineers. This bridge was a through lattice structure of nine panels; the abutments at one end had been blown out by the enemy and that end of the bridge had fallen to the ground below, a distance of perhaps 12 feet, without injuring the trusses very much. When the engineers came to repair the structure they decided it would take too long to raise the fallen end and build new abutments, so they ran up struts from each panel point to the proper height and built a new track on the caps of these struts, leaving the bridge where it was with little further care than to make a firm bed for the fallen end.

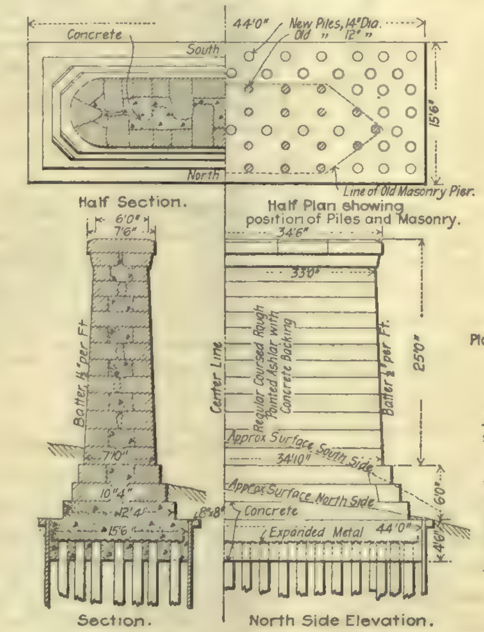


Fig. 1 Long Pier.

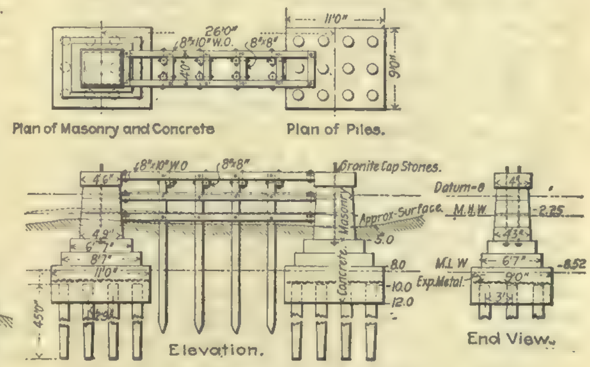


Fig. 2 Double Pier.

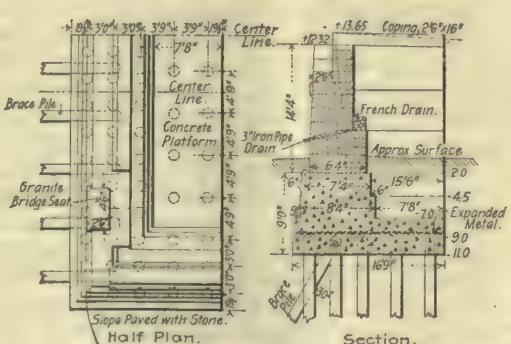


Fig. 3 North Abutment.

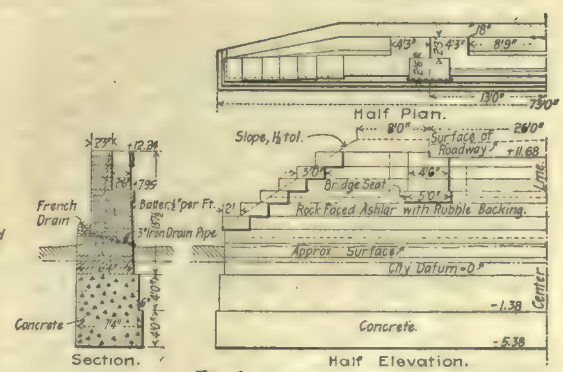
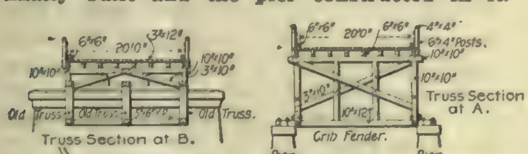


Fig. 4 South Abutment.



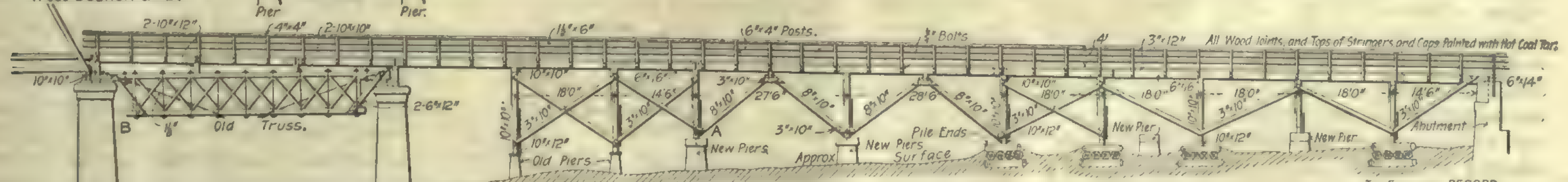


Fig. 5 Elevation of Temporary North Approach.

RECONSTRUCTION OF THE PENROSE FERRY BRIDGE, PHILADELPHIA.

W. H. BROOKS, CHIEF OF BUREAU OF HIGHWAYS; HARRISON SOUDER, ASSISTANT SUPERINTENDENT OF BRIDGES.

A CONCRETE GASHOLDER TANK.

A gasholder tank built of concrete instead of brick or steel was constructed at Hamilton, Ohio, during the latter part of 1897. It was described by Mr. C. W. Andrews at the recent annual meeting of the Ohio Gas Light Association and printed in the "American Gas Light Journal," from which the following facts have been taken:

The tank is 83 feet 6 inches in diameter and 22 feet deep inside dimensions. Preliminary excavation showed that good sand and gravel underlaid the site of the tank and these materials were used in making the concrete. The excavation was bounded by a railway switch on one side, a large dwelling on another and a coke pile 15 feet high on the third; the nearest part of each of these was within 12 feet of the curb of the tank and extra precautions were therefore necessary to prevent caving of the banks. The sides of the excavation were carried down with a slope of three to one, and as the depth increased they were continually slushed with neat cement grout to prevent caving.

A washing machine was used to separate the gravel and sand from the loam. It consisted of a 3 x 6-foot screen, with ¼-inch mesh, inclined at an angle of 45 degrees and fed from a hopper. A number of fine streams of water played on the gravel as it fell into the hopper and rolled down the screen, thus cleaning it and washing the sand and loam into a box below. These were continually agitated by hoeing the sand out on an inclined bottom, the muddy water escaping through an opening near the top of the box. The concrete was made of one part of Portland cement, three parts of sand and seven parts of gravel. The cement and sand were first well mixed, the gravel was added and the whole turned over dry, after which sufficient water was added to bring it to the proper consistency.

The walls were 24 inches thick at the bottom and 16 inches at the top. The bottom of the tank and the footing course were laid first. An inside circular form 3 feet high and cut in halves was then erected and carefully centered. It consisted of three horizontal rings made of two layers of 1 x 8-inch boards sawed to the circle and spaced 17 inches between centers. The outside was sheeted with 1 x 3-inch matched flooring, tarred to prevent the cement adhering. The inside was suitably braced and was supported by means of iron clamps attached to 4 x 4-inch posts 22 feet high and placed 6 feet apart. The outside mold consisted of similar segments about 30 feet long. The footing course was thoroughly grouted with neat cement, and the concrete was then filled in and tamped in layers of 6 inches until the top of the mold was reached. The forms were then raised with jacks and the work was continued. The inside and outside forms were connected together every 6 feet with 1 x 4-inch strips and the bottom of the outside form was braced against the bank. The back filling was tamped in 6-inch layers.

The concrete was protected from freezing by covering and by the use of fires. The top curb, the inside of the tank and the bottom were all plastered with a ½-inch coat of 1 to 2 mortar and during the erection of the iron work an additional wash of neat cement grout was applied with a heavy brush. A pit surrounding the inlet and outlet pipes was constructed so as to expose a section of the wall 7 feet wide and 15 feet deep in order to observe the amount of seepage. Upon filling the tank it was found that the seepage through the walls themselves was unimportant, but on account of the expansion bolts fastening the wall plates having been inserted without proper pointing afterwards, a slight amount of leakage occurred. This was stopped by the addition of bran, and the leakage was reduced to no more than in a brick tank of the same size.

SEWAGE DISPOSAL, KINGSTON-ON-THE THAMES, ENGLAND.

[By James H. Fuertes, M. Am. Soc. C. E.]

The following article is a continuation of the series of papers on European Sanitary Engineering, of which the last, on the water-softening plant at Southampton, England, appeared in the issue of February 4.

The A B C process is employed at Kingston under the control of the Native Guano Company, Limited, which manufactures a manure from the sludge. The Kingston plant is the largest under the control of the company, and receives the sewage of Kingston, Surbiton and Hampton Wick, with an aggregate population of about 43,000. The A B C process was first put into practical use at Aylesbury, but, on account of an unfavorable contract by which the works were operated at a loss, they were discontinued after having been in service for twelve years. The process was adopted at Wellington College under the advice of Baldwin Latham, M. Inst. C. E., and in 1888 the plant at Kingston was installed. The process has also been tried at many other places.

The original A B C was aluminum, blood and charcoal; no blood is now used and the B C mixture, which is first added to the sewage, consists largely of charcoal and clay. They are ground up in a pan by heavy revolving wheels to the consistency of a stiff paste, which is afterwards thinned by the addition of water. The B C mixture flows to the pump well and is pumped with the sewage to the precipitation tanks, thus ensuring a satisfactory admixture of the chemicals.

The sewage from Kingston and Surbiton reaches the works in two different sewers, and after being screened passes in separate channels through meters, and finally into the pump well. A plan and two sections of the screen house are given in Figures 127, 128 and 129.

The screens are cleaned by hand with a rake. The fluctuations of the depth of the sewage causes the fouling of the walls of this screen chamber with grease and decomposable matter, requiring considerable attention to keep it free from nuisance. The meter for measuring the sewage flow is a simple under-shot-wheel having a revolution counter at the shaft, Figure 130.

The alum-cake or sulphate of alumina is dissolved in water in large pits, and flows through a pipe to a set of troughs with notched edges, spanning the main carrier. The solution drops out of the notches in these troughs and becomes mixed with the sewage, as shown in Figures 131 and 132.

There are eight precipitation tanks in groups of four each side of the main distributors. They are so designed that they may be used either continuously or intermittently. Figure 133 shows a ground plan and Figures 134 and 135 sections of these tanks, which, although expensive, are very conveniently arranged.

The sewage enters the tanks through the gates, B, passes around the division walls, I, and out through the bell-mouth pipes, D, into the effluent channels, H. The gates, C, are provided to make possible the passing of the sewage through several tanks in series before drawing off the surface liquid through the bell-mouth pipes. The liquid remaining in the tanks below the bell-mouth pipes is decanted down to the sludge level by the floating arms, E. The effluent goes over the tumbling-bay at the end of the works, into the outfall sewer discharging into the Thames.

The sludge is sucked out of the tanks by pumps and delivered into the sludge well, P. after passing through a set of screens, O. The sludge is drawn out of the sludge well by exhaustion into six large cast-iron receivers. When the recivers are full, a float shuts off the exhaust supply and stops the air pumps. The receivers are about 9 feet high and 2 feet 6 inches in diameter. At the bottom of each, over the inlet, is a check valve to prevent the sludge being forced out when the air pressure is put on the receivers to force the sludge up to the presses overhead. There are 16 filter presses and each is filled about once in 24 hours.

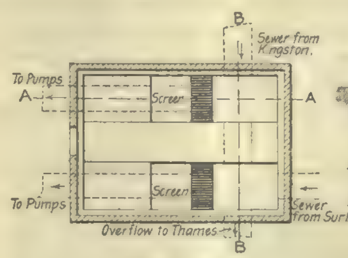


Fig.127 Plan.

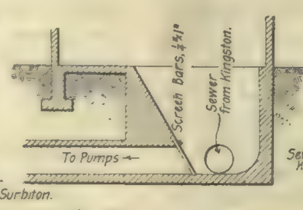


Fig.128 Section A-A.

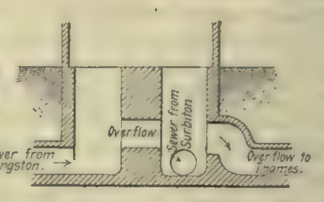


Fig.129 Section B-B

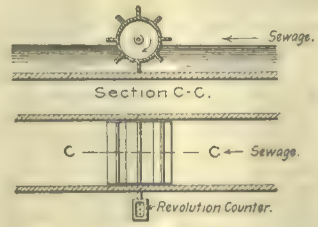


Fig.130

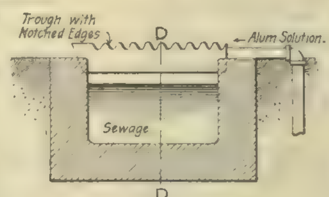


Fig.131.

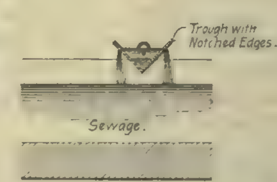


Fig.132 Section D-D.

DETAILS OF THE KINGSTON SEWAGE DISPOSAL WORKS.

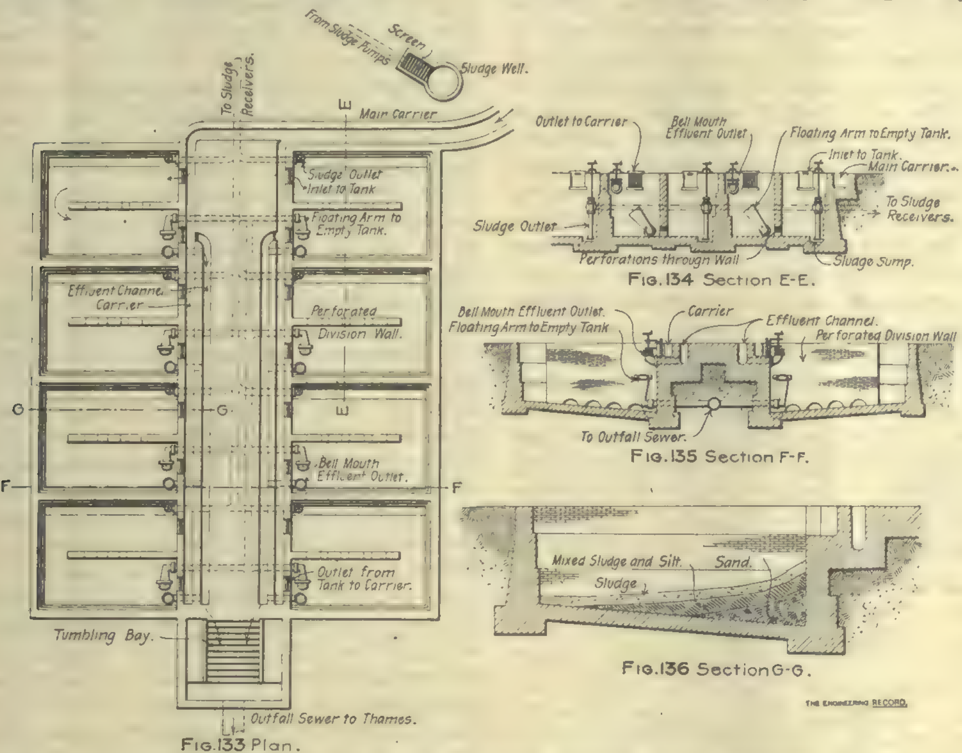
After being taken out of the presses, the sludge cakes are broken up and thrown through a funnel into a cylinder containing a horizontal revolving shaft studded with arms. The cylinder is placed over a furnace and the cakes are thus broken up and dried. The powder and lumps are elevated from the cylinder by an endless chain which dumps upon a screen having a mesh of ¼-inch. The fine powder passing through the screen is taken in barrows to the store shed, and the coarse matter is put through the driers and broken up a second time. The drying of the sludge cakes is attended with considerable offensiveness, which is overcome at Kingston in the following manner: The gases from the drier are exhausted by a fan and blown through a vertical chamber and then downward through a second, in which brush wood is fixed, upon which clean water is sprayed. The water absorbs a considerable amount of the vapors, and those which are left are passed over the fires in the furnaces and burned, finally escaping up the stack.

The powdered sludge is sold as a manure for about $25 per ton.

The works are well managed and kept very clean. In a public park lying between the works and the river and close to the settling tanks, a grand stand has been erected, around which many people gather during the summer evenings to listen to the music. There has never been any complaint made that the works were objectionable. The effluent from the tanks is clear and

odorless, and the premises are kept free from nuisance, the most disagreeable place being in the neighborhood of the shed where the fertilizer is stored.

As the Kingston sewage often contains a large amount of sand washed from the street surfaces, the tanks, after emptying, frequently show the different rates of subsidence of matters of different specific gravities. Figure 136 illustrates this. The sand from the streets settles rapidly, and is found near the inlet to the tanks; a little further away is a mixture of fine silt and sludge, and on top and at the further side of the tanks is the deposit of sludge composed largely of organic matter.



PRECIPITATION TANKS OF THE KINGSTON SEWAGE DISPOSAL WORKS.

THE NORTH YARRA SEWER TUNNEL, MELBOURNE.

The sewer tunnels of Melbourne, Victoria, which were constructed through water-bearing strata by various methods have already been described at some length in these columns, particularly in an article in the issues of October 15 and 29, 1898. Some additional information has recently appeared among the "Selected Papers" of the Institution of Civil Engineers, however, in an article by Mr. Henry Vine Champion on the North Yarra main sewer, which is reprinted in part herewith. This sewer passes under a shallow creek, known as Stony Creek, by means of an inverted syphon 1,581.7 feet long between the centers of the shafts, 8½ feet in diameter and laid on a grade of 1 in 2,300. The preliminary examination of the site showed that for 900 feet the ground was very bad. Along this length piles 12 inches in diameter required little or no driving. After being driven 38 feet a fall of 8 or 9 feet of an 1,800-pound hammer sank every pile more than 9 inches and some of them from 12 to 20 inches per blow. A trial tunnel driven on the level of the sewer on the bank of the creek revealed a quantity of silt which ran readily and soon filled the tunnel. In no place did the boring augers find solid material nearer than 38 feet to the surface, the material above being a semi-fluid slurry.

Good progress was made with the work on each side of the creek, the type section varying somewhat according to the nature of the ground. Arrangements were made to construct the syphon of brick in cement and cement-concrete from the south end of the creek, the excavation being supported by timbering; and from the north end of blue-stone blocks, a wrought-iron shield being used to facilitate construction. After completing about 580 feet of the tunnel from the south end, the contractors were ordered to stop the construction at this point, as the brickwork showed signs of failure under the heavy pressure caused by the swelling of the clay in which the tunnel had been driven. The stonework was steadily pushed forward from the north shaft until a point was reached about 350 feet from it, when a stratum of sand carrying a large body of water was tapped. The shield had met with various mishaps during the progress of the work, owing to striking against boulders in its course; it was now strengthened, and several ineffectual attempts were made to continue the contract. The sand when fully exposed extended to about 15 inches above the bottom of the shield, and the inburst of water increased to probably 18,000 gallons per hour. The contractors had great difficulty in preventing the sand from washing out, and in securing the clay face above; and finally had to abandon the work and close the sliding doors of the shield, as the water was gaining on the two pumps in the shaft, which were capable of dealing with 13,000 gallons per hour. During the few hours in which a larger pump was being fitted in the shaft the whole length of tunnel was filled to springing level; but, after that, the flow of water seemed to gradually decrease until it remained constant at about 9,600 gallons per hour. Further boring operations were then undertaken to define more clearly the nature and extent of the sand drift, and a bulkhead was built across the sewer about 20 feet back from the shield, a Bourdon gauge being fixed to test the pressure of water behind the bulkhead. These efforts to keep back the water were not wholly successful, as it found its way along the outside of the stonework and forced a passage through the joints. Calking with oakum was then resorted to; but, although the leakage was much reduced, it was not entirely prevented. A pressure of 25 pounds per square inch was recorded by the gauge, while the escape of water through the joints between the bulkhead and the shaft was estimated at about 3,600 gallons per hour. It was considered that if there had been no escape, the pressure would have closely approached the full amount due to the head of water from the surface, viz., 33 pounds per square inch above atmospheric pressure.

After these experiments had been made and the fresh bore-holes had been completed, the contractors plotted a detailed longitudinal section of the ground in which the sand drift was clearly defined. It was considered impossible to proceed further with the tunnel under the existing mode of construction; and Mr. Champion was called in to advise upon the works necessary for the successful completion of the contract, to negotiate with the officers for a satisfactory settlement and to direct the further progress of the undertaking. A complete examination of the contract having been made, a preliminary report was submitted to the contractor upon the state of the work and the practicability of further operations. This report described the condition of affairs and gave a brief resumé of the operations which had so far been conducted from the shaft on the north side of the syphon. The flow of water there was estimated at 9,600 gallons per hour, and was easily kept under by the Worthington pump in use. The extent of the sand drift as defined by later bore-holes of the Board of Works was 380 feet along the line of sewer, at levels varying between invert level and about 2 feet 6 inches above it. The total length of tunnel to be driven was 540 feet. The sand was overlaid by a good solid drift clay deposited from denudation of schist rock, and showed a good dry face, which had, however, fallen to a slope from the front edge of the hood to the bottom of the top doors. The thinnest covering of clay over the arch was about 7 feet, overlaid by 7 feet 6 inches of rotten rock and 48 feet of silt of varying degrees of stiffness. The invert of the syphon at the north shaft was about 73 feet below low water. Flood level was shown by the Board of Works 8 feet above low water. Allowing for the thickness of the invert a total head of 82 feet 2 inches might be developed. As, however, a flood of this character would not occur without timely warning and during its operation work might be discontinued, it was considered sufficient to allow for a very high tide, giving a total head of 79 feet, or a pressure of 34.29 pounds per square inch. The highest tide recorded above Melbourne Harbor Trust datum was 4 feet 6 inches. The men showed great disinclination to work in compressed air, and the contractors were very averse to its use. The terrible accident of Good Friday, 1895, in the Yarra tunnel, described in "The Engineering Record" of July 13, 1895, had also a bad moral effect upon all engaged in sub-aqueous operations. Taking into consideration the experiments made in this case and the experience gained in other parts of the world it was considered probable that a pressure between 20 and 25 pounds per square inch would be sufficient to carry on operations, but there was a possibility that the pressure due to the full hydrostatic head might be encountered, and provision must be made to meet it up to a pressure not exceeding 35 pounds per square inch.

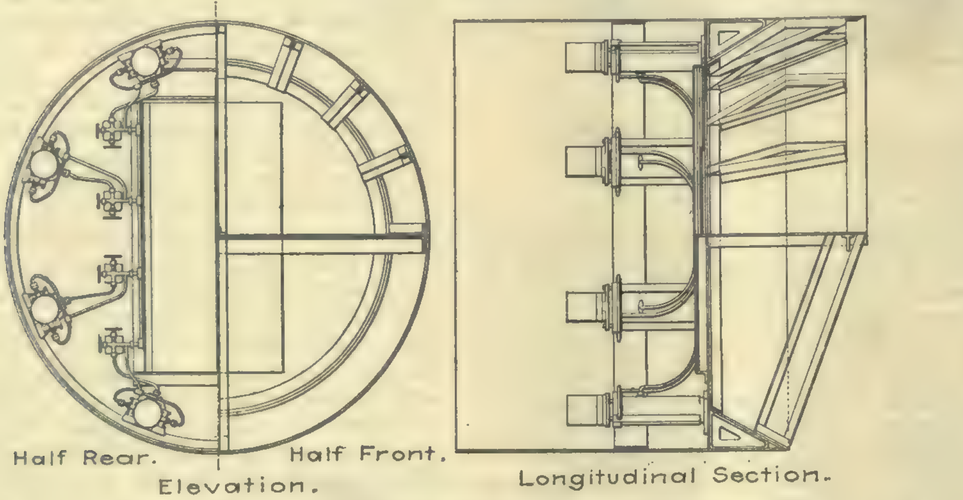
Owing to the difficulty in making the stonework watertight in the ground already traversed, and the still greater difficulty, if not impossibility, of doing so through the sand drift, the contractors were advised to substitute cast-iron lining, 1½ inches thick, with cement concrete and brick interior. The great pressure of the clay upon exposure in the south section of the tunnel had already materially affected the brickwork, and, taking this into account, as well as the depth at which the tunnel was laid, the thickness of 1½ inches was decided upon. The deformation of the 1¼-inch cast-iron lining in the Yarra tunnel, which amounted in some places to a difference of some inches between the horizontal and vertical diameters, and the fact that unplaned flanges were used in this class of work by the board, were additional reasons affecting the thickness adopted. The Board of Works approved of the proposed alteration, and negotiations were ultimately concluded. It was decided that the lining should extend for 380 feet, the full length of the sand drift, the remaining 160 feet having to be finished in stonework. Each complete ring of cast-iron plates was 1 foot 6 inches in width

over flanges, and consisted of seven plates each 4 feet 6 6/7 inches long and a key-piece 1 foot 5 inches long. This width of plates was decided on as giving more security in carrying on the work than the greater widths formerly adopted in the Yarra tunnel, as being more easily erected, and as fitting in with the 20-inch stroke of the shield rams, so that a complete ring could be erected with one movement of the shield. The thickness of the flanges was 1½ inches, the depth 3½ inches, and the diameter of the wrought-iron screw-bolts 1¼ inches, and their spacing 8 inches from center to center. The bolt holes were cast slightly larger than the bolts to secure facility of erection. The shanks were round iron and no difficulty was experienced in screwing up. In the Yarra tunnel, afterwards carried to a successful completion by Mr. A. G. Shaw, square holes in the linings and square shanks were used with 1-inch bolts.

Precautions having been taken, by means of horizontal bores in the face, to test the ground immediately in front for a length of 50 feet, the contractors decided to endeavor to push on without installing a compressed-air plant. The first ring of iron to be placed next the stonework was cast with a specially deep flange on that side and strengthened by ribs across the plate at frequent intervals. The deep flange was secured to the stonework by six 1½-inch lewis bolts. The bottom plates were placed by an iron derrick secured to the diaphragm of the shield and furnished with a single block and endless chain. The top plates were inserted by hand from temporary staging, the only difficulty occurring with the two top side-plates and the key-piece. These two side-plates were loosely bolted to those immediately below, the top ends being held up by the men. The key-piece, weighing about 200 pounds, was then inserted by hand. The top ends of the side-plates being pushed up as far as possible, the key-piece was slid between them and temporarily secured to the side pieces by two drifts slipped in smartly at opposite corners. Bolts were then inserted through the other holes and screwed up, the drifts being then removed and bolts substituted.

A segment-erector was designed for the purpose of relieving the men in the erection of the plates, but it was difficult to avoid taking up a great deal of space in the tunnel, and the contractors were so satisfied with the progress made without it, that they decided not to use it. The height of the trucks was about 3 feet 3 inches, and the erector gave only about 2 inches above this, so that earth could not be piled on the trucks, and time would be lost in trucking excavated material to the shaft.

The first shift took place in the presence of the contractors and their engineers, and, contrary to expectation, no great increase occurred in the quantity of water. Everything working satisfactorily, and, the ground ahead being well exploited, it was decided to push on as rapidly as possible. The joints in the ironwork were made with tarred felt, and arrangements were made, as the work progressed, to have the bottom plates made with 4-inch cast-iron pipes in them projecting upwards about 14 inches. These pipes were left in the bottom about every half chain, and the water from the sand was allowed to flow freely through them into the tunnel. This practice was decided on when it was ascertained that the sand did not come away with the water to any appreciable extent. The effect was to keep down the water in the face as the work progressed, and facilitate excavation and construction. The pipes were not closed until after the interior lining was completed, and by thus relieving the pressure the brickwork and cement-concrete was allowed to become thoroughly set. As the work was proceeding on a down gradient it was necessary to intercept the water coming from these pipes and prevent it from flooding the face. Temporary dams were therefore erected from time to time between the last pipe and the face. The water from the face was pumped over these to the shaft by a Worthington pump at the bottom of the shaft with a long horizontal suction pipe. The main body of water in the north shaft was pumped to the surface by the large steam pump before mentioned. The water in the shaft included part of that discharging from the upper tunnel, whenever it was syphoned over a small dam at the junction to the sump at the bottom of the shaft. This was usually unnecessary, as there were two small Worthington pumps at the end of the upper tunnel, which ordinarily were enough to lift the water to the surface. Sometimes, however, they had to be stopped for repairs, and if a flood occurred there was too much water for the pumps to deal with and the syphon came into operation. It was certainly not economical to double the height which it was necessary to lift the water, but the arrangement was not often used, and might be regarded in the light of a stand-by.



SHIELD USED ON NORTH YARRA SEWER TUNNEL, MELBOURNE.

The rate of progress through the sand continued satisfactory, five rings per day being frequently erected. The horizontal test boring was performed weekly, and the ground between the vertical bores in this way thoroughly tested These precautions gave great confidence to all concerned, and although the water was exceedingly troublesome at times, no mishap occurred excepting an injury to one of the workmen's hands in erecting the plates. This, however, was due to carelessness or to a misunderstanding.

The shield, shown in the accompanying illustration, was constructed by Mr. Mephan Ferguson, of Melbourne. On approaching the bad ground it had been specially strengthened and refitted by the contractors. Previously, owing to a deformation of one of the plates which remained undiscovered for some time, it was found impossible to keep the shield moving in the proper direction. Eventually the increasing error became serious, and a careful examination showed that extensive repairs were necessary. The shield had been previously fitted with a pojecting hood, but it does not appear that it was the cause of the error as no difficulty was found after the repairs had been effected in keeping the shield moving in the required direction. The hood projected 2 feet beyond the cutting-edge and was made of ¾-inch wrought-iron plate, supported by brackets stiffened with angle irons extending back to the diaphragm. A wrought-iron plate, extending forward from the diaphragm to the end of the hood, was placed horizontally in the center of the shield, supported by angle-bars at its junction with the shield and by a stiffened plate in the center sloping outwards from the bottom of the shield to the outside of the plate. This support practically divided the lower half of the shield into two chambers, while a vertical wrought-iron plate also divided the top half into two working chambers. The horizontal plate was also stiffened and supported near its outside edge by a T-bar. The diaphragm, as originally constructed, had only one door space, 6 feet by 4 feet, but this was eventually cut into four doorways. The doors were composed of wrought-iron plate sliding in grooves faced with gun-metal. The lower doors slid up in front of the upper ones, two doors being above and two below the horizontal plate. The doors were fitted with projecting studs which were engaged by flat swinging hooks when they were open, the hooks being so shaped that when properly fastened they firmly engaged the studs and kept the doors up, but a smart tap sufficed to swing them clear of the studs, when the doors dropped at once with some force to the closed position. This arrangement worked well. The top doors were first opened and the ground excavated by one man in each chamber to the extremity of the cutting-edge and as far beyond it as was necessary for a complete shift. The men were then withdrawn and the doors shut down. The lower part was then similarly excavated. The pressure was then put on to the jacks and the shield forced forward. In excavating the lower portion, where the sand continually rose higher as the tunnel progressed, it was frequently necessary to use bags of silt or clay to control the flow of water.

The movement of the shield was effected by eight hydraulic jacks. The power was supplied from a force pump on the surface worked by a semi-portable engine hereafter described. From the pump the power was conveyed to the jacks by wrought-iron tubes secured to the tunnel at frequent intervals by iron clips, to prevent the pipe springing under pressure. As the work progressed further lengths of tubing were added to maintain the connection, a flexible hose being always used at the junction with the shield. The ram cylinders were of cast-iron, 9 inches in external diameter and 1¼ inches thick, the solid ends being cast in one piece with the cylinder and varying in thickness between 1½ and 1⅞ inches. The length of the cylinders over all was 2 feet 6¼ inches, and the travel of rams about 20 inches. The rams were 6 inches in diameter, and were dished on the inner ends and provided with the ordinary cut-shaped leather collars. When used against the stonework the outer ends of the rams were fitted with cast-iron cross-heads secured with one set bolt to each ram. In the case of the cast-iron lining it was required to distribute the pressure of the ram over a considerable length of the very narrow annular surface formed by the cross section of the lining, and for this purpose cast-steel shoes were substituted. They were 3 feet 11 inches long, and were curved to the same radius as the cast-iron lining, the inner sides being bevelled off so as to prevent the shoe from bearing on the unsupported

flanges. When the tunnel was constructed in masonry the travel of the shield, viz., 20 inches at each stroke of the rams, was not enough to permit of the long stones being inserted, and it was therefore necessary to use blocking-pieces, which were readily placed on the ends of the rams. The stonework was also protected by wooden baulks cut to the shape of the tunnel and used to take the pressure from the cross-heads. The drawback motion of the rams was effected by two small pistons, each having an effective area of 0.88 square inch, the rods being attached to the cross-heads or shoes. The packing of the drawback pistons and piston-rods was of the ordinary screw-down pattern, and was not altogether satisfactory for the high pressure used, which frequently amounted to 1½ tons per square inch. The construction of the supply valve was such that water was admitted to the drawback cylinders at the same time that the ram was being forced out, but the drawback rods only came into operation to return the rams when the pressure in the ram cylinder was released.

The exterior of the stonework and of the cast-iron was covered with cement grout, forced in by the Greathead method with compressed air at pressures varying up to a maximum of 40 pounds per square inch. This compressed air was supplied by an ordinary locomotive Westinghouse brake-pump.

The tunnel workings were lit by electricity, which at one time was supplied by a factory situated near the shaft on the south side of Stony Creek. When the work was confined to the north end, however, the contractors furnished their own generators, a 100-volt dynamo being driven by a small engine.

During the progress of the work from the north shaft the atmosphere frequently became oppressive below, and it was found necessary to reinforce it by introducing air from the surface, by a fan driven by the small engine. The air was conveyed to the face by light galvanized-iron pipes, 7 inches in diameter, joined with tarred canvas. The sand drift having been safely passed through, the contractors resumed the bluestone block construction in good ground.

Measurements were made of the vertical and horizontal diameters of the cast-iron lining at various places in the tunnel, starting from the north end of the iron work, with the following results:

Rings Inserted.	Horizontal Diameter. Feet.	Inches	Vertical Diameter. Feet.	Inches.	Difference, Inches.
2	10	5	10	3⅝	1⅜
40	10	5¼	10	3⅜	1⅞
75	10	5¼	10	3½	1¾
115	10	5¼	10	4	1¼
155	10	4½	10	4⅛	⅜
197	10	4¾	10	4⅛	⅝
236	10	5	10	3⅝	1⅜

The iron was coated with a mixture of hot Stockholm tar and Archangel pitch, according to the Board of Works' specification, before the plates left the foundry.

The alignment and levels of the tunnel were carried out under the direction of Mr. Charles Lyell, resident engineer to the contractors, and his operations were characterized by extreme simplicity and an absence of those refinements in the smaller accessories which have been deemed a necessity in some tunnelling operations. An ordinary 5-inch transit theodolite was used throughout, except when the work was nearing completion, when a 7-inch instrument was obtained from the Board of Works and the alignment checked therewith. The latter instrument was mounted so that it could be moved bodily in azimuth on a sliding plate without interfering with the legs, and, therefore, without appreciably disturbing the level. This is an excellent arrangement for tunnelling work and saves much time. The center-line of the tunnel was ranged over the two end shafts, and screws were fixed to the timbers with their slots in the direction of the alignment. Owing to the timbering of the shafts interfering with the transference of the center-lines to the bottom, it was necessary to offset from the two surface points about 4 inches, and from the new line plumb-lines were dropped down the shaft into buckets of oil at the bottom. The observer then set up the instrument, about 60 feet ahead of the shaft, and prolonged the line by plunging the telescope. The telescope was then lifted out of its bearings and turned over on its horizontal axis and the operation repeated. The mean of the two observations was accepted as correct. Although, as has been previously stated, in carrying on the work the tunnel was allowed to get off the line, it was utlimately brought back and the two faces met with precision, the error in alignment being less than 1 inch, and in level about ½ inch.

THE BUFFALO GENERAL HOSPITAL.

The Buffalo General Hospital was organized in 1855 and its first building erected in 1858. Successive buildings were erected in an independent manner as needed, but in 1894 it was found they were inadequate for the increasing number of patients and modern requirements. They were not fireproof, not ventilated, entailed a big expense to heat and light, and rendered the service complicated as they were spread over a city block of over 300 feet square. Steps were then taken to secure plans for their replacement. Five architects from Boston, Albany and Buffalo were called in competition, and Mr. George Cary, of Buffalo, was appointed architect in 1895, at which time construction was begun for an entirely new structure, to be built in successive portions as funds became available without interrupting the service and use of the old buildings, till the patients were moved from the old into the new portions. The total capacity of the new structure when completed provides for over 500 patients, while the old nine detached buildings accommodated only 150 patients.

On March 29, 1899, the new part shown in Figure 1, and accommodating 150 patients, was formally opened, so that the western portion may now be built replacing the old ward building built 30 years ago.

The new building when completed will form a double H with semi-circular wards facing the courts to the south and semi-circular clinics to the rear or north courts. It is proposed that these courts may be enclosed from the streets by one-story building to the south for private patients, and by two-story building for the help, facing the northern street.

As Goodrich street to the north is some 12 feet lower in level than High street to the south, it allows of the stable, morgue, laundry and boiler rooms being on the ground floor under the helps rooms and makes the administration department the central feature, with dining rooms for the staff back on the upper floor, which is only 4 feet above the level of High street facing south.

The central portion or administration part is intended to supplant the old administration building and will be carried up four stories in height; the top floor being a gymnasium—and the two intermediate floors for private patients, with the director's apartment in front over the entrance hall.

The ward wings east and west are similar to each other, that of the east already carried up three stories above the basement, each story being 15 feet high in the clear. The basement contains an eastern entrance from the center of the block on Elm street, for students only, with their toilet and loafing rooms and laboratory, and a circular stairway of the Guastavino construction leading to the seats in the clinic.

From the Goodrich street, or north side, is the entrance for accident cases opposite the elevator, which enables the patients to be taken to any floor.

All supplies and help have their entrance on the north or Goodrich street front. Each floor above the basement is planned as shown in Figure 2 with the wards 30 x 100 feet running north and south to get the sun all day from east and west. The dining rooms open off each ward with a diet kitchen adjoining, communicating with the basement by means of a lift. These diet kitchens are fitted with steam tables, refrigerators, natural gas and china closets, and have a large porcelain sink with hot and cold water. The floor is of vitrified tile and marble base. These kitchen or serving rooms, one on each floor, are so located as to serve three wards each with economy of service.

The stairs of iron and marble are located on the east and west ends of the halls with outside light and near the wards, while the elevator is located adjacent to the central or administration portion, for the use of the whole building. This one elevator makes a great saving of expense in outlay. It is built of iron enameled in white and is carried above the roof to enable the patients to use the roof as a roof garden. The stairs likewise are carried up to the roof.

The halls throughout are wainscoted and floored with marble as well as toilet rooms and some linen rooms. In the entry adjoining the long wards are clothes chutes open to the basement. There are medicine and linen closets with large store linen closets in the angles adjacent to the toilet rooms.

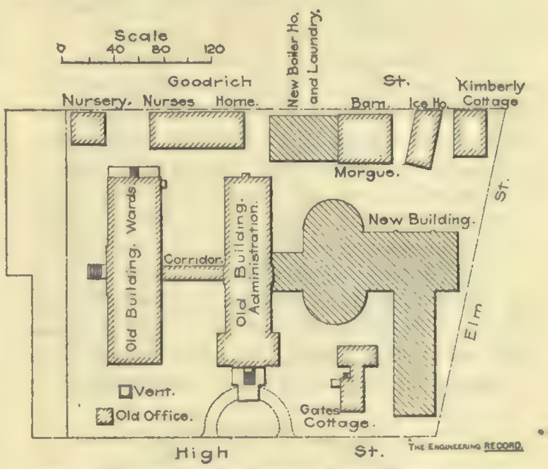


FIGURE 1.—PLAN OF BUILDINGS.

The clinic occupies the height of two stories and is open to the skylight besides having 11 windows with north light and 11 windows opening into six surgical rooms under the seats. All this portion is built of Guastavino tile showing a face and ceiling of enameled tile and a floor of marble. The clinic will seat 300 students, all having a clear view of the operating table.

There is a compressed air apparatus worked by electric button to close all windows, shades and skylight with shutters so as to darken the room for stereopticon views. The pit of the clinic is fitted with natural gas, compressed air, electricity, hot and cold water for operating purposes. Oval wash basins here as well as elsewhere are operated by foot pedals to leave the hands free. The clinic as well as the rooms under the seats may be washed down.

The dome over the clinic is 55 feet in diameter put in by the Guastavino Construction Company. The only attempt at decoration in the clinic is a frieze 25 feet long and 5 feet high in blue and white enamel copied from one of the seven works of mercy by Della Robia made in the year 1525 in a hospital at Pistoja, Italy. The subject is giving drink to the thirsty and is the gift of the architect.

The exterior of the building is a cream yellow brick and enameled terra-cotta basement, and terra-cotta trimmings and cornice to match. The architecture is of the classical order with columns surmounted by a pediment for the contemplated central feature. Over the east or Elm street entrance to the clinic is a shield of enameled terra-cotta over 3 feet high bearing

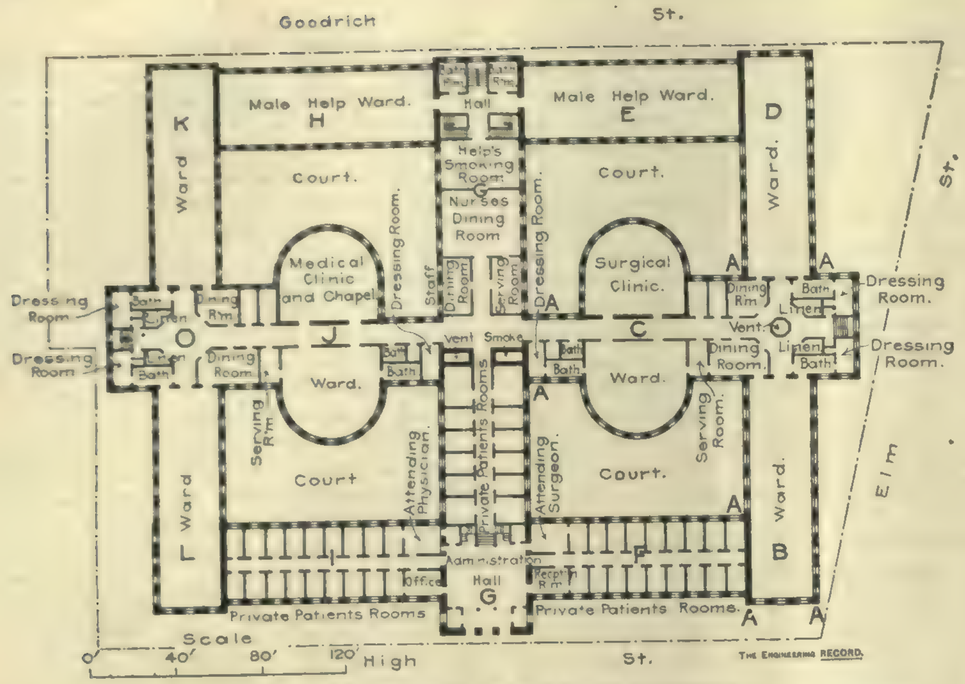


FIGURE 2.—GENERAL PLAN OF NEW BUILDINGS.

the city escutcheon. At each corner of the building under the cornice are infants in swaddling clothes done in blue and cream enameled terra-cotta, three times as large as those from the Foundling Hospital in Florence, by Della Robia. These were the gift of the Perth Amboy Terra-Cotta Company, their first attempt at using two colors in enamel on one piece.

The construction is entirely fire-proof, two of the long wards having the Guastavino fire-proof dome with ventilating flues in the haunches of the arches, while the rest of the building has the hollow brick arches supported by iron columns and beams covered with terra-cotta fire-proofing. The roof is of the same construction covered with concrete and gravel.

The new building is heated and ventilated by the fan system operated by steam from the boiler house which is already built, and equipped with three of its four batteries of boilers. Fans, radiators and conduits have been installed in the basement of one wing "B". The fan and conduits are of sufficient capacity to serve the eastern half of the new building, including duplicate wing ward "D" to the north. Eventually a duplicate plant will be provided for the western side of the hospital including the central portion. The plant is guaranteed to have ample capacity to change the air in the corridors every 15 minutes and to change it in all other rooms in 10 minutes, and to maintain everywhere a temperature of 70 degrees when the outdoor air is at 10 degrees below zero. Fresh air is admitted from courts into the basement (farthest removed from the street) and taken through a conduit of No. 16 steel plate to fine-mesh wire screens set in angle iron frames. After being filtered through them it is washed by a water spray apparatus and passes over steam heating coils and through a 9-foot Buffalo steel plate fan 64½ inches wide. The fan has two independent outlets on opposite sides which discharge into galvanized iron rectangular conduits delivering air to the main building and to the ward building respectively. A by-pass is arranged to furnish cold air if desired and the

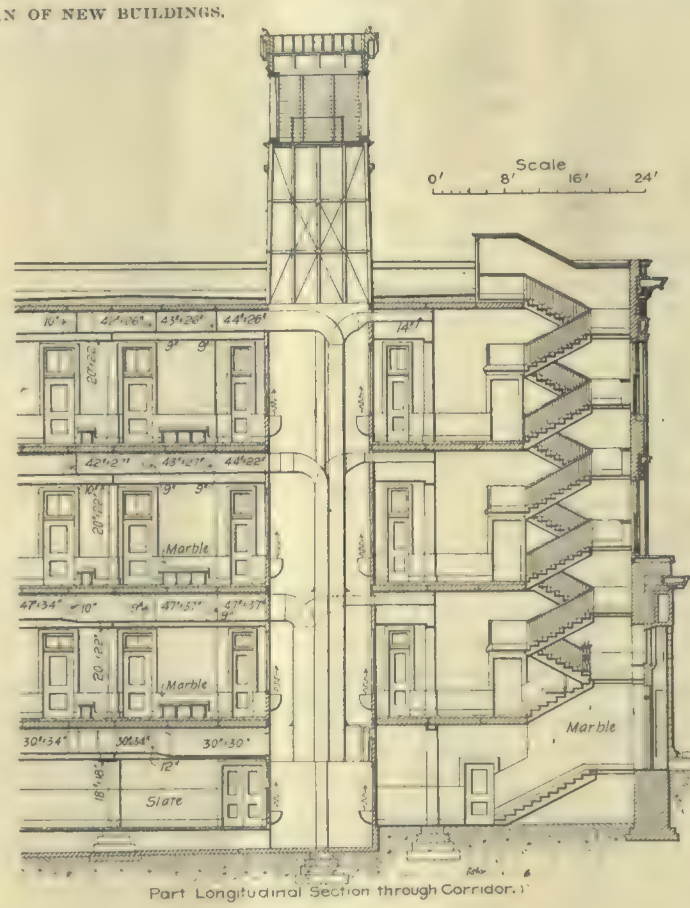


FIGURE 3.

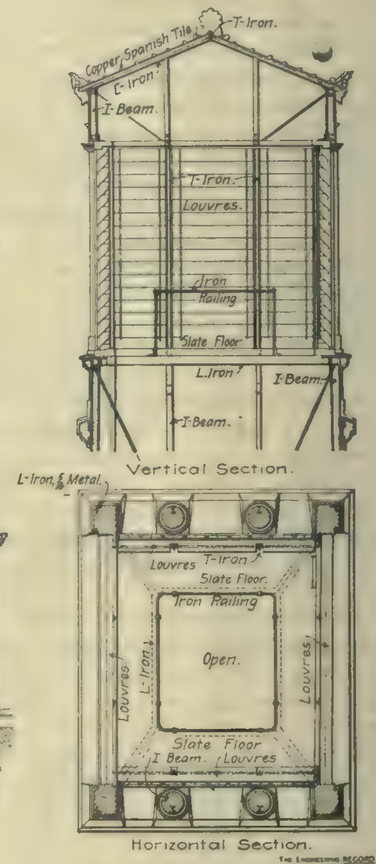


FIGURE 4.

VENTILATING SYSTEM.

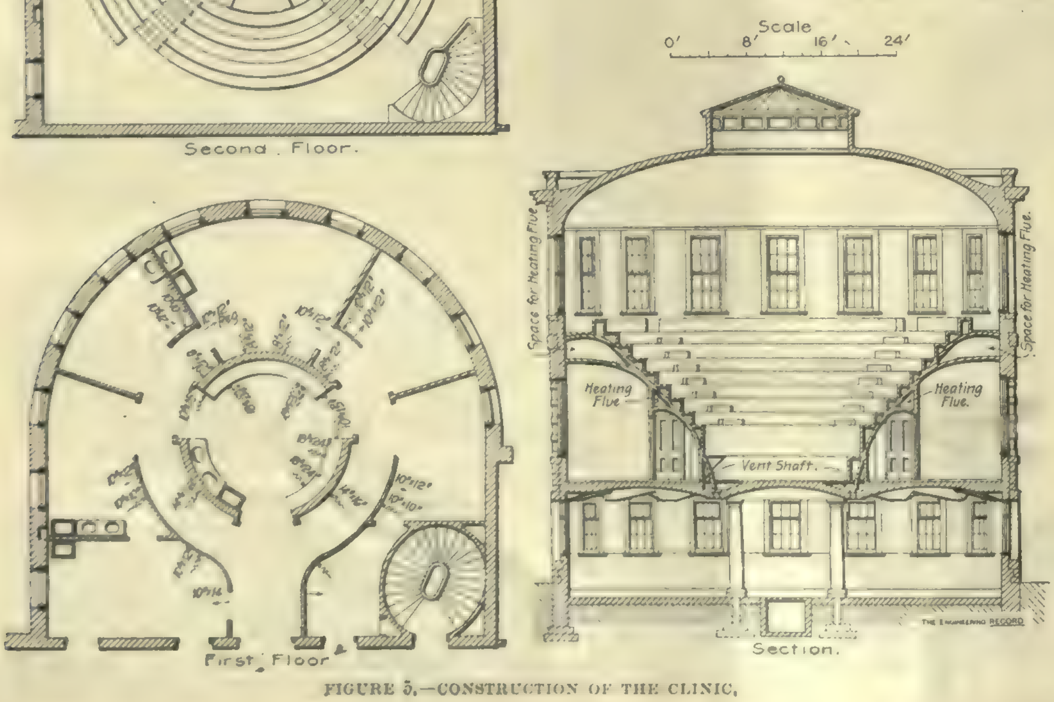


FIGURE 5.—CONSTRUCTION OF THE CLINIC.

fresh air at any required temperature is delivered to the different rooms through wall registers about 8 feet from the floor. The air is withdrawn from each room through wall registers near the floor and is taken through vertical iron wall ducts whence it is conducted to the vent shaft and escapes through its louvres above the main roof level. In the main building a chamber 4 feet high is formed between the floor and ceiling of the corridors at each story and serves as an exhaust duct receiving the foul air from the adjacent flues and discharging it into the vent shaft. In the ward building the vertical vent flues communicate at each story with hollow spaces left in the corners of the Guastavino tile ceilings. These spaces exhaust into galvanized iron ducts along the ceiling, which discharge into the centrally located vent shaft. The fresh-air ducts are run into the ventilation spaces above the false ceilings in the corridors of the main building. The heater is composed of independent sections of steel pipe radiators arranged to be operated by low-pressure steam, to utilize the fan engine exhaust, and to be used separately or in combination. Vertical air

ducts in wall chases are protected by ½-inch fire felt backing on the outside. The arrangement of false ceilings in the corridors, fresh air ducts and ventilation outlets is shown in Figure 3, which gives a vertical center section through the vent shaft and part of the adjacent ward. An enlarged section of the top of the vent shaft, showing the details of the louvres, is given in Figure 4. The arrangement of the clinic is given in Figure 5.

In the basement under the halls is a shaft 3 feet square closed by an iron cover which communicates with the boiler house, and in this shaft are carried all steam and supply pipes and sewer.

Under all showers, which are equipped with regulating thermometers, are 3-inch countersunk marble slabs, 20 square feet, made in one piece.

The plumbing is centrally located so as not to have the piping spread all over the buildings, and has baths, showers, wash basins, urinals and closets located on each floor adjacent to each ward and dressing room. All fixtures and connections are exposed and the requirements for pipe lines, valves, etc., conform to advanced practice. For setting all water closets, urinals and wash basins, grafting wax was used, and cement and white lead were prohibited. All enclosures of water closets, bath rooms, etc., have ⅞-inch marble partitions and wainscots 7 feet high. The 10-inch running trap in the street sewer connection has a 6-inch fresh air pipe which terminates in a sidewalk hitching post with three rows of 1-inch holes drilled near its base. Circulating hot water is provided in all parts of the building and natural gas is piped to the diet kitchens and laboratories and wards for fuel. The bath tubs are porcelain and special arrangements are made for bed pan racks and other hospital requirements.

The building is lighted by electricity throughout, and likewise provided for gas light, with durable and plain fixtures.

The beds are white enameled iron of simple design, and tables have glass tops on white enameled iron legs. The furniture througnout is simple and substantial.

The cost of the new part was $150,000 and $20,000 additional is spent in fitting over old buildings and laundry and kitchen. The whole cost of building when completed will be about $800,000. It has been built entirely by private donations, Mrs. Gates and her three daughters, Mrs. Hamlin, Mrs. Pardee and Miss Gates being the chief benefactors. The endowment of the institution amounts to $350,000.

Mr. J. H. Tilden was the mason contractor; the Niagara Marble Works having a contract for $10,000 of marble; the Buffalo Forge Company, the heating and ventilation contract of $17,000, and Barr Bros., of Rochester, N. Y., $8,500 of plumbing; the Howard Iron Works installed the elevator and appliances for $2,000; the Guastavino Fire-proof Construction Company, $7,000; J. C. Stearns & Company, $3,000 for electric lighting and telephones, and J. Shame and Wm. Henrich's Sons, carpenters, together, $7,000.

GAS ENGINES.

The difficulties that have been overcome in the development of the gas engine, the future of these machines, their economy and other points of similar nature were discussed recently by Mr. Edwin Ruud, the gas-engine expert of the Westinghouse Machine Company, in a paper read by him before the Technical Society of Pittsburg, Pa.

"Gas-engine engineering," began the author, "is a peculiar and difficult line, probably one of the hardest branches in the entire mechanical field to-day. The temperature in the cylinder during the explosion periods is a dazzling white heat, and many parts are exposed to this high temperature. Add to this the different behavior of the various **kinds of** gases, and the fact that the whole process is going on within closed doors, so to speak, where you have very little chance to see what is taking place, and you can imagine the difficulties of the problem. It requires a constant association with the subject in order to fully understand and to be able to overcome the numerous difficulties which present themselves. The difficulties increase with the size of the engine, due to the fact that the heat problem becomes more and more troublesome to solve. It is for this reason that the gas engine has not made much headway in the larger sizes. Also, few men have been willing to experiment in large sizes of gas engines in view of the uncertainty and the abnormally heavy expense connected with the development of, say, 1,000 brake horse-power gas engine."

The author stated that gas engines may be divided into two classes, as far as regulation is concerned. In one of these, called the "hit and miss" type, the usual arrangement is to employ a cam-shaft, operating the exhaust valve and other parts, running half the number of revolutions that the engine does. On this shaft is fastened a cam, which moves the gas valve when a roller operating the valve is brought in the proper position so as to ride on the cam. The governor controls the position of this roller by the aid of a bell-crank lever. Thus, if the speed of the engine is too low the cam will raise the gas valve and permit the gas to be drawn to the inlet valve, where it mixes with the air as it enters the cylinder of the engine. On the return stroke of the piston the charge is compressed and ignited at dead center. Now comes the expansion stroke, and then the exhaust valve is opened, and on the return stroke the products of combustion are expelled. With this mode of governing one or more charges may be cut out, and the engine either takes in a full charge of gas and air or omits the gas altogether, as the gas valve stem is only in position to be operated by the cam when the engine is running at or below normal speed.

The author stated that when the "hit and miss" gas engine is used to drive dynamos they are generally belted to a jack shaft and from this in turn to the dynamo. He thought that this machinery needed a great deal of floor space and introduced a frictional loss of about 10 per cent. He did not believe this type of engine should be adopted for service where steady speed was required. It has one advantageous feature, however, in his opinion, namely, that the charge is always ignited under the same pressure, and hence the actual work done by the exploding gases, in a given cycle, is practically the same for a full load as for no load.

The other type of gas engine to which the author referred was that in which the admission of gas and air into the cylinder is proportioned in accordance with the load. The author showed photographs of the Westinghouse engine, which has already been illustrated in these columns. The gas and air are mixed in a cylindrical mixing valve in the proper proportions for which it is set. This device is in reality a proportional meter, designed to preserve the proportions between the gas and air whether the engine runs at no load or full load. The charges are ignited by an electric igniter, which differs from all other igniters, in the respect that it is duplex, and the bonnet covers two separate mechanisms. This construction makes it possible to change the connections of the wire from the battery to either set of terminals while the engine is running. If desired, both sets of terminals can be used at one time, thus insuring absolute certainty of ignition. This is often done in large electric station work.

The author continues in part as follows: "The gas consumption in all engines varies with the kind of gas used and also with the size of the engine up to certain limits. The average performance of the Westinghouse gas engine, say, from 20 horse-power upwards, is 10.5 to 12 cubic feet of natural gas per brake-horse-power. According to numerous tests with the Junker calorimeter, I have found that the average heat value of natural gas is 1,000 British thermal units per cubic foot. That is, the engine requires 10,500 to 12,000 British thermal units for each brake-horse-power, giving a heat efficiency at the shaft $(33{,}000 \times 60) \div (772 \times 10{,}500) = 25.4$ per cent. and 21.3 per cent. respectively. The above are not fancy figures, but represent the every-day performance of the engines while in the hands of the customer.

"Some special Westinghouse gas engines have been built which have given much better results than the above mentioned, and I have in mind a special 125 brake-horse-power gas-engine which when tested gave the phenomenal economy of 9 cubic feet per brake-horse-power. This would give an efficiency at the shaft of $2{,}564 \div 9{,}000 = 28.7$ per cent.

"These are good results, but they are not as good as may be expected, and I firmly believe that the every-day performance of a gas engine will within a short time reach 33 1-3 per cent. Some experiments are being made along this line now and with reasonable show of success.

"It is necessary in a gas engine to have the cylinders and all the parts exposed to the heated gases water-cooled in order to prevent overheating. This is generally done by letting a stream of water flow through cylinder jackets. In winter the consumption of water may be put down at about 30 pounds, and in summer, 38 to 40 pounds per brake-horse-power. In places where water is expensive, this need not be wasted, as by putting up a tank or tanks, according to the size of the engine, the loss of water need not be more than a few gallons per week, or just as much as the evaporation of water from the surface of the tanks would amount to. Another way of cooling is by means of a cooling tower. The water is pumped from a well through the water jackets of the gas-engine cylinder, where it becomes heated, and from there over to the top of a cooling tower, to return again to the well at about atmospheric temperature, to be used over and over. This mode of cooling produces a greater loss of water than that of the tank system, but it is almost always used in connection with large-sized engines. Not long ago I made some tests for the purpose of determining the amount of water necessary for cooling and to determine the heat lost through the same. It was found that:

	B. T. U.
Went out in the cooling water	5,121
Was converted into work	2,922
Then the approximate amount of heat which went out through the exhaust and was lost by radiation must be	2,957
Total	11,000

From this you will see that there is still room for improvement towards efficiency. The bulk of the loss is in the cooling water.

"Until recently the gas engine has been made in comparatively small sizes only. In the early part of 1898 an engine of about 650 brake-horse-power was completed in the works of the Westinghouse Machine Company. This engine is of the three-cylinder type and has a speed of 150 revolutions per minute. It is now running in regular commercial service at the works of the Westinghouse Electric and Manufacturing Company. It is the largest gas engine in the world. The Westinghouse Machine Company are now making plans for a 1,500 brake-horse-power gas engine. This engine is of the three-cylinder type, and it is designed to run at 100 revolutions per minute. Remarkable economy is expected from this engine, and it would not be surprising if it developed a brake-horse-power for every 8½ cubic feet of natural gas consumed per hour, or 8,500 British thermal units per brake-horse-power. This would give a heat efficiency of $2{,}564 \div 8{,}500 = 30$ per cent. at the shaft."

THE WATER PROBLEM IN PHILADELPHIA.

The following article is an address by Prof. Edgar Marburg before a special meeting of the Engineers' Club of Philadelphia, called to consider the typhoid fever epidemic in that city:

We are met this evening to do our part, as engineers and as citizens of Philadelphia, in an effort to bring about a rational solution of what has come to be known as the water problem. Aside from the simple question of finance and the complex one of practical politics, the problem is purely an engineering one. It is not necessary, however, that one should be versed either in finance or in engineering, much less in machine politics, to arrive at sound general conclusions, that is, to discern a straight, clear way through the maze of visionary, corrupt or quack schemes that have been proposed or prompted in endless variety and number. Disinterested honesty and plain common sense are the only real essentials.

To squarely meet the issues as they stand today, what are the facts? 1. That the net revenues to the city from its water-works are about $1,000,000 per annum. 2. That for the past several years practicaly no appropriation has been allowed for extensions, however urgent the need and the demand. 3. That for the present year the estimates for bare maintenance, that is current necessities, have been scaled down to sums known by experience to be absolutely inadequate. 4. That through lack of restrictive measures against wanton waste the average daily pumpage has reached the stupendous aggregate of 275,000,000 gallons, or about 230 gallons for every man, woman and child in the city of Philadelphia. 5. That most of the pumping machinery must be kept in perpetual operation in its ceaseless race against impending water famine. 6. That through accident to the machinery a crisis may be reached at any moment to cause widespread suffering in our community. 7. That some districts are feeling, even now, the infliction of an inadequate water supply and insufficient pressure. 8. That with the present extravagant rate of consumption mere sedimentation for a limited period is impracticable. 9. That through lack of timely measures for effective purification our city is now scourged by a visitation of typhoid fever more appalling in its death-rate than any experience of the past. 10. That the earnest recommendations and appeals of the Bureau of Water, renewed for these many years with unfailing regularity, are cast to the winds. That this bureau, instead of receiving proper aid in carrying out the sound policies it has proposed, finds its eneregies largely wasted in vain attempts at making serious responses to absurd inquiries and formal reports on impracticable schemes.

These are the salient facts in the situation as it exists to-day. The remedy may be summed up in a dozen words. Let the public and the press unite in loyal support of the Water Bureau. If the officials of this bureau should prove themselves incompetent or faithless to their trust, the officials should be changed. The principle itself remains unaffected. In the campaign against recalcitrant members of City Councils let the watch-word be "support our engineers." Let matters of engineering be entrusted to the unhampered control of engineers. No profession has shown itself more worthy of trust in mattters coming within its sphere. Let laymen not presume to dictate policies or to obtrude advice in matters purely professional. Let Councils confine themselves to the honest discharge of their own special functions—that of providing ways and means for the speedy and effective execution of such measures as are recommended by the engineers.

Summed up in brief, what does the Bureau of Water propose in the present exigency?

First: Adequate appropriations for placing its plant in a state of uniform efficiency.

Second: Measures for the restriction of wanton waste.

Third: The installation of filtration plants.

Concerning the first proposition, there can be no division of honest sentiment. Its reasonableness will be admitted by every right-minded member of this community. It may be dismissed off-hand on its merits without argument.

The second and third propositions cannot be treated separately. We need no training as engineers to recognize the folly of plunging out upon an elaborate scheme of filtration, unaccompanied by measures for the restriction of our present wholesale waste. Referring first to filtration, it is probably true that the overwhelming proportion of our population have come to recognize its imperative need. This is not the time to discuss the relative merits of various systems. Such questions may be left with confidence to the proper officials, who propose to avail themselves of the absolutely disinterested counsel of leading experts. The problem of filtration may well be dismissed with these general statements.

It is against the evils of reckless waste that the campaign of popular education should be especially directed and it behooves us, as engineers, to be leaders, not weak-kneed followers, in this campaign. As engineers, familiar, if only in a general way, with the experiences of other cities, we know that the introduction of meters is the only proper solution. The proposed substitution of automatic valves for appliances now in common use, especially in connection with hopper-closets, though an encouraging step in the right direction, does not strike at the root of the evil. The present opposition of the public and of the local press against water meters is but a repetition of the history in many other cities where meters have come to be recognized as the helpful agencies they really are. The oft-repeated popular cry that water should be as free as air and sunlight, is as fallacious as many other phrases that captivate the unthinking ear. Water is free to him alone who fetches it with pail in hand from its place in nature and sets no value on his time and labor.

Making all reasonable allowance for errors in the computation of pumpage, for evaporation and seepage from the reservoirs, and for leakage in the distributing system, the stubborn fact remains that from one-half to two-thirds of our so-called consumption is chargeable to the most reckless waste. It is not my purpose to present elaborate arguments and statistics in support—I will not say defense—of meter systems. The exeperience of the numerous municipalities in which such systems have been adopted all point to the same general conclusions. I propose therefore to direct attention merely to a few leading facts, not for the information of engineers, but as an appeal to thoughtful laymen.

The adoption of meters will meet with immediate response in the reduction of waste. With a sufficiently comprehensive system, our consumption will be reduced one-half or more. The reckless consumer must reform, or pay the penalty of his own folly. His waste will no longer fall as a tax upon his more prudent townsmen.

Decreased consumption means a proportionate saving in coal bills and numerous other operating charges. The capacity of the distributing system will be correspondingly increased. In low-pressure districts, increased pressure will result without the purchase of additional pumps. Pumps now driven night and day may be thrown out of service and kept in reserve for contingencies.

The fixing of water rates will be changed from mere guess-work to a system equitable to all consumers. With equal revenues to the city the cost to the average consumer will inevitably be reduced.

Lastly, if waste is to proceed unchecked, the outlook for filtration seems well-nigh hopeless; both by reason of its enormously increased cost and because of the then urgent need for extensions in all directions. With restricted waste, the existing reservoirs will probably suffice for at least preliminary sedimentation preparatory to filtration.

If the foregoing facts were fully appreciated by the public the present widespread opposition to the meter system would doubtless quickly melt away.

The objections urged against meters with some sound of reason may be grouped under three principal heads:

First—That a charge for water according to consumption would cause the poorer classes to stint themselves in its use, discourage cleanliness, and prove prejudicial to the general health and comfort of the community.

The answer is: Prescribe a fixed minimum charge regardless of quantity actually used, provided the latter does not exceed a certain stipulated but amply liberal allowance, and impose an additional pro-rata charge on extra consumption only. The per-capita allowance may be fixed at will, the main contention being that some limit should be set.

Second—That since water-rents in Philadelphia are borne by property owners, not by tenants, the former would be held liable for waste or leakage, which they are powerless to prevent, and that innumerable disputes and lawsuits would be the outcome.

The change to a system exempting the owner and placing the tax wholly on the tenant, however rational, would meet with determined opposition and could not easily be brought about. An obvious solution, in line with the present system, would be to have the lease so drawn that the owner assumes the fixed minimum charges and the tenant is held responsible only for surplus waste.

Third—That meters would affect the manufacturing interests unfavorably.

But, as has frequently been pointed out, the meter dos not fix the rate, but simply registers the quantity. Without entering upon the merits of any particular line of policy, water might be furnished to the manufacturers at discriminating rates or even gratis, if deemed expedient. Nevertheless, a reasonable limit should be set even to public bounties and without the meter the common interests cannot be safeguarded against gross abuse in individual cases. Unless the present average rates to manufacturers are entirely disproportionate to their average legitimate consumption, it follows, on the basis of the present net revenues to the city, that a saving will accrue to the average manufacturer, without resort to discriminating rates.

The most signficant fact in the history of meters is that wherever they have been allowed to gain a reasonable footing, their merits have become recognized by the public and that in no instance a backward step has been permitted in their use.

A FACTORY POWER PLANT.

An interesting mechanical plant was recently seen in a Newark, N. J., manufacturing establishment. It is one in which power and light are generated on the ground, and includes a water-supply system from a well on the premises, supplying water for domestic purposes and for a fire-protection system. The plant is, therefore, practically independent. The factory is on the corner of Washington and Warren streets, and is owned and occupied by The Whitehead & Hoag Company, which manufactures badges, buttons and advertising novelties in general. It consists of a large brick building, three, four and five stories in height, as additions have been built on from time to time. The house in which the power plant is set apart is a single-story brick structure ad-

joining the five-story addition. The floor surface in the factory covers about two acres.

The power plant consists of two boilers, two steam engines, two generators, two air compressors and various steam pumps. Steam is generated at a pressure of 105 pounds in two 100-horse-power McEwen tubular boilers, and is carried through a brick partition into the engine room. One of the engines is a 15 x 30-inch simple non-condensing Hewes & Phillips Corliss engine of 97 horse-power, and drives a jack shaft. The other engine is a New York Safety 13 x 12-inch engine of the simple automatic-cut-off type, and is belted to a 65-kilowatt C. & C. generator. The second generator, 30 kilowatts in capacity, is driven from the jack shaft. The power for driving the machinery is transmitted from the jack shaft by belt and shafting. From floor to floor, however, the power is available from a vertical shaft, 66 feet in length, extending through the building. This construction, of course, dispenses with the openings necessary with belting from floor to floor. The shaft is in three sections, from 2 15/16 to 2 7/16 of an inch in diameter, and makes 200 revolutions per minute. It is supported on a brick pier in the basement by a bearing made by A. and F. Brown, of Elizabeth, N. J.

The connections to the two generators lead to a switchboard and through switches and circuit breakers to the bus bars on its back. The building is lighted on the two-wire 110-volt system with 12 sets of feeders, controlled from this point by a corresponding number of switches with fuse connections. The conductors are carried about the building on wooden strips, and supply ceiling drop lamps. The generators may be run at the same or separate times, an equalizing bus bar effecting the parallel arrangement. During the night, or whenever the power is shut down, light is derived from a storage battery, which has been installed. The battery connections with switches, ammeter and voltmeter occupy a special panel of a switchboard comprising four panels in all. The battery has a capacity of 50 lights for seven hours. It is charged during the day by a small 60-volt booster, by which the pressure is raised to the required voltage. The booster is of the compound type, and a circuit breaker is put in the circuit to break the connection whenever the battery becomes fully charged.

The building is heated in part by direct radiation and in part by a heated supply of fresh air. Exhaust steam is used in the system, supplemented with live steam through a pressure-reducing valve. The water derived from the driven well while satisfactory for ordinary use is too hard for the boilers, and hence a metered supply is taken from the Newark water system for power purposes. The exhaust steam is therefore cleaned of its grease in a grease extractor, and may be used for heating the feed-water in addition to its use in the heating system. As it is condensed it drains back into a drip well, and is pumped automatically into the boilers.

The indirect system of heating is confined to those parts of the factory where the employees are more or less crowded together. There are two centers of air distribution. A Seymour disk fan is set up in each and draws fresh air through adjacent window openings. The air is forced through nests of radiators, passing thence into the distributing system. Ceiling ducts on the first and second floors are used to carry the air to various rooms. In the five-story building, the latest constructed, provision was made for flues in the rising walls. The air is carried from the hot-air chamber to the base of the flues, and is delivered at each floor. The air within the ducts passes into the rooms through circular holes 3 inches in diameter and about 18 or 20 inches apart. There are no vanes or dampers to divert the air through holes likely to be least favored; instead, the amount of air delivered by the fan is such as to maintain a pressure above that of the room within all parts of the ducts. On every floor there are two toilet rooms, for men and women, and these are provided with a wall vent register which opens into a flue, carrying the vitiated air to the roof, where it is exhausted by a roof fan. No other provision is made for carrying away the air supply, the intention being to cause a flow of air to take place from the building into these rooms and out into the atmosphere.

The water supplied the building for domestic purposes is lifted by the Pohlé air pump. Compressed air for the purpose is delivered by an Ingersoll-Sergeant power compressor, with 10 x 10-inch air cylinder and run by belt from the jack shaft. The well is 342 feet deep, but the water stands within 19 feet of the top of the well. It is lifted by the Pohlé method to a tank on the roof, 65 feet above. It is estimated that between 800 and 1,000 cubic feet of water is raised through this height every hour, and at one time, when it became necessary to use the Newark water for a brief period, it was found that the use of a driven well produced a saving of from $4 to $5 a day. The tank is of wood, and has a capacity of about 8,000 gallons.

For protection against fire, the building is equipped with an automatic sprinkler system. This includes a steel tank, also on the roof, of about 10,000 gallons capacity, and the water is subjected to a constant pressure of 80 pounds, maintained by a Crane air compressor of the locomotive type in the engine room. Besides this a Deane duplex pump is set apart for fire purposes, and is regulated to work whenever the pressure on the mains drops below 60 pounds. The pump draws its supply from a steel tank 9 feet high, 9 feet broad and 90 feet long, on a slightly lower level. The capacity of the pump against the pressure mentioned is 500 gallons per minute. All water used in the building and not unfitted for storage in the tank, drains into it and an overflow into the sewer about 6 inches from the top of the tank keeps the quantity of water constant. The tank holds thus about 35,000 gallons, which is thought ample to cope with any fire until the fire department of the city shall have arrived. A recording pressure gauge is used in connection with the boiler plant and serves two purposes: it provides for a pretty careful regulation of the steam pressure by the watchmen, to ensure the fire pumps being able to work effectively at any time; and it may be taken to disprove the complaints which have been made by neighboring residents to the effect that there are occasional blow-offs during the night prejudicial to good sound sleep.

The original plant was put in under the direction of Messrs. Francis Brothers & Jellett, of Philadelphia. The later additions to the heating work were made by Messrs. T. B. Cryer & Company, of Newark.

THE ROGERS PARK WATER-WORKS CASE.

A few years ago the Supreme Court of Illinois rendered a decision on the validity of contracts between private water companies and cities, which was recognized as giving considerable security to investments in works of this character in that State. The decision was in a suit brought by the Danville Water Company against the City of Danville, and was printed in these columns on November 20, 1897. Recently the same court has rendered a decision which, to a lay mind, reverses its former ruling and incidentally shows that a strict interpretation of the law may not be in accord with what business men regard as just dealing; the courts are, of course, obliged to decide the questions before them on the basis of the existing laws. Another recent case is that of the Rogers Park Water Company, which has been supplying the residents of Rogers Park with a filtered supply of better quality than that furnished to the citizens of Chicago, of which the town is now a part, by the city works. The expense of filtering the water as well as the comparatively greater cost of running a plant of small size compared with the enormous works of the City of Chicago, made it necessary for the company to charge a slightly greater price for its purified water than Chicago charged for the Lake Michigan supply delivered without any pretense of purifying it. The suit was brought to compel the company to supply water at the same price as the city works, and while the decision of the State court has been against the company, as will be seen from the text reprinted below in full, nevertheless it is stated that it will be appealed to the Federal courts and carried to the highest tribunal which will receive it. In view of the recent success of the Walla Walla Water Company before the United States Supreme Court, reviewed in "The Engineering Record" of January 28, the further course of the Rogers Park suit will be well worth watching. Comment on the reversal of the Danville decision will be found elsewhere in this issue.

"On the 12th day of November, 1888, the village of Rogers Park, in Cook County, was organized under the general act providing for the incorporation of cities and villages. On the 4th day of April, 1893, the village was annexed to and became a part of the City of Chicago. The appellant company is a corporation organized under the general statute providing for the formation of corporations, the object for which it was incorporated being 'to locate, construct and operate a system of water-works in the village of Rogers Park.' On the 4th day of October, 1897, the city council of the City of Chicago passed an ordinance fixing the maximum rates to be charged for water furnished to the inhabitants of that part of the territory of the said city, which had formerly composed the village of Rogers Park, making water rates in such territory uniform with the rates provided by other ordinances, to be paid in other portions of the city. The appellee, who occupied premises situate within the former limits of the said village of Rogers Park, which premises were supplied with water from the water mains of the appellant company, filed this a petition for a writ of mandamus, to require the appellant company to furnish water at the rates fixed by the said ordinance of the City of Chicago. The appellant company plead-ed the village of Rogers Park, prior to the annexation thereof to the City of Chicago, on November 12, 1888, adopted an ordinance, granting to it the exclusive right of laying pipes and mains and other conduits in the streets, alleys and public places in the said village, for the purpose of furnishing and conducting an adequate supply of water to said village and the inhabitants thereof for public and private use, for and during the period of thirty years, and by the same ordinance fixed the rates to be charged to individual consumers of water during the said period of thirty years, and that in pursuance of said ordinance, it completed and put in operation a system of water-works, and was ready and willing to furnish the appellee with water at the rate fixed by the said ordinance of said village of Rogers Park, and that it was not legally required to accept the rates fixed by the ordinance of the City of Chicago, the maximum rates fixed by the City of Chicago being lower than the maximum rates fixed by the ordinance of the said village for the same service. After a trial the court entered a judgment awarding a peremptory writ as prayed by the appellee, from which judgment this appeal is prosecuted.

"The appellant corporation voluntarily sought corporate existence, in order to enable it to engage in an enterprise essentially public in its character, in the prosecution of which it

would be necessary the property of the corporation should be devoted to a use in which the public had an interest. For the accommodation of the business it designed to pursue it was necessary it should secure, and it did secure, a special privilege to occupy the streets, alleys and public places of the village of Rogers Park. This license was granted because it was engaged in a business of extreme necessity to the inhabitants of the village. It is not a private but a quasi public corporation, and is subject to be controlled by the public with relation to the rates to be exacted for the commodity it was created to supply to the public. Power is possessed by the State to prevent extortion by such quasi public corporations, and to restrict them to the exaction of reasonable rates and charges. (Munn vs. People, 69 Ill. 80; Ruggles vs. People, 91 id. 256; Munn vs. People, 94 U. S. 113; Spring Valley Water-Works vs. Schotten, 110 id. 347; Beach on Public Corp. Secs. 2, 3; Hanger vs. Water Co. 28 Pac. Rep. 244; Tiedeman on Limitations of Police Power, Sec. 93.) We do not understand counsel for appellant antagonize this as the true view of the law. But the position of the appellant company seems to be, the alleged ordinance of the village of Rogers Park was a proposition on the part of the village to it to construct and maintain a system of water-works in the village for a period of thirty years, and that to induce it to accept such proposition and provide a supply of water for the village and its inhabitants the rates to be paid by the village and by the inhabitants thereof for water during that period were fixed and prescribed by the terms and conditions of the ordinance; that it accepted said ordinance in view of the prices and rates so fixed, and having constructed the system of water-works in accordance with the provisions of the ordinance, and having in all other respects complied with its terms, the ordinance, the acceptance thereof and fulfilment by it of all things required to be done upon its part constituted a binding, irrevocable contract.

"The ordinance of the City of Chicago requires the appellant company shall accept the same scale of prices for the water supplied to the inhabitants of that part of the said city which was formerly embraced within the limits of the village of Rogers Park, as is paid by the consumers of water in other portions of the city. This scale of prices is lower than the rates fixed by the alleged ordinance of the village of Rogers Park. The argument of counsel for the appellant company is, that the provisions in the alleged ordinance of the village of Rogers Park, fixing the rates to be charged by it for water, and its acceptance of the said ordinance and compliance therewith, constitute a property right of the appellant company and an irrevocable contract right, and that the ordinance of the City of Chicago contravenes Section 2 of Article 2 of the constitution of 1870, which provides, no one shall be deprived of property without due process of law, and also is in violation of Section 14 of the same article of the constitution, which prohibits the enactment of any law impairing the obligation of a contract, and that for these reasons said ordinance of the City of Chicago is void.

"We do not think the adoption of the alleged ordinance by the village of Rogers Park and the acceptance and fulfilment of the conditions thereof by the appellant company vested it, as with a property right, with the power to demand that the rates named in the ordinance should remain fixed and unchanged for the period in which it was licensed to occupy the streets of the village, or that the ordinance and its acceptance constituted a contract, or that any contract obligations arose by reason thereof. The appellant company stood charged with a legal duty to supply water to the inhabitants of the village for a reasonable compensation. It received corporate existence in order to enable it to discharge that duty, and the State possessed ample power to enforce the performance of that duty. The power possessed by the State to enforce the duty might be properly exercised by establishing a scale of rates and prices to be demanded by the company from the inhabitants of the village, and this power, and that mode of exercising it, were delegated by the State to the village by Section 1, Article 10, Chapter 24 of our statutes. (Starr & Curtis' Stat. 1896, p. 785.) The village exercised the power by incorporating in the ordinance a scale of prices as being just and reasonable maximum rates to be paid to the company by the consumer of water. This provision of the ordinance had no effect to establish a contract between the appellant company and the village that the individual inhabitants of the village should and would pay such rates for the period of thirty years, or any fixed period of time, but was simply a declaration on the part of the village that such rates were reasonable. The legal effect was to establish, prima facie, the corporation, in order to discharge the duty it owed to the public, must supply the commodity it had been created to supply at the prices named in the ordinance. It was a mode of regulating and enforcing the discharge of a legal duty—not a proposition looking toward a contract. No contract was necessary to create an obligation on the part of the corporation to supply water at a reasonable rate, for that rested upon it as a duty.

"Nor did the fixing of rates by the alleged ordinance of the village of Rogers Park vest in the appellant company an irrevocable right to exact such rates for the period it had been granted permission to occupy the streets, alleys and public places of the village, or for any fixed period. A rate or price reasonable and just when fixed may in the future become so unreasonably high that the exaction of such rate or price is but an extortion. The duty of the corporation does not, however, change, but remains the same—that is, to exact only reasonable compensation. The power of the State to enforce that duty is not exhausted by its exercise in the first or any subsequent instance, but is continuous, and may be exerted from time to time, whenever necessary to prevent extortion by the agency created by the State to serve the public. Whenever the evil of extortion exists the power to eradicate it may be successfully invoked. In the exercise of that power by the State or by a municipality exercising the power by delegation from the State, there is no admixture whatever of any contractual element, nor does the corporation against whom the power is exercised obtain any vested property interest or property right in the scale of rates deemed at any particular time to be reasonable maximum prices for the article to be supplied by the corporation. The annexation of the village of Rogers Park to the City of Chicago operated to clothe the City Council of the city with ample authority to determine, prima facie, whether the rates demanded by the appellant company for water supplied to the inhabitants of that part of the city which was formerly within the limits of the village were reasonable, and to enact an ordinance reducing such rates if deemed by the council to be extortionate.

"It is suggested the members of the City Council are elected by the people and are agents of the people, and that the action of the council in fixing the prices to be paid for water is, in effect, that of those who are to purchase water, and is therefore violative of the general principle no man shall be a judge of his own case. If there is any force in this view it is destructive of the doctrine, in its entirety, that the State is possessed of power to restrict, within reasonable limits, the charges of quasi public corporations, for the State acts through the members of the General Assembly, who are the agents and representatives of those who are to be benefited by such restrictions. The suggestions omit from consideration the controlling fact that quasi public corporations are created by the State for the good of the public—to serve the public—and that they accept corporate life subject to the power retained by their creator to regulate and control them for the public good. The General Assembly is the legislative department of the State, and the City Council is the governing board, and in a sense the legislative department of the city. The members of each of those bodies act in their official capacity and are bound, in morals and in law, to act honestly, conscientiously and impartially, and with due regard for the rights and interests of all who may be affected by their official determination. The best interests of the public will not be subserved by denying fair and reasonable profits and gain for services to be rendered by quasi public corporations to the people, for the reason that if insufficiently remunerated such corporations cannot exist. The public good, therefore, demands unselfish, consicentious and patriotic treatment of the question at the hands of those entrusted with the duty and power to consider and determine as to the interests of the people and of corporations, which, properly viewed and judged, are and should be mutual. It is not assumed that a duty so obvious will be wilfully disregarded, and that narrow and selfish considerations will prevail and control such representative bodies. Nor are the corporations left without remedy against unwarranted and unjustifiable acts of the municipal council. If the scale of rates established by a city council is deemed unreasonably low and unjust, it is expressly provided that the action of the council may be reviewed and determined by the courts on application of the corporation. (Starr & Curtis' Stat. 1896, Chap. 24, Par. 458, p. 868.)

"The contention here is not that the rates fixed by the City Council of Chicago are so low as to be oppressive, but that the rates fixed by the ordinance of the village are unalterable for a period of thirty years. That contention cannot be maintained. Appellee, on May 17, 1897, signed an application to the appellant company to be supplied with water, 'subject to the rules and regulations of the company now in force or hereafter to be enacted or adopted, which rules and regulations are hereby made and declared to be part of the contract between me (appellee) and the said company for supplying said premises with water. The application was accepted and the appellee received water thereunder and paid the rates fixed by the ordinance of the village and the rules of the company framed thereunder, until December 11, 1897. On October 18, 1897, the City Council of the City of Chicago adopted the ordinance reducing the rates, and on December 11, 1897, appellee tendered payment for a future supply of water according to such reduced rates, which being refused, he filed this petition to require the appellant company to submit to the provisions of the ordinance of the city as to the amount to be paid by him. There is no force in the insistence his application and its acceptance constituted a contract on his part to pay indefinitely, or during the period of thirty years, at the rate fixed by the rules and regulations of the company framed under the ordinance of the village. It but bound him to pay such rates only so long as the appellant had lawful right to demand and receive the prices fixed by the ordinance of the village. The rules and regulations in force referred to in the application became inoperative by force of law as to the rate to be paid when a new scale of rates was established by the ordinance of the city.

"The view we have taken of the question here involved rendered it unnecessary we should determine the contention of the appellee that the alleged ordinance of the village set out in the pleading by the appellant company had not been legally adopted by the board of trustees of the village. The judgment is affirmed."

MOVING AN IRON BUILDING IN PARIS.

At the Paris Exposition of 1889 the Machinery Hall and the Central Dome were united by an iron building about 98x492 feet in outside dimensions, which was called the Thirty-Meter Gallery and was preserved after the removal of the other exposition buildings. In constructing the new buildings for the exposition of 1900 it was decided to incorporate the framework of this building in that of the longer Electricity Building, which was accordingly designed to have the same columns, roof trusses and general cross sections, but differed from the old building in the longitudinal spacing.

Machinery Hall had seven main roof trusses dividing it into six 82-foot panels or sections. The Electricity Building has two wings, each composed of three 82-foot panels separated by 36-foot panels and having end panels of different lengths at both extremities. To conform to these conditions, six new trusses and pairs of columns were built for one wing and united in three 82-foot panels by the purlins and other longitudinal and intermediate members removed from three alternate panels of the old building, in which the three other alternate panels were left standing as isolated towers, each of which consisted of four columns, two trusses and nine purlins, together with longitudinal side struts, jack rafters, etc. Each tower was moved bodily to the required position in the other wing of the new building, and the framework of the end sections and of the 36-foot panels in both wings was assembled with new members.

Special appliances and minute preparations were made for moving these towers, and the work is elaborately illustrated in the "Genie Civil." The building was apparently without transverse, lateral or sway bracing, and each tower virtually consisted of two inclined roof planes made wholly of longitudinal and transverse members and supported at the four corners on 70-foot columns. These columns each had two wide solid plate webs in the transverse plane and were apparently in two sections, the upper one extending from the springing line to the hip of the riveted girder truss with which it was integral and connected by a horizontal flange splice with the top of the lower section. Each tower was stiffened by the addition of a temporary horizontal strut, made from an old purlin, extended when necessary, across each of the four sides connecting the bottoms of the columns, and by the insertion of a pair of wire rope diagonals above it in each face, which were furnished with screw adjustments. Each connection of the column and roof truss was also reinforced by a peculiar offset plate girder about 10 feet long, riveted to both members in the vertical transverse plane, like a huge inside flange cover splice. Brackets and transverse girders were riveted to the bottoms of the columns and jacks were set under them and lifted the tower about 16 inches. Rollers were placed under it and it was moved a maximum distance of 328 feet in the direction of the axis of the building, then revolved 90 degrees around a central vertical axis, and moved a maximum of 525 feet to the new foundations. The total weight moved at each tower was about 180 tons, and it was lifted one side at a time, alternately, in 4-inch steps by 16 men operating eight jacks, four under each column.

Base plates with vertical gudgeons projecting downward from their centers were bolted on the under side of the column bases. Each column was set on a car about 15 feet long, whose sides were plate girders 25 inches deep at the ends and notched down to 12 inches in the middle, where they received the base plate of the column on a bearing surface, which was pierced to receive the gudgeon and center the column. Four wheels were set in a row between the web plates, with movable journals having screw adjustments to enable the axes to be set slightly oblique. Trenches about 3 feet wide and deep were dug, and in them two single lines of rails were laid about 98 feet apart; on them each tower was moved until its center was at the intersection of the axes of the old and new buildings. Then it was jacked up, the cars revolved 45 degrees on the gudgeons, and lowered to the rail of a circular turntable track 131 feet in diameter, to which the axles had been set radial. The tower was revolved 90 degrees on the turntable, lifted, the cars and wheels restored to their original alignment, movable sections of the circular rail replaced by those of the intersecting track parallel to the axis of the new building, and the tower lowered and moved to its final position.

During the moving the tracks settled as much as 2 inches and had to be leveled up. The tower was moved by four windlasses, one on each car, each operated by four men, who wound up on a steel cable anchored to the track about 40 feet in advance, and attained a speed of about 80 feet an hour. One tower was moved from its original position to the turntable and revolved ready to be moved in the new direction in 8 hours. After the first two towers had been moved to their new positions, both were blown down by a wind storm.

NOTES.

The American Public Health Association will hold its twenty-seventh annual meeting at Minneapolis October 31, November 1-3.

The New England Cotton Manufacturers' Association announces that its sixty-sixth annual meeting will be held April 26 and 27 at Boston, Mass.

The Large Steel Chimney of the Cincinnati Edison Electric Company, which was illustrated in these columns on April 1, is surpassed in girth by the steel chimney built at the Natrona, Pa., plant of the Pennsylvania Salt Company, according to Mr. W. W. Christie. He states that this chimney is 200 feet high, 41½ feet in diameter at the base and 28½ feet in diameter at the top. It is lined with fire brick and is used to carry off smoke and chemical vapors.

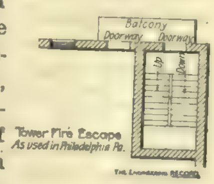
The College of Engineering of the University of Wisconsin seems to be a popular branch of that institution. The gain in attendance during the last seven years has averaged 20 per cent. greater than that of the rest of the university, while the increase in the number of students during the last five college years has been nearly 25 per cent., in spite of the fact that an increase in the tuition fees caused a temporary falling off of the attendance during one of these years.

The Kinzua Viaduct on the Erie Railroad is to be taken down in a short time. This famous structure was erected by Clarke, Reeves & Company and has always been regarded as one of the leading achievements of American engineering. It is 2,052 feet long and its greatest height from the masonry piers to the rails is 285 feet. The erection of the structure, which weighs about 1,750 tons, was accomplished without falsework. The bridge has been considered for several years to be too light for the heavy traffic of the present day.

The Fertilizing Properties of Street Sweepings have been investigated by the Division of Chemistry of the United States Department of Agriculture and the various samples analyzed show that the value of the material is from 34 cents to $1.46 a ton. Gardeners declare that the sweepings improve the mechanical condition of stiff and badly aerated soil as well as fertilize it. It was found that sixteen cities were selling this material to farmers at prices ranging from 15 cents to $2 a ton. In Atlanta a contract had been made by the terms of which the city was paid $60 a year for the sweepings and the street cleaning department given certain privileges in the way of short hauls to collecting stations.

The Control of Water Supplies by the State Board of Health of New York is proposed in a bill now before the Legislature, which is the result of more than a year's work by Professor Olin H. Landreth of Union College, Schenectady. It is intended to allow the Board to procure information and make investigations which will enable it to act intelligently in the future when the pollution of water supplies assumes a more acute stage than is now the case. The bill intrusts the Board with the general care and oversight of the purity of the waters of the State, and allows it to co-operate with town and city authorities to make special investigations when the purely local features of the examinations are made at the expense of the local officials. Authority is also granted the Board to co-operate with all public or private corporations which discharge contaminating matter into the waters of the State, in making investigations to ascertain the most efficient methods of abating or entirely removing the pollution. Another bill appropriates $10,000 for the purpose of carrying out these studies and examinations. The objects sought by this legislation are of much importance and it is to be hoped that the bill will pass.

The Philadelphia Fire Escape referred to in the course of an article in these columns on March 25 on the fire in the Windsor Hotel in New York, is described more fully in the following note from Mr. William C. Haddock, chief of the Bureau of Building Inspection of Philadelphia: "You will find enclosed a sketch showing what is practically the standard tower fire-escape as used in Philadelphia, and as made obligatory for mills, factories, department stores, hotels, apartment and tenement houses, etc., by act of Assembly. You will see from the sketch that it is a stair tower enclosed by brick walls with no openings into the building on any of the floors to which it is attached, and none but the door to balcony from which the tower is entered. Very seldom are the stairs in this tower fire-escape constructed spiral or with winders, so that very easy safe stairs are obtained—much better in times of panic or rush of a crowd, and very much better for a woman to use. The tower or shaft is entered through a doorway leading from an iron balcony, but in most cases no door is hung, it being preferred to have this opening so that the stairs may always be accessible without the risk of a door being hooked or bolted when access is most wanted. With this fire escape one may enter and be safe from fire and smoke, although the building to which it is attached may be entirely enveloped in flames, and probably its greatest feature is its being smoke-proof."



The Conditions at the Mouth of the Mississippi River were described very clearly in a paper recently read before the Louisiana Engineering Society by Major B. M. Harrod of the Mississippi River Commission. He stated that in 1875 the South Pass had a length of about 10 miles and a depth of 28 feet, enough for the vessels then entering the river. At each end of the pass there was a bar which had to be removed to make the channel navigable. That at the head was removed by building dams and dikes reaching about 6,000 feet upstream and involving extensive and costly engineering works. The bar at the sea end was removed by building jetties, which, with the works at the head of the pass, made the channel about one-third longer than its natural length. For a

time the works at the head of the delta satisfactorily accomplished the adjustment of flow between the several passes. Little by little, however, as a flood of more than usual magnitude came, or as they were weakened by decay, pieces were washed out and positions were reoccupied by the river which had been wrested from it with difficulty, until at the present time a large part of the most exposed work is lost and the river flows over its site with depths of 50 to 75 feet. Any project to enlarge the South Pass involves a struggle with the well-defined intention of the river. The cost will be great and success doubtful. If it is once obtained it will not be final, for the river will persist in its efforts to choose its own route. The struggle can be largely if not entirely avoided by the selection of the Southwest Pass for improvement.

A Fire Test of a Concrete Floor was recently carried out by the British Fire Prevention Committee at its experimental plant briefly noticed in these columns a few weeks ago. The floor tested was 10 feet square and supported on three parallel 6-inch I beams, one at the center and two close to the walls. On top of the beams was laid a sheet of expanded metal and on this 3 inches of concrete with a half-inch finishing coat of cement. Below the beams there was an expanded metal and plaster ceiling. The floor was allowed to stand for three months before testing. The object of the test, as stated in the report issued by the Committee, was to record the effect of a smouldering fire of fifteen minutes' duration and of a temperature not exceeding 600 degrees Fahrenheit, followed by a fierce fire of one hour, gradually increasing to a temperature of 2,000 degrees, followed suddenly by the application for three minutes of a stream of water and the consequent rapid cooling. The floor was loaded with 140 pounds per square foot and was 7½ feet above the bottom of the combustion chamber, of which it formed the roofing. The result of the test are stated as follows: "The plaster ceiling below the floor remained intact until the application of water. There was a slight defection of floor and ceiling. The concrete of floor was slightly and superficially cracked. The fire did not pass through the floor."

TRADE PUBLICATIONS.

The Ingersoll-Sergeant Drill Company, New York, has prepared a little pamphlet index to its larger publications, which is itself a handy brochure for those who do not care to retain bulky catalogues.

The Laurent-Cherry cable hoist-conveyors, which do not require fall rope carriers, are described in a well-illustrated book issued by the Trenton Iron Company, Trenton, N. J. It contains an unusually full explanation of the construction and working of the apparatus and views of a number of installations.

A short treatise on the characteristics and properties of pigments and paints for the use of architects has been written by Mr. Stanton Dudley and printed in attractive form by the New Jersey Zinc Company, 52 Wall street, New York City. All who enjoy reading an interesting article on house painting are advised to apply for a copy.

The Wilkinson Manufacturing Company, Stephen Girard Building, Philadelphia, has prepared a book describing the automatic mechanical stokers it manufactures and illustrating a number of plants in which they are used. The book describes the method of fitting the apparatus to boilers of different types and contains a large number of testimonials from power users who have found it satisfactory.

The S. Wilkes Manufacturing Company, 53-55 South Clinton Street, Chicago, Ill., has prepared a new catalogue of its line of hot water heaters, steam generators, steel tanks and other products, which will be sent on application if this journal is mentioned. The pamphlet contains considerable information concerning the methods of heating in which the company's apparatus is employed and many testimonials as to its efficiency.

Handling earthwork at a low cost is a matter in which every contractor is interested, and to accomplish this result it has now become necessary to use time and labor saving apparatus. The Kansas City Wheel Scraper Company, 913-917 East Nineteenth Street, Kansas City, Mo., is distributing a catalogue of its line of such appliances for plowing, grading and carting, and a copy will doubtless be sent to those who make an application for one to the above address.

PERSONAL AND OBITUARY NOTES.

Mr. William Moran has been appointed superintendent of the Titusville, Pa., water-works.

Mr. John N. Wolfe has been re-elected city engineer of Lancaster, O., for the fifth consecutive term.

Mr. P. E. Pettee has been appointed superintendent of sewers of Natick, Mass., succeeding Capt. A. A. Kane.

Mr. G. H. Swan has been appointed superintendent of the water-works of Niagara Falls, N. Y., succeeding Mr. Henry Keller.

Mr. Walter Frick has resigned the office of city engineer of Carbondale, Pa., to take charge of the engineering work of the Crystal Lake Water Company.

Mr. William C. Haddock has been appointed director of public works of Philadelphia. At the time of the appointment he was chief of the bureau of building inspection.

Mr. Harrison R. Van Duyne has resigned from the city engineering force of Newark, N. J., to go into business with his father, Mr. Harrison Van Duyne, commissioner of public works.

Messrs. Pepper & Register, engineers and general contractors, announce the removal of their offices from 1414 South Penn Square to Rooms 712-715, Fidelity Mutual Life Building, Philadelphia.

Mr. Theod. G. Hoech, M. Am. Soc. C. E., royal Prussian inspector of public works, who has been studying American engineering works for several years, has returned to Germany and will be located at Geestemunde for the present.

Mr. John J. Finigan, superintendent of the water-works of Lyons, N. Y., was burned to death a week ago while attempting to rescue his family from a burning house. He had been a contractor on public works in addition to managing the water company.

New members recently elected to various grades of membership in the American Society of Civil Engineers were announced as follows at the meeting of April 5: Members—Judd Allen Lockwood, New York City; Arsene Perrilliat, New Orleans, La.; Charles Henry Rust, Toronto, Ont.; Jonas Waldo Smith, Paterson, N.J.; William Richardson Webster, Philadelphia, Pa. Associate members—Julius Leroy Adams, South Manchester, Conn.; George Baum, Bloomfield, N. J.; Edward Everett Betts, Chattanooga, Tenn.; Edward Wallace Bush, Hartford, Conn.; Frederick Albert Coleman, Rome, N. Y.; Allan Winter Cuddeback, Paterson, N. J.; Charles Adriance Mead, Newark, N. J.; James C. Nagle, College Station, Tex.; George Fetter Stickney, Macon, Ga. Associates—Alger Crocheron Gildersleeve, New York City; John Byron Goldsborough, New York City. Juniors—Pitson Jay Cleaver, Brooklyn, N. Y.; Thomas Crabb, Newark, N. J.; Almon Homer Fuller, Seattle, Wash.; Charles Rufus Harte, Boston, Mass.; Frederic de Peyster Hone, New York City; Thaddeus Merriman, Washington, D. C.; Garrett Edward Tilt, Paterson, N. J. Fellow—John Robert Stanton, New York City.

CONTRACTING NEWS

OF SPECIAL INTEREST TO

CONTRACTORS, BUILDERS, ENGINEERS, AND MANUFACTURERS

OF ENGINEERING AND BUILDING SUPPLIES.

For Proposals see pages xi, xii and 440.

WATER.

Madison, Wis.—The Superintendent of the Water-Works recommends that arrangements be made at once for new pumps at the station.

Kenney, Ill.—The question of issuing $[illegible],000 water-works bonds is under consideration.

Princeton, Minn.—It is stated that this village has voted for an electric light and water-works system.

Lakefield, Minn.—Press reports state that at a recent mass meeting it was voted to build water-works and electric light plant.

Prineville, Ore.—Press reports state that it has been voted to issue $10,000 bonds for the purpose of erecting water-works and an electric light plant.

St. Charles, Mo.—A special election will be held April 15 to vote on the matter of granting a new water-works franchise.

Nyack, N. Y.—It is proposed to put to a vote of the taxpayers the proposition to appropriate $35,000 to complete the filter beds and make other needed improvements in the water-works.

Pine Island, Minn.—The Council has voted to issue $5,000 water bonds.

Rockyford, Colo.—A vote is about to be taken on the proposition to issue $10,000 bonds for the improvement of the water-works.

Leipsic, O.—It has been voted to construct water-works. C. W. Franklin, Chmn. of the Committee.

Kansas City, Mo.—An ordinance was passed by the Council appropriating $5,000 to be used in repairing the Holly St. reservoir.

Salt Lake City, Utah.—The Hills Canal & Irrigation Co., with L. M. Olson as Pres., M. P. Braffet, Vice-Pres., and Paul Hunter, Sec. and Treas., has been incorporated. The company will operate a canal from a point on Price river, near the mouth of Gordon creek, ten miles in a southeasterly direction. Capital stock, $20,000.

Durand, Mich.—Wm. H. Putnam, Village Clk., writes that an election will probably be called early in June to vote on the issue of water-works bonds.

Laurel, Del.—Chas. S. York of 1526 E. Biddle St., Baltimore, Md., is preparing plans and specifications for the construction of water-works and a sewerage system.

Vineland, N. J.—Charles Keighley & Sons, owners of the city water-works, have offered to sell the works to the town for $127,000.

Sandusky, O.—A resolution has been passed for the laying of 6 in. water mains in several streets.

North Braddock, Pa.—It is stated that a municipal water-works system is to be built.

Bloomfield, Ind.—The Town Board has employed an engineer to furnish plans and estimates for a water and light plant. At the election to be held May 1 a vote will be taken on the proposition to construct the same.

Spencer, Mass.—The town will vote on the matter of constructing a stand pipe at an estimated cost of $5,000. N. E. Craig, Engr. in Charge.

Canonsburg, Pa.—A committee has been appointed to obtain estimates for the proposed water-works and sewer system.

Rockville, Ia.—Mayor C. W. Harris writes that it was voted on March 27 to construct water-works.

Wyandotte, Mich.—It is stated that an election will be held April 17 to issue $12,000 bonds to repair the city pumping station and purchase the Doyle electric light plant.

Pittsburg, Pa.—The Laidlaw-Dunn-Gordon Co., of Cincinnati, O., has received the contract for a 5,000,000 gallon pumping engine. Cost, $25,000.

Zumbro Falls, Minn.—T. R. Watson, Village Recorder, writes that the village has voted to lay aside 50% of its income toward securing a water supply.

Little Falls, Minn.—A bill has passed the Senate authorizing the issue of bonds for the purchase of the water and light plant.

Colorado Springs, Colo.—Water bonds to the amount of $50,000 have been sold.

Essex Junction, Vt.—A vote will be taken April 28 on the proposition to bond for the construction of water works.

Hammonton, N. J.—Press reports state that bids are wanted by the Water Committee April 10 for water-works.

Dubuque, Ia.—The Dubuque Water Co. will receive bids for laying about 2 miles of 20 and 24-in. water mains. W. W. Bonson, Secy.

College Hill, O.—Bids are wanted May 1 for $40,000 water-works bonds. J. E. Bruce, Mayor.

Ottawa, Ont.—City Engineer Galt has been authorized to advertise for bids for pumping machinery and appurtenances, estimated to cost $60,000.

New York, N. Y.—Bids are wanted April 20 for repairs to aqueduct viaduct at Sing Sing and to aqueduct gate-houses at High Bridge; also for cast-iron water pipes, branch pipes, special castings, stock cock boxes, etc. William Dalton, Commr. Water Supply.

Elkpoint, S. D.—N. L. Moore, City Clk., writes that it was voted April 3 to issue $12,000 bonds for a water system.

Fremont, O.—The Shaw-Kendall Engineering Co., of Toledo, estimates the cost of completing and installing the artesian well system at $10,000.

Dubuque, Ia.—Press reports state that the City Council has declared the charter of the Dubuque Water Co. forfeited and ordered legal proceedings for the purchase of the plant by the city.

Appleton, Minn.—It is proposed to construct a system of municipal water-works at a cost of $6,000 to $10,000. Edward Lende, Village Recorder.

Chicago, Ill.—Bids are wanted April 13 for 26,500 pieces of 4 to 24 in. cast iron water pipe. L. E. McGann, Commr. Pub. Wks.

Baltimore, Md.—Bids are wanted April 19 for pipe-tapping machine and fittings. William L. Kenly, Ch. Engr. Water Bd.

Milwaukee, Wis.—Bids are wanted April 11 for laying 6, 8 and 12-in. pipe. G. H. Benzenberg, Chmn. Commrs. Pub. Wks.

Laporte, Ind.—Chas. F. Lefmann, Chmn. Bd. of Water Commrs., writes that the following bids were opened March 27 for 27,000 ft. of pipe; R. D. Wood & Co., Philadelphia, 16 in., $24 per ton; delivered f. o. b. Laporte. United States Cast Iron Pipe and Foundry Co., Cincinnati, O., 16 in., $23.50 per ton, delivered f. o. b. Chicago Bridge & Iron Co., Chicago, Ill., 18 in., $2 per lin. ft.; 20 in., $2.15 per lin. ft.; delivered f. o. b. Abendroth & Root Mfg. Co., N. Y. City, 18 in., $1.43½ per lin. ft.; 20 in., $1.60 per lin. ft.; delivered f. o. b. Springfield Boiler Mfg. Co., Springfield, Ill., 16 in., $1,29½ per lin. ft.; 18 in., $1.44; 20 in., $1.59. Auxiliary proposition, 16 in., $1.06 per lin. ft.; 18 in., $1.18½; 20 in., $1.27½ delivered f. o. b. American Pipe Foundry Co., Chattanooga, Tenn., 16 in. $23.40 per ton, 2½ cents per pound, delivered f. o. b.

SEWERAGE AND SEWAGE DISPOSAL.

Providence, R. I.—Bids are wanted April 10 for 4,489 ft. of 16 to 32-in. brick, 6,721 ft. of 8 to 15-in. pipe and 276 ft. 8-in. rider sewers. Robert E. Smith, Commr. Pub. Wks.

Atlanta, Ga.—Bids are wanted April 27 for a sewer system at Tybee Island. John Simpson, Dept. Q. M. Gen., U. S. A., Ch. Q. M.

Nevada City, Cal.—An election has been called for May 6 to vote on the issue of $28,000 bonds for a public sewer system.

Redbluff, Cal.—Press reports state that an election will soon be called to vote on the issue of $30,000 bonds for a general sewer system.

Somerset, Pa.—James S. Haring, of Crafton, Pa., has been engaged to design a sewerage system and superintend construction. Bids will be asked for about 5 miles of the work in a short time.

Wellsville, O.—The Council has approved and adopted the plans prepared by H. E. Riggs of Toledo for a system of about 12½ miles of sewers. Probable cost $69,000.

Kansas City, Mo.—See "Paving and Roadmaking."

Cripple Creek, Colo.—Cripple Creek Sewer Co. has filed articles of incorporation at Trenton, N. J., to construct and operate a sewer system in Cripple Creek, Col., and similar systems elsewhere. Capital stock, $100,000. Incorporators, Henry M. Blackmer, Henry McAllister, Jr., Robert H. Widdicombe, all of Colorado Springs.

Pueblo, Colo.—An appropriation of $14,000 has been made for a sewerage system in Bessemer.

Valdosta, Ga.—A vote will be taken on the proposition to issue $40,000 bonds for the establishment of a sewer system.

Canonsburg, Pa.—See "Water."

Minneapolis, Minn.—It is stated that bids are wanted April 14 for sewer brick, vitrified clay pipe, cement and special castings. G. W. Sublette, City Engr.

South Bend, Ind.—Bids are wanted April 24 for a 24x32-in. egg-shaped brick sewer in South Lafayette St. L. A. Hull, City Clk.

Elyria, O.—Bids are wanted May 8 for a sewer. W. H. Park, City Clk.

Carrollton, Mo.—Bids are wanted April 25 for $50,000 bonds to be used in building the sewerage system and for paving. Wm. Riblett, City Clk.

Auburn, Ind.—A correspondent writes that bids will be received about May 20 for a sewerage system to cost $30,000. J. J. Van Anken, City Engr.

Columbus, Miss.—J. L. Ludlow of Winston, N. C., has been elected constructing engineer of the water-works and sewerage systems to be established here.

Chester, Pa.—The Sewer Committee has been instructed to advertise for bids for the construction of sewers in several streets.

Derby, Conn.—A bill has passed the Senate authorizing the issue of $30,000 sewer bonds.

Gloversville, N. Y.—Local press reports state that bids will be received April 11 for the construction of sewers in several streets.

St. Cloud, Minn.—The Council has voted to construct a sewer in the 4th Ward. Cost, $4,000.

Saratoga Springs, N. Y.—A bill is before the Legislature to authorize the issue of $75,000 bonds to defray the cost of sewage disposal.

Stockbridge, Mass.—The town has voted to build a sewerage system and authorized the issue of $15,000 bonds for same.

Concord, Mass.—The town has voted a loan of $25,900 in addition to the $70,000 already appropriated for a system of sewers.

Cohoes, N. Y.—Bids are wanted April 26 for constructing 8¾ miles of sewers as advertised in "The Engineering Record."

Winchester, Va.—An ordinance has been introduced in the City Council providing for the appropriation of $15,000 for a sewer system.

Lock Haven, Pa.—Mayor Elliott in his annual message recommends the construction of a system of general sewerage.

Kansas City, Kan.—Bids are wanted April 11 for a sewer in sub-sewer district No. 7 in sewer district No. 14. Geo. E. Yeager, City Clk.

Webster, Mass.—The Selectmen have been authorized to borrow $10,000 for the construction of an outfall sewer.

Havana, Ill.—The following bids for sewer work were opened April 1, by H. C. Breidert, City Engr., as advertised in "The Engineering Record."

Name and Address of Bidders.	Price Per Lin. ft. 48 in. Brick Sewer, Avg. Cut 16.8 ft.	24 in. x 36 in. Brick Sewer, Cut 15.5 ft.	23 in. x 33 in. Brick Sewer, Cut 13 ft.	13 in. Pipe Sewer Cut 9.2 ft.	Man Holes, 3 ft. in Diam.	Basins 4 ft. x 7 ft. Each.	6 in. House Slants with Covers, Each	Total.
H. G. Bruning, Havana, Ill	$5.20	$3.90	$3.20	$1.70	$16	$24	$0.30	$11,348
J. H. Roche 210 31 st Street, Chicago, Ill	4 90	2 85	2.15	0.84	25	30	.50	9 677
J. W. Pierce Jacksonville, Ill	4.10	2 70	2.50	0.65	31	33	.50	8,914
J. H. Green & Sons, Appleton, Wis	3.40	2.55	2.23	0 73	40	35	.50	*8,140

*Contract awarded.

Andover, Mass.—Bids are wanted April 13 for $30,000 sewer bonds. Geo. A. Parker, Town Treas.

Sewickley, Pa.—Bids are wanted April 17 for 2,250 ft. of 6 and 24-in. sewer pipe, 100 ft. 24-in. cast iron pipe, manholes, etc. H. F. Hirst, Boro. Engr. and Supt. Highways.

Kearney, N. J.—William S. Logan, Town Surveyor, writes that the following bids were opened March 28 for the construction of lateral pipe sewers: *a*, section No. 1; *b*, section No. 2; *c*, section No. 3; *d*, section No. 4. Green & Tierney, Kearney, N. J., *a*, $3,652.93; *b*, $2,148.50; *c*, $4,131.72. A. Costa, Orange, N. J., *a*, $4,015; *b*, $2,436.92; *c*, $4,849.42; *d*, $11,678.66. E. Sargent, Kearney, *a*, $2,977.16; *b*, $1,966.70; *c*, $3,943; *d*, $8,855.55. James Conway, Newark, N. J., *a*, $3,025.20; *b*, *$1,958.10; *c*, *$3,744.60; *d*, *$8,377.03. Henry M. Dowd, Orange, *b*, $2,533.70; *d*, $10,159.70. Carlson & Levison, Kearney, *b*, $2,248.60.

*Contract awarded.

BRIDGES.

Leavenworth, Kan.—Press reports state that the County Commissioners propose to build an iron bridge across the creek near Tonganoxie.

Northampton, Mass.—Plans have been prepared by City Engineer Thatcher for a 12-span truss, foot bridge, over South St., to cost about $8,000.

Boston, Mass.—Local press reports state that the Board of Street Commissioners have passed an order for the extension of Cove St., and the building of a bridge across the tracks of the Terminal Co.

Cleveland, O.—Press reports state that the Park Board has under consideration the construction of a bridge at the entrance of the lower boulevard, at Gordon Park.

Dubuque, Ia.—It is stated that the Illinois Central road will replace the present bridge spanning the river with a new superstructure.

Panablanca, N. Mex.—The County Commissioners have passed a resolution providing for the construction of a bridge over the Rio Grande, near this city, at a cost of $15,000.

Winton Place, O.—County Engineer Krug has, according to local press reports, been instructed to estimate the cost of an iron bridge 50 ft. wide over Ross Run on Paddock road.

Sewell, W. Va.—Press reports state that the bridge across New river has been carried away. It was built at a cost of $14,000.

Winnebago, Minn.—The construction of an iron bridge across the Blue Earth river, near A. Bartlett's, to replace present wooden structure, is being considered.

Shelbyville, Tenn.—Bedford county will erect several new steel bridges over Duck river.

Lockport, N. Y.—The Ways and Means Committee has reported favorably on the bill appropriating $16,000 for a lift bridge over the canal at Chapel St.

Fremont, O.—Local press reports state that the Lake Shore R. R., will build a steel bridge across its tracks at Front St.; also rebuild its bridge over the river and the bridge over Green Creek.

Sauk Rapids, Minn.—It is proposed to repair the bridge across the Mississippi river, at a cost of $3,000.

Bainbridge, N. Y.—It was voted April 4 to appropriate $15,000 for the construction of a bridge. C. G. Norton, Highway Comm.

Washington, D. C.—The Pennsylvania R. R. Co. proposes to replace the old Long Bridge with a steel bridge costing about $1,000,000.

Ft. Wayne, Ind.—W. H. Goshorn is the engineer in charge of constructing a $20,000 bridge across Maumee River at Walton Ave. Contracts have not yet been awarded.

Boston, Mass.—The Board of Estimate and Apportionment has appropriated $30,000 for widening Chelsea bridge, north side of the Mystic river.

Waterport, N. Y.—The contract for a bridge, for which $14,000 was recently appropriated, has been awarded to Horseheads Bridge Co., Horseheads, N. Y.

Chicago, Ill.—J. G. Wagner & Co., Malwaukee, Wis., are stated to have received the contract for the 2 bridges across the canal at Joliet as follows: Cass St. bridge at $38,265. Jefferson St. bridge at $45,627.

Joliet, Ill.—Bids are wanted May 31 for a railroad bridge over the Desplaines river. Joseph F. Haas, Clk. Sanitary Dist., Chicago.

Long Prairie, Minn.—The Village Council will erect an iron bridge over the Long Prairie river, which will replace the present wooden structure.

Ellenville, N. Y.—The Town Board has under consideration the construction of an iron bridge to replace the White bridge over the Lacawack river, cost about $7,000.

Indianapolis, Ind.—Plans are being prepared by City Engineer Jeup, for several stone bridges across Fall creek, between Central and Northwestern Aves.

Kansas City, Mo.—A steel viaduct to be built jointly by the Street and Steam Railway companies is under consideration. Probable cost about $40,000.

Kansas City, Mo.—The construction of a viaduct at Allen Ave. is stated to be under consideration.

Norwalk, O.—Mayor F. W. Van Dusen writes that it was voted on April 3 to issue $11,000 bonds for a bridge.

Seneca Falls, N. Y.—The Governor has signed the bill appropriating $8,000 for a new bridge over Cayuga and Seneca Canal.

Buffalo, N. Y.—Bids are wanted April 11 (re-advertisement) for masonry, paving, etc., for constructing piers, abutments of and approaches to a viaduct over Lake Shore & Michigan Southern Ry. in Elk St. and over the Erie R. R. between Elk St. and Abbott Road. Edward B. Guthrie, Ch. Engr., Grade Crossing Commrs.

PAVING AND ROADMAKING.

Bay City, Mich.—Local press reports state that the Bridge Committee will advertise for bids for cedar or stone pavement on the west approach of Third St. bridge; estimated cost about $3,000.

Rochester, N. Y.—Whitmore, Rauber & Vicinus, of Rochester, have the contract for repairing asphalt streets for the year at $2.10 per sq. yd. for a new surface and concrete foundation, $1.35 for resurfacing and $1.25 for "skimming." The contract for Medina block paving in North Clinton St. has been awarded to Brayer & Albaugh, of Rochester, for $47,067.

Baltimore, Md.—Bids are wanted April 12 for trap rock asphalt blocks, vitrified paving bricks and vitrified sewer bricks. Wm. W. Varney, City Commr.

Remington, Ind.—Bids are wanted April 10 for macadamizing Ohio and Railroad Sts. Ira W. Yeoman, Town Clk.

Muncie, Ind.—Bids are wanted April 24 for the improvement of Howard and 15th Sts. F. W. Clevenger, City Clk.

Wallington, N. J.—Bids are wanted April 10 for macadamizing Wallington and Cooley Aves. Chris De Keyser, Boro. Clk.

Benwood, W. Va.—Bids are wanted May 1 for brick paving. M. Dolan, Chmn. Com.

Vanwert, O.—Bids are wanted April 24 for 28,500 sq. yds. of brick or asphalt paving, 10,410 ft. curbing and 10,500 cu. yds. excavation. C. F. Manship, Village Clk.

Brazil, Ind.—J. W. Williams, City Clk., writes that petitions are being circulated for considerable street improving to be done this summer.

Hartselle, Ala.—John A. Rogers writes that $265,000 bonds have been sold for the purpose of macadamizing public roads. A stone crusher, to crush 100 yds. in 10 hours, is wanted.

Houston, Tex.—Bids will probably soon be asked for brick or asphalt paving on Congress and Montgomery Aves.

Winnipeg, Man.—C. J. Brown, City Clk., writes that Kelly Bros. & Co. of Winnipeg have received the contract for the establishment of an asphalt plant; their bid was $6,854 for plant without engine and boiler.

Saco, Me.—Mayor Luther R. Moore in his inaugural address recommended the macadamizing of the streets.

Mount Vernon, N. Y.—It has been decided to macadamize several streets.

Kansas City, Mo.—Henry A. Wise, City Engr., states that about $1,000,000 worth of public work will be done this year, to be divided as follows: About 300,000 yds. of paving, mostly asphalt, and some brick; brick and pipe sewers to cost about $125,000, the balance to be used for curbing, sidewalks, etc.

Marion, Ind.—South Main St. and Henley Ave. are to be paved with brick this season.

Ilion, N. Y.—A. D. Morgan, Village Clk., writes that a stone crusher is to be purchased at once for the town of German Flats. James Conkling of Ilion is interested.

Jamestown, N. Y.—Bids are wanted April 15 for constructing about 11,580 sq. yds. of brick pavement, 5,700 lin. ft. of curbing and 210 ft. of curved curbing, as advertised in "The Engineering Record."

Jersey City, N. J.—Bids are wanted April 18 for 3,250 sq. yds. Belgian paving and 45 sq. yds. of repaving. Geo. T. Bouton, Clk. Bd. Street & Water Commrs.

Woodbury, N. J.—D. T. Mathers, City Clerk, writes that bids will be received until April 11 for resetting about 3,500 lin. ft. of curb stone and 3,700 sq. yds. vitrified brick gutter.

Newark, N. J.—Bids are wanted April 13 for Telford pavement on Mt. Hebron road in Montclair and Township of Bloomfield; also for Bloomfield Ave. and Fairfield Road in Caldwell Township, a distance of 6½ miles. Thomas McGowan, Dir. Com. on Roads & Assessments, Bd. Chosen Freeholders.

Windsor, Ont.—The City Council will make application to the Provincial Legislature for permission to borrow $100,000 for the construction of 14 miles of pavements, should the proposition be approved by the citizens.

Chillicothe, O.—The City Council has adopted a resolution to construct about $90,000 worth of paved streets this summer.

Saginaw, Mich.—The following bids have been received for asphalt paving on Hoyt St.: Barber Asphalt Paving Co., $18,167; F. E. Cole, of Toledo, $19,793, and the Alcatraz Construction Co., $18,880.

Blountville, Tenn.—A bill has been passed authorizing Sulivan Co. to issue $100,000 bonds for road purposes.

Pittsburg, Pa.—The County Commissioners have awarded contracts for about six miles of road construction to Booth & Flinn, of Pittsburg. The contract price was about $12,000 per mile.

Hammond, Ind.—It is stated that bids are wanted April 18 for macadamizing 150th St. Peter J. Lyons, City Engr.

Fort Wayne, Ind.—Local press reports state that bids will be received about May 4 by the Board of Public Works for sheet asphalt, brick and asphalt block paving in several streets.

Carrollton, Mo.—See "Sewerage and Sewage Disposal."

Algiers, La.—The Comptroller has been directed to advertise for bids for asphalt paving in several streets.

Owosso, Mich.—It has been voted to issue $15,000 bonds for asphalt paving.

Meadville, Pa.—Bids are wanted April 13 for 27,900 sq. yds. of brick paving in 3 streets. D. T. McKay, Jr., City Clk.

Indianapolis, Ind.—See "Miscellaneous."

St. Louis, Mo.—It is stated that bids are wanted April 18 for paving and repaving with brick on 12 streets, granite block paving on Jefferson Ave. and for repairing rock asphalt on Euclid Ave. Bids are wanted April 21 for improving portions of 30 streets. Robt. C. McMath, Pres. Bd. Pub. Improvements.

Worcester, Mass.—The contract for furnishing 30,000 ft. of curbing, 800 ft. of circle curbing and 12,000 yds. of paving block, has been awarded to the Webb Granite & Construction Co. of Worcester for $25,430.

Mt. Pleasant, N. Y.—It has been voted to appropriate $2,000 for a stone crusher.

New York City, N. Y.—Governor Roosevelt has signed a bill authorizing the issue of $2,000,000 bonds for repaving in the various boroughs.

Sullivan, Ind.—The contract for building free gravel roads in Jackson Township has been awarded to J. E. Hart of Vevay, Ind., for $57,400.

Plainfield, N. J.—An appropriation of $20,000 has been made for street improvements during the year and an additional $20,000 bonds will be issued for asphalting Front St. and Park Ave.

Leicester, Mass.—Chief Engineer Charles R. Mills recommends the construction of 3,500 ft. of state road westward to Spencer, and 2,500 ft. in Spencer.

St. Paul, Minn.—Bids are wanted April 10 for paving Sherburne Ave. C. H. Bronson, Clk. Bd. Pub. Wks.

St. Paul, Minn.—According to local press reports the contract for paving Cedar St., from Second St. to Summit Ave., with asphalt, has been awarded to The Warren Scharf Asphalt Paving Co. for $32,412, and for sandstone paving from Summit Ave. to Como Ave. to Fielding & Shepley of St. Paul for $22,888.

Brooklyn, N. Y.—The Concrete and Asphalt Paving Co. has been incorporated; capital, $50,000. Directors: Noah Cocheu, Lewis R. Stegman and William J. Trimple.

Buffalo, N. Y.—Bids are wanted April 18 for paving Grosvenor St. and paving, repaving and surfacing Ohio St. R. G. Parsons, Secy. Bd. Pub. Wks.

Philadelphia, Pa.—Bids are wanted April 13 for improving McPherson Sq. and repairing Fairmount Ave. wharf. Abraham L. English, Dir. Dept. Pub. Safety.

Webster, Mass.—The selectmen have been authorized to borrow $2,500 for the purchase of a steam road roller.

Highland Park, Mich.—The matter of paving Woodward Ave. is under consideration. Engineer W. H. Ashwell estimates that it would cost $110,000 to pave with asphalt a distance of 10,025 ft., brick would cost $75,000 and cedar on concrete about $60,000.

Binghamton, N. Y.—Resolutions have been introduced for brick paving in several streets.

Atlanta, Ga.—An appropriation of $10,000 has been voted for the widening and improvement of Whitehall St.

Toronto, Ont.—The contract for asphalt paving on Queen St. has been awarded to the Warren Scharf Asphalt Paving Co. for $29,656.

Leavenworth, Kan.—Petitions are now before the Council for 15,000 sq. yds. of asphalt and 20,000 sq. yds. of brick pavement. Contracts will probably be let this spring.

Meriden, Conn.—Bids are wanted April 27 for 4,200 sq. yds. of sheet asphalt pavement on North Colony St., as advertised in "The Engineering Record."

Reading, Pa.—Local press reports state that the following bids were opened March 30 for 1,650 sq. yds. of asphalt pavement (with 10 years maintenance guarantee), on North 6th St.; Pennsylvania Asphalt Co., Philadelphia, at $2.18 per sq. yd. and Richardson & Ross of Philadelphia, at $2.33.

Gloversville, N. Y.—The following bids for 15,000 sq. yds. of brick paving were opened March 28 by C. Fiske, Jr., City Engr.: Erbeck Bros., Homestead, Pa., $31,925; A. M. Banker, Gloversville, N. Y., $32,470; Callanan Road Imp. Co., Albany, N. Y., $32,966; Baker & Judson, Gloversville, N. Y., $33,308; Chas. T. Hookway, Syracuse, N. Y., $33,408; John Twomey, Schenectady, N. Y., $33,452; Frank Pidgeon, Saugerties, N. Y., $34,749. All bids were rejected. New bids will be received April 11.

Paterson, N. J.—The following bids were opened April 3, according to local press reports, for brick paving, total length about 68,400 sq. yds. The various kinds of brick on which bids were received are indicated as follows: a, Canton; b, Porter; c, Mack; d, Eastern Paving Co.; e, Clearfield; f, Johnsonburg; g, Brick and Terra Cotta Supply Co.; h, McAvoy; i, Preston; Fred. R. Pratt, a, b, c, d and e, $2.05; John R. Lee, c, d and e, $2.25; f, $1.90 and g, $1.85; Alcatraz Paving Co., b and c, $2.37; d and e, $2.30; Marley & Forbes, a, $2.03½; b, $2.02; c and e, $2.03; f, $2; McKiernan & Bergen, a, $2.11; g, $1.98; h, $2.05; Passaic County Construction Co., a and b, $2.18; i, $1.95.

POWER PLANTS GAS AND ELECTRICITY.

Urichsville, O.—The Council is said to be considering the matter of constructing an electric light plant.

Montevideo, Minn.—It is reported that the electric light plant has been sold, and the new owners will extensively improve it.

Albany, N. Y.—The Senate has passed the bill appropriating $60,000 for the establishment of an electric lighting plant in the Capitol.

Potsdam, N. Y.—The Hannawa Falls Water Power Co. has been incorporated, to develop power for manufacturing, chemical and electrical purposes through the construction of dams on the Raquette River; capital, $300,000. Directors: Wm. B. Cogswell, Syracuse; Ogden H. Toppen, Potsdam; Wallace C. Johnson, Niagara Falls, and others.

Wilkesbarre, Pa.—It is stated that The People's Light & Power Co. is being organized by J. B. Reynolds, S. J. Tonkin, Maj. J. Roberts. It is to furnish light and power.

Defiance, O.—The proposition to issue $25,000 bonds for the erection of an electric light plant carried at a recent election.

Dover, Del.—The Governor is stated to have approved the bill for an electric light plant, and the town will issue $20,000 bonds for the work.

Garner, Ia.—The citizens are stated to have voted to grant a franchise to the Garner Electric Light, Power & Telephone Co.

Wyandotte, Mich.—See "Water."

Eufaula, Ala.—There is talk of building a city electric light plant. Mr. McKenzie, Mayor.

Kennebunk, Me.—It is stated that estimates have been submitted for a new electric plant, to cost $5,500.

Mankota, Minn.—See "Electric Railways."

Tazewell, Va.—The Council is stated to have granted Spotts Bros. of Tazewell, and John Spotts of Staunton, Va., a franchise to put in an electric plant.

Waterport, N. Y.—The contract for the construction of an electric power dam to cost $25,000, has been awarded to Adams & Co., Niagara Falls, N. Y. Wallace C. Johnson, of Niagara Falls, Engr. in Charge.

Bloomfield, Ind.—See "Water."

Moundsville, W. Va.—The City Clerk writes that an appropriation of $7,000 has been made for an electric light plant, capable of supplying about 1,400 lights, for the State Penitentiary. Only dynamos and engines will be required. Address John L. Laughlin, Secy. Board of Directors.

Ithaca, N. Y.—A corespondent writes that a $40,000 gas plant is to be erected.

Bluefield, W. Va.—Wm. A. Cather writes that bids will be asked in about 30 days for the construction of an electric light plant to cost from $8,000 to $10,000.

Moulton, Ia.—J. J. Russell, Town Clerk, writes that it was voted March 27 to grant a franchise for electric lighting.

Princeton, Minn.—See "Water."

Vincennes, Ind.—Bids are wanted May 22 for lighting the streets, alleys, parks, public buildings, etc., for a period of 10 years, as advertised in "The Engineering Record."

Marquette, Mich.—The Senate is stated to have pased a bill authorizing the Water Commission to expend $10,000 to enlarge the electric light and power plant.

Perkasie, Pa.—It is stated that a company is about to be formed to construct an electric light plant to furnish this place and Sellersville with electricity. Harry E. Grim of Perkasie is said to be interested.

Chateaugay, N. Y.—J. Ovette Smith, of Plattsburgh, is stated to have received a franchise for an electric light plant.

Indianapolis, Ind.—It is stated that plans are being prepared for heating, lighting and plumbing for the court house and jail.

Buffalo, N. Y.—The Westinghouse Electric & Mfg. Co., of Pittsburg, is stated to have received the contract for 7-3,500 h. p. transformers for the Niagara Falls Power Co., of Buffalo; contract price said to be about $100,000.

Mechanicsburg, Pa.—Bids are wanted April 27 for lighting the streets with electricity. C. W. Owen, Chmn. Light Com.

East Dubuque, Ill.—There is talk of constructing an electric light plant here. Geo. B. Newell, City Clk.

Boston, Mass.—The Board of Aldermen is stated to have passed the order appropriating $4,000 for electric lighting at the House of Reformation on Rainsford Island.

St. Augustine, Fla.—P. S. Arnan, City Clk., writes that it has been voted to issue bonds for the construction of an electric light plant.

South Bethlehem, Pa.—Hoffman & Lauer are stated to have received the contract to light the streets with arc lights for 5 years, the lights to burn all night and every night, for 24½ cts. per light per night.

Chippewa Falls, Wis.—C. H. Stanley of Chippewa Falls is reported to be interested in the construction of an electric light plant.

Buffalo, N. Y.—At a meeting of the Committee on Military of the Board of Supervisors April 3 it was decided to recommend that the bid of McCarthy Bros. & Ford for construction of a lighting plant for the 74th Regiment Armory be accepted; their bid was $11,995.

Warren, Mass.—At the annual town meeting April 3 a committee was appointed consisting of W. P. Canning, Edw. Fairbanks and others to report, before July 1, on the question of a municipal lighting plant. Present contract expires in the fall.

Jeffersonville, Ind.—It is stated that bids are wanted April 22 for lighting the city with electricity for 10 years. W. B. Hassen, City Clk.

Iowa City, Ia.—It is stated that the Electric Light Co. will rebuild the plant recently burned, at a probable cost of $18,000. D. F. Sawyer, Pres.

Winnipeg, Man.—It is stated that bids are wanted April 17 for an electric light plant. C. J. Brown, City Clk.

Defiance, O.—M. W. Steinberger, City Engr., writes that the only bid received for electric street lighting was from the Defiance Light & Railway Co., W. R. Fabin, Receiver. About 75 arc lights of 2,000 c. p. will be required. The prices given are per lamp for 5 and 10-year contracts respectively: All night and every night, about 4,000 hours, $95 and $85; moonlight schedule, about 2,300 hours, $75 and $70; every night until 1 o'clock A. M., about 2,300 hours, $75 and $70; present schedule (Philadelphia plan), about 3,000 hours, $90 and $80; moonlight until 1 o'clock A. M., about 1,500 hours, $70 and $65.

ELECTRIC RAILWAYS.

New Castle, Pa.—It is reported that surveys are being made for an electric railway about ten miles long, between New Castle (Pa.) and New Wilmington.

Knoxville, Tenn.—It is stated that the Knoxville Traction Co. will expend about $100,000 in improvements. C. C. Howell, Gen. Mgr.

Columbus, O.—The County Commissioners are stated to have granted a franchise to the Columbus & Buckeye Lake Electric St. Ry. Co.

East Pittsburg, Pa.—The Union Ry. Co. is stated to have received a franchise through the borough.

Mankato, Minn.—A. E. Clark is stated to have received a franchise for a street railway and an electric light plant.

Millbury, Mass.—The Linwood St. Ry. Co. is stated to have received a franchise for an electric road between Linwood and Whitinsville.

Scranton, Pa.—The Scranton Ry. Co. is stated to have received a franchise to extend its line.

Corvallis, Ore.—Thos. Welsher and others are stated to have petitioned for right of way for an electric railroad between Corvallis and Eugene.

Middletown, N. Y.—W. B. Royce, Receiver of the Middletown Goshen Traction Co., is stated to have received permission to extend the trolley line on Canal St.

Lorain, O.—The stockholders of the Lorain & Cleveland Ry. Co. are stated to have decided to extend the line to South Amherst. Jas. B. Hoge, Secy.

Cleveland, O.—The Cleveland, Wadsworth & Southern Electric Ry. Co. is stated to have received a franchise to construct an electric line between Cleveland and Wadsworth.

Claremont, Mass.—The Claremont Street Railway Co. is to be incorporated on April 11.

Cambridge City, Ind.—Kenney & Kepler of the Cambridge City Interurban Traction Co. propose to begin work in May on the construction of about 25 miles of road estimated to cost $250,000.

Florence, Colo—Thos. Robinson of Florence writes that he has received a franchise to construct an electric street railway in Florence, and between Florence and Canon City, total length of road about 20 miles. Estimated cost $250,000. Contracts will be let about July.

New Kensington, Pa.—The Creighton, Tarentum & New Kensington St. Ry. Co. is stated to have applied for the right of way through this borough. If franchise is granted work will begin at once on the proposed line, which will extend from Pittsburg to Natrona, 28 miles in length.

Clyde, N. Y.—The Clyde & Sodus Bay R. R. Co., is stated to have been formed to build an electric railway 12½ miles long; capital, $200,000. Chas. W. Field and Lucius L. Moses are said to be interested.

Atlanta, Ga.—The Consolidated St. Ry. Co. is stated to have received a franchise over the Mitchell St. viaduct and through west Atlanta.

Windgap, Pa.—The Windgap & Nazareth St. Ry. Co. has been incorporated with a capital of $60,000, to build a line in Northampton County, from Nazareth to Windgap. Directors: M. P. McGrath, Worcester, Mass.; Chas. H. Cox, Bethlehem; Thos. H. Hay, Easton, and others.

Scarsdale, N. Y.—The Tarrytown, White Plains & Mamaroneck Trolley Co. is stated to have received a franchise through this place.

Allentown, Pa.—An ordinance was introduced in Council April 5 granting a right of way to the People's Electric Ry. Co.

Tiffin, O.—It is stated that the Tiffin, Fostoria & Eastern Electric Railway will be extended to Norwalk by way of Republic and Bellevue.

Marblehead, O.—The Marblehead, Port Clinton & Southern R. R. Co., of Danbury Township, Ottawa County, was incorporated March 29 with a capital of $100,000, to build a line from Tiffin north through Seneca, Sandusky and Ottawa counties to Marblehead, to be operated by steam, electricity or other motive power. Incorporators, W. E. Guerin, W. E. Bense and others.

Kane, Pa.—A charter has been granted to the Kane R. R. Co., with a capital of $110,000, to build a line 11 miles long in McKean County, from Mt. Jewett to Kane. Directors: H. W. Sweely, Thos. S. Kane and others, of Kane.

St. Clair, Mich.—The Rapid Railway Co., of Detroit, is stated to have applied for a franchise to build a road from Detroit to Port Huron from its Mt. Clemens terminal, through St. Clair.

Pittsburg, Pa.—It is stated that the Pittsburg & West End Traction Co. propose to extend their Sheridan branch line and connect with the McKees Rocks branches.

Trappe, Pa.—A charter has been granted to the Trappe & Limerick Square Ry. Co. with a capital of $30,000, to build a line in Montgomery County, from Collegeville to Trappe and Limerick Square. Directors: John G. Macpherson, Philadelphia; Jade C. Wilson, of Beverly, N. J., and others.

Dunkirk, N. Y.—Daniel E. Toomey is stated to have received a franchise.

Elizabeth, N. J.—The City Council on April 1 passed an ordinance on first and second reading granting permission to John Kean to extend his street railroad through the city to Union Township, and also to change the motive power to electricity.

St. Paul, Minn.—W. R. Johnson, Co. Aud., writes that Theo. Borup, Chas. W. Bunn and others of St. Paul have petitioned the Board of County Commissioners for a franchise to construct an electric railway between St. Paul and White Bear Lake.

Kansas City, Kan.—The Kansas City-Leavenworth R. R. Co. has been incorporated with a capital of $1,000,000, to build an electric line from Kansas City to Leavenworth, a distance of 26 miles. Directors: David H. Kimberly, Cleveland, O.; C. H. Wheeler, Akron, O.; C. H. Chapin, Kansas City, Kan., and others.

Paris, Tenn.—The Paris Electric St. Car Co. is stated to have been organized to construct a railway here; capital $100,000. Incorporators: J. C. Sweeney, W. A. Carter and others, all of Paris.

Lancaster, Pa.—The People's Electric Ry. Co. is stated to have applied for a franchise.

New Castle, Del.—The New Castle & Delaware City Electric Ry. Co. is about to apply for a charter; capital, $100,000. Incorporators: Harry A. Richardson, Peter J. Ford, of Wilmington; Frederick H. Treat of Philadelphia, and others.

Waupaca, Wis.—Bids are wanted about May 1 for constructing 5 miles of electric line for the Waupaca Electric Light & Ry. Co. Irving P. Lord, Pres.

Goshen, Ind.—W. W. Hatch of this city is said to be interested in the construction of an electric railway through Goshen, Lagrange, Angola, Lake James, Lake Gage and Montpelier.

RAILROADS.

Columbus, N. M.—The Columbus & Northern R. R. Co. has been incorporated to build a road from Columbus to Deming, a distance of 35 miles; capital $525,000. Incorporators: A. O. Bailey, W. R. Merrill and others.

Kansas City, Mo.—Creech & Lee of this city have received the contract to build a sixty-mile extension for the Chicago & Eastern Illinois R. R., from Marion, Ill., to Mississippi River. Work, to begin at once, contemplates grading, masonry and timber bridges.

Elnora, Ind.—The Southern Indiana R. R. Co. is reported to have filed with the Secretary of State a certificate of the extension of its line from Elnora to Terre Haute, a distance of 46 miles.

Winona, Minn.—There is talk of extending the Winona & Western Railroad from Simpson to Rochester, a distance of about 7 miles.

Easton, Pa.—It is reported that the Lehigh Valley R. R. Co. will expend about $250,000 on improvements. E. P. Wilbur, Pres., South Bethlehem. John R. Fanshawe, Secy., Philadelphia.

PUBLIC BUILDINGS.

(See also Schools and Government Work.)

Menomonie, Wis.—The congregation of the R. C. church, recently burned, is stated to have decided to erect a $20,000 edifice.

Brockton, Mass.—The erection of one or two brick fire stations in this city is under consideration.

Madison, Wis.—The Senate is stated to have passed a bill appropriating $151,000 for new buildings and improvements to the State University.

Mineola (L. I.), N. Y.—The plans of R. H. Hunt, Metropolitan Bldg., N. Y. City, are stated to have been accepted for a $25,000 hospital to be erected here by the Nassau Hospital Association.

Cambridge, Mass.—It is stated that plans are being prepared for an engineering building for the Harvard University.

Bath, N. Y.—The Governor has signed the bill reappropriating an unexpended balance of $78,000 for improvements to the New York State Soldiers' and Sailors' Home.

Philadelphia, Pa.—It is stated that plans are being prepared for a memorial tower to cost about $60,000, to be erected by the Houston Club of the University of Pennsylvania.

Minneapolis, Minn.—It is stated that a $50,000 edifice will be erected for the Forest Heights Methodist Church. Mrs. Hettie Gates is said to be interested.

Springfield, Ill.—The contract for remodeling the county court house has been awarded to Warren Roberts & Co. of Chicago for $49,850.

Red Lodge, Mont.—It is stated that bids will be received by the County Commissioners April 11 for a court house, to cost about $10,000. P. J. Donohoe, Archt., Butte.

Georgetown, Ky.—Bids are wanted April 12 for a building. A. H. Sinclair, Mayor & Chmn. Bldg. Com.

Laurin, Mont.—Bids are wanted April 18 for a church. C. S. Haire, Archt., Helena.

Whitehall, Wis.—Bids are wanted about May 1 for a county asylum. John Charles, Archt., Menomonie.

South Bend, Ind.—Plans and specifications are wanted April 18 by the City Council for a $50,000 city hall.

Grand Forks, N. D.—Bids are wanted April 10 for putting in a new foundation and repairing the city hall. George F. Honey, City Aud.

Kentville, N. S.—Bids are wanted April 18 for a building. E. F. E. Roy, Secy. Dept. Pub. Wks., Ottawa.

New Castle, Pa.—S. W. Foulk of New Castle is stated to have prepared plans for a $22,000 addition to the court house.

Vasa, Minn.—Bids are wanted April 22 for rebuilding the Orphan's home. Rev. S. Johnson, Cannon Falls.

Dallas Ore.—Erb & Van Patton of Salem, Ore., are stated to have received the contract for the court house at $24,932.

Medina, N. Y.—The Senate is stated to have passed a bill appropriating $50,000 for the erection of an armory.

Woonsocket, R. I.—It is stated that bids are wanted April 25 for a church. E. O. Ronian, Globe Congregational Society.

Mineola (L. I.), N. Y.—The Nassau County Board of Supervisors are stated to have accepted plan No. 22 for a court house to cost about $100,000.

Milwaukee, Wis.—The plans of E. Brielmaier, 602 2nd St., are stated to have been accepted for a $60,000 church for the St. Kasmir Polish Congregation. Rev. A. Tarasiewicz, Pastor.

Berkshire, Vt.—It is stated that bids are wanted April 10 for a town hall. D. M. Rublee, Chmn. Com.

Catskill, N. Y.—The Governor is stated to have signed a bill authorizing an expenditure of $15,000 for a village hall.

Philadelphia, Pa.—Bids are wanted April 13 for a bathhouse and alterations to a police station. Abraham L. English, Dir. Dept. Pub. Safety.

Madison, Minn.—Bids are wanted April 18 for a court house, also for ventilating and heating the same; estimated cost $37,000. John B. Oadson, Co. Aud.

Norristown, Pa.—The Commissioners of Montgomery County are stated to have adopted the plans of Thos. P. Lonsdale of Philadelphia for an $18,000 infirmary for the almshouse.

Wayne, Neb.—It is stated that bids are wanted April 12 for a court house. J. R. Coyle, Co. Clk.

Syracuse, N. Y.—The plans of Archimedes Russell of Syracuse are stated to have been accepted for a new edifice for the First M. E. Church; probable cost $60,000. Geo. C. Sawyer, Chmn. Bldg. Com.

Council Grove, Kan.—Bids are wanted April 12 for an addition to the court house; also for ventilating and heating the same. M. J. Kimmel, Co. Clk.

Junction City, Kan.—J. W. Dorn, City Clk., writes that it has been voted to issue $35,000 bonds for a court house.

Hallock, Minn.—Plans and specifications are wanted May 9 for heating the court house and jail. G. A. Gunnerson, Co. Aud.

New York City.—The following bids for work on the new city prison were opened April 4 by Francis J. Lantry, Commr. Dept. of Correction:

For the construction of steel cells; P. J. Carlin & Co., 26 Court St., Brooklyn, $310,000; Van Dorn Iron Wks. Co., Cleveland, O., $330,000; Pauly Jail Bldg. & Mfg. Co., St. Louis, Mo., $345,150; Champion Iron Co., Kenton, O., $354,875; Stewart Iron Wks., Cincinnati, O., $387,250.

For installing a steam plant; Armstrong & Bolton Co., 62 Grand St., $93,325; Blake & Williams, 362 W. B'way., $102,764; Gillis & Geohegan, 539 W. B'way, $106,800; Baker, Smith & Co., 81 W. Houston St., $108,390 and $112,495; P. J. Carlin & Co., Brooklyn, $111,950; E. Rutzler, 178 Center St., $113,314; Frank Dobson, 218 E. 42d St., $113,649; Walker & Chambers, 50 E. 20th St., $118,800; James Curran Mfg. Co., 512 W. 36th St., $119,800; N. Y. Steam Fitting Co., 137 Elm St., $123,148; Wells & Newton Co., 235 Eldridge St., $128,340; Howe & Bassett, Rochester, N. Y., $129,000; W. N. Tobin, 532 Columbus Ave., $129,585; Francis Bros. & Jellett, 70 Trinity Pl., $130,000.

For plumbing, drainage, etc.; M. J. O'Brien, 835 6th Ave., $58,300; Howe & Bassett, Rochester, N. Y., $64,000; Wells & Newton Co., $66,460; P. J. Carlin & Co., $83,200; L. D. Hosford, 68 Beekman St., $84,858.

BUSINESS BUILDINGS.

Philadelphia, Pa.—J. E. & A. L. Pennock, 305 Walnut St., have received the contract for a 2-story granite boiler and engine house for the Penn Mutual Life Insurance Co. Cost, $40,000.

St. Louis, Mo.—The Lindell Real Estate Co. is reported to be considering the matter of erecting a 7-story building at Washington Ave. and 12th St. J. M. Carpenter, Vice-Prest.

South Bethlehem, Pa.—It is stated that a $20,000 hotel will be erected here.

Chicago, Ill.—Jarvis Hunt, 1407 Monadnock Bldg. is said to be preparing plans for a warehouse and business block, to be erected on West Randolph St. for Edw. B. Butler; estimated cost $250,000.

Cincinnati, O.—It is stated that The Globe Co., manufacturers of office furniture, will erect a warehouse to cost about $50,000.

Washington, D. C.—B. S. Simmons, Warder Bldg., has prepared plans for a 5-story brick building owned by R. H. Harper and to be used as a headquarters for the Police and Fire Departments. Cost $28,000, including steam heat and electric wiring.

Mobile, Ala.—H. C. Fonde of Mobile has received the contract for the erection of a $40,000 theatre to be erected by J. Pollock. Sully & Stone, Architects, New Orleans.

H. Hammond has prepared plans for a brick and stone office building to be erected by Mrs. Sandgoher at a cost of $20,000.

Newark, N. J.—Hurd & Sutton, Prudential Bldg., are preparing plans for an office bldg., corner Halsey & Bank Sts., to cost over $100,000.

Detroit, Mich.—Louis Kamper, 10 Miner Bldg., is said to be preparing plans for a 5-story warehouse for the Detroit Stove Works.

Savannah, Ga.—It is stated that the city contemplates building an auditorium to cost about $75,000.

Jersey City, N. J.—The Taylor Building Co. is stated to have been organized by R. H. Reed, lessee of Taylor's Hotel, with a capital of $600,000 to rebuild Taylor's Hotel.

Fargo, N. D.—Plans and specifications are wanted May 2 for the Masonic Temple. H. C. Plumley, Secy. Bd. of Trustees of the Scottish Rite Bodies.

Waco, Tex.—The plans of Sam Herbert, of Waco, are stated to have been accepted for a building for the Auditorium Company.

Washington, D. C.—It is reported that the Pennsylvania R. R. Co. will erect a new union station, abolish grade crossings and improve its facilities for handling freight. W. H. Brown, Ch. Engr., Philadelphia.

Cleveland, O.—John Gill & Sons of Cleveland are stated to have secured the contract for erecting the Williamson building, contract price said to be $800,000.

Lancaster, O.—Bids are wanted April 17 for a factory. Address The Ohio Flint Glass Co.

Indianapolis, Ind.—Bids are wanted April 11 for a lodge hall for the I. O. O. F. Homer Cook, Secy.

Lamberton, Minn.—Bids are wanted April 18 for a bank. Frank Schandera, Pres. State Bank.

NEW YORK CITY.

Permits for the following buildings have been issued; o, signifies owner; a, architect; b, builder, and c, contractor.

327 to 331 E. 4th St., 2 br stores & flats, cost $60,000 all; o, Adolph Mandel; a, Horenburger & Straub.

33 to 37 W. 13th St., 34 to 38 W. 14th St., br warehouse, cost $200,000; o, B. J. Ludwig; a, Louis Korn.

88 & 90 Lewis St., br stores and tenem't, cost $45,000; o, Lena & Sarah Michelson; a, Horenburger & Straub.

572 & 574 Madison Ave., br & stone hotel, cost $225,000; o, Francis S. Kinney; a, Howard, Cauldwell & Morgan.

557 to 563 W. 47th St., 2 br factory & stable, cost $53,700 all; o, American Meter Co.; a, Edwin Ogden & Son.

78 to 82 E. 113th St., 2 br stores & flats, cost $58,000 all; o, Davis Karp; a, Max Muller.

7th Ave. & 124th St., br clubhouse, cost $150,000; o, A. V. Bergen; a, Alfred Zucker.

604 to 648 W. 133d St., br factory, cost $50,000; o & a, Consolidated Gas Co.

ALTERATIONS.

656 & 658 6th Ave., interior alterations, cost $23,500; o, Union Trust Co., trustees and administrators of Carroll C. Rawlings; a, Jno. B. Snook & Son.

DWELLINGS.

Minneapolis, Minn.—F. B. & L. L. Long are the architects for a $50,000 residence to be built by F. B. Semple on Franklin Ave. and Vine Place.

NEW YORK CITY.

Permits for the following buildings have been issued; o, signifies owner; a, architect; b, builder, and c, contractor.

Ave. C & 5th St., br tenem't., cost $28,000; o, St. John the Baptist foundation; a, Albert E. Davis.

Madison Ave. & 40th St., br & stone dwell'g., cost, $135,000; o, Lydia P. Hyde; a, N. C. Mellen.

Irving Pl. & 19th St., br & stone flat, cost $70,000; o, Dr. Elliot Gorton; a, Israels & Harder.

19 & 21 E. 54th St., br & stone dwell'g, cost $75,000; o, Mrs. M. E. Young; a, Hiss & Weekes.

36th St. & 8th Ave., br & stone flat, cost $30,000; o, James Clarke; a, Neville & Bagge.

Park Ave. & 65th St., 6 br dwell'gs, cost $150,000 all; o, Edward W. Candee; a, Brun & Hauser.

13 E. 80th St., br dwell'g, cost $23,000; o, Samuel Sass; a, Brun & Hauser.

109 & 111 E. 123d St., 2 br flats, cost $50,000 all; o, Arthur Clark; a, G. F. Pelham.

85th St. & Park Ave., br & stone flats, cost $23,000; o, Harry Bimberg; a, G. F. Pelham.

65th St. & Park Ave., 5 br dwell'gs, cost $125,000 all; o, Gilbert C. Brown; a, Buchanan & Deisler.

98th St. & West End Ave., br flat, cost $50,000; o, James Kilpatrick; a, Fredk. Jacobson.

76th St. & Central Park West, 2 stone dwell'gs, cost $100,000 all; o, C. W. Luyster; a, Jno. H. Duncan.

Broadway & 75th St., br flat, cost $140,000; o, James A. Frame; a, Neville & Bagge.

Manhattan Ave. & 118th St., br flat, cost $80,000; o, Salvadore Lagrassa; a, Neville & Bagge.

St. Nicholas Ave. & 120th St., br flat, cost $150,000; o, Laura E. Mander; a, Thomas Graham.

7th Ave. & 112th St., br flat, cost $45,000; o, Alexander McDowell; a, G. A. Schellenger.

123d St. & 8th Ave., br flat, cost $20,000; o, Arthur G. Muhlker; a, Richd. R. Davis.

113th St. & Madison Ave., 4 br flats, cost $80,000 all; o, Fritz Wegener; a, Adolph Pfeiffer.

Westchester & Robbins Ave., 6 br flats, cost $115,000 all; o, Lane D. Robertson; a, W. C. Dickerson.

7th Ave. & 114th St., br flat, cost $90,000; o, Walter Reid; a, Buchanan & Deisler.

Mott Ave. & 144th St., 2 br flats, cost $40,000 all; o, Wm. F. Cunningham & Philip J. Kearns; a, Chas. Stegmayer.

Mott Ave. & 144th St., br flat, cost $23,000; o, Carl J. Breidbach; a, Adolph Pfeiffer.

BROOKLYN, N. Y.

Nostrand Ave. & Hancock St., br flat, cost $35,000; o & b, Harry A. Cooper; a, Edward Betts.

NEW INDUSTRIAL PLANTS.

The Dangler Stove & Mfg. Co., Cleveland, O., will rebuild its plant, recently burned, on a larger scale than before. The main building was about 450x50 ft. and there were a number of smaller structures, some of which were saved.

The Emerson Manufacturing Co., Rockford, Ill., will put up a large foundry during the summer.

The Cheshire Manufacturing Co., West Cheshire, Conn., has placed contracts with the Berlin Iron Bridge Co. for a 162x40-ft. building with a 75x40-ft. addition and a 100x40-ft. building. Part of the power plant has been ordered.

E. B. Tate will put up a small flouring mill at White Plains, Hopkins Co., Ky., during the spring. His present address is Greenville, Ky.

The National Cash Register Co., Dayton, O., Mr. W. S. Canright, purchasing agent, expects to have the plans for its new addition and specifications for power plant ready in about a month.

Charles E. Brown, 216 North Third St., Philadelphia, will put up a six-story 36x100-ft. factory and install a 50-H.P. engine and a 70-H.P. boiler.

J. J. Dayton, Lake City, Minn., expects to enlarge his cold storage plant.

The Falk Company, Milwaukee, Mr. E. A. Wurster, secretary, is erecting a 60x125 power house and blacksmith shop, a 100x125-ft. machine shop and a 100x125-ft. open-hearth steel plant. The company will put in a 150-H.P. engine and generator and run the entire plant by electricity.

The Imperial Chinese Government is equipping a machine, wood-working and blacksmith shop for the Tien-Tsin University. The funds for the equipment have been placed in the hands of the American Trading Company, 100 William St., New York, which is purchasing the machinery.

BUSINESS NOTES.

The Findlay Crushed Stone Co., Findlay, O., is building a plant with a capacity of about 1,200 yards per day. The crusher house will be 50x100 ft. and contain two Gates crushers, an elevator about 65 ft. between centers, and screens and chutes for separating and delivering the broken stone into bins, which will have a capacity for the present of about 1,000 yards. The power house will be 41x38 ft. and contain two 100-H.P. boilers, a 100-H.P. engine and a 60-H.P. air compressor.

The Coatesville, Pa., Boiler Works have placed a contract for building a 60x172-ft. addition to their boiler shops, increasing their capacity about one-third.

The Gillette-Herzog Manufacturing Co., Minneapolis, has purchased the malleable iron business of the Walter A. Wood Harvester Co., and will carry it on under the name of the Minnesota Malleable Iron Works. The Gillette-Herzog Mfg. Co., Proprietors. The offices of the works will be in the Manhattan Building, St. Paul.

PROPOSALS OPEN.

WATER WORKS.

Bids Close		See Eng. Record
Apr. 10.	Boilers, Montgomery, Ala.	Mar. 18
Apr. 10.	Tank, Washington, D. C.	Mar. 11
Apr. 10.	Walker, Minn.	Apr. 1
Apr. 10.	Bermidji, Minn.	Apr. 1
Apr. 10.	Hammonton, N. J.	Apr. 8
Apr. 11.	Milwaukee, Wis.	Apr. 8
Apr. 11.	Philadelphia, Pa.	Mar. 11
Apr. 12.	Seattle, Wash.	Mar. 18
	Adv., Eng. Record, Mar. 18, 25.	
Apr. 12.	Manka'o, Kan.	Mar. 25
Apr. 12.	Iron pipe, etc., Cincinnati, O.	Mar. 25
Apr. 12.	Canton, N. Y.	Apr. 1
Apr. 13.	Chicago, Ill.	Apr. 8
Apr. 15.	Golden, Colo.	Mar. 18
Apr. 15.	Forestport, N. Y.	Mar. 4
Apr. 15.	Pumping engine, Montgomery, Ala.	Mar. 25
Apr. 15.	Tinley Park, Ill.	Apr. 1
Apr. 15.	Hintonburgh, Ont.	Apr. 1
Apr. 17.	Lakeport, Cal.	Mar. 25
	Adv. Eng. Record, Apr. 1.	
Apr. 17.	Goshen, Ind.	Apr. 1
Apr. 18.	San Carlos, Ariz.	Mar. 25
Apr. 18.	Meters, Camden, N. J.	Apr. 1
Apr. 19.	Butte, Mont.	Mar. 18
	Adv., Eng. Record, Mar. 18, 25.	
Apr. 19.	Baltimore, Md.	Apr. 8
Apr. 20.	Greenville, Cal.	Apr. 1
Apr. 20.	Air cyl'ders, etc., Montgomery, Ala.	Apr. 1
Apr. 20.	New York, N. Y.	Apr. 8
Apr. 26.	Washington, D. C.	Apr. 1
Apr. 28.	Cincinnati, O.	Mar. 25
	Adv., Eng. Record, Mar. 25 to Apr. 8.	
May 1.	Cullman, Ala.	Apr. 1
——	Napoleonville, La.	Mar. 25
——	Corinth, Miss.	Mar. 25

SEWERAGE AND SEWAGE DISPOSAL.

Apr. 10.	Collinwood, O.	Apr. 1
Apr. 10.	Concord, Mass.	Apr. 1
	Adv., Eng. Record, Apr. 1.	
Apr. 10.	Providence, R. I.	Apr. 8
Apr. 11.	Kansas City, Kan.	Apr. 8
Apr. 11.	Gloversville, N. Y.	Apr. 8
Apr. 12.	Salem, O.	Mar. 18
Apr. 12.	Jersey City, N. J.	Apr. 1
Apr. 12.	Pipe, Baltimore, Md.	Apr. 1
Apr. 13.	North Braddock, Pa.	Apr. 1
	Adv., Eng. Record, Apr. 1, 8.	
Apr. 14.	Independence, Mo.	Apr. 1
	Adv., Eng. Record, Apr. 1, 8.	
Apr. 14.	Ottawa, Ont.	Apr. 1
Apr. 14.	Brick, etc., Minneapolis, Minn.	Apr. 8
Apr. 15.	Akron, O.	Apr. 1
Apr. 15.	Carrollton, Mo.	Apr. 1
Apr. 15.	Honolulu, H. I.	Feb. 25
	Adv., Eng. Record, Feb. 25, Mar. 4.	
Apr. 17.	Goshen, Ind.	Apr. 1
Apr. 17.	Sewickley, Pa.	Apr. 8
Apr. 18.	Bayonne, N. J.	Apr. 1
Apr. 18.	San Carlos, Ariz.	Mar. 25
Apr. 20.	Greenville, Cal.	Apr. 1
Apr. 24.	South Bend, Ind.	Apr. 8
Apr. 26.	Cohoes, N. Y.	Apr. 8
	Adv., Eng. Record, Apr. 8.	
Apr. 26.	Washington, D. C.	Apr. 1
Apr. 27.	Atlanta, Ga.	Apr. 8
May 3.	Sauk Centre, Minn.	Apr. 1
May 8.	Elyria, O.	Apr. 8
May 15.	Medford, Ore.	Apr. 1
May 20.	Auburn, Ind.	Apr. 8

BRIDGES.

Apr. 10.	Oakland, Cal.	Apr. 1
Apr. 10.	Chicago, Ill.	Feb. 18
	Adv., Eng. Record, Feb. 18.	
Apr. 11.	Buffalo, N. Y.	Apr. 8
Apr. 12.	Columbus, O.	Mar. 18
Apr. 12.	Batavia, O.	Mar. 25
Apr. 12.	Providence, R. I.	Apr. 1
	Adv., Eng. Record, Apr. 1, 8.	
Apr. 15.	Crescent, Ill.	Apr. 1
Apr. 15.	Hartford, Conn.	Mar. 25
	Adv., Eng. Record, Mar. 25.	
Apr. 15.	Gainesville, N. Y.	Mar. 25
Apr. 23.	Raleigh, N. C.	Mar. 18
Apr. 24.	Huntington, W. Va.	Apr. 1
Apr. 27.	Washington, D. C.	Apr. 1
	Adv., Eng. Record, Apr. 1, 8.	
May 10.	Chicago, Ill.	Mar. 18
	Adv., Eng. Record, Mar. 25.	
May 31.	Joliet, Ill.	Apr. 8
——	Quincy, Ill.	Feb. 25
	Adv., Eng. Record, Feb. 25.	

PAVING AND ROADMAKING.

Apr. 10.	Morristown, N. J.	Apr. 1
Apr. 10.	Lafayette, Ind.	Mar. 18
	Adv., Eng. Record, Mar. 18, 25.	
Apr. 10.	South Bend, Ind.	Mar. 25
Apr. 10.	Bedford, Ind.	Mar. 25
Apr. 10.	Des Moines, Ia.	Mar. 25
Apr. 10.	Wabash, Ind.	Apr. 1
Apr. 10.	St. Paul, Minn.	Apr. 8
Apr. 10.	Wallington, N. J.	Apr. 8
Apr. 10.	Remington, Ind.	Apr. 8
Apr. 11.	Gloversville, N. Y.	Apr. 8
Apr. 11.	Woodbury, N. J.	Apr. 8
Apr. 11.	Schenectady, N. Y.	Mar. 25
Apr. 11.	Huntington, Ind.	Mar. 11
Apr. 12.	Salem, O.	Mar. 18
Apr. 12.	Baltimore, Md.	Apr. 8
Apr. 13.	Philadelphia, Pa.	Apr. 8
Apr. 13.	Newark, N. J.	Apr. 8
Apr. 13.	Crown Point, Ind.	Apr. 1
Apr. 13.	Meadville, Pa.	Apr. 8
Apr. 14.	Waukesha, Wis.	Mar. 25
Apr. 15.	Akron, O.	Mar. 25
Apr. 15.	Colden, N. Y.	Apr. 1
Apr. 15.	Shamokin, Pa.	Apr. 1
Apr. 15.	Carrollton, Mo.	Apr. 1
Apr. 15.	Petersburg, Va.	Apr. 1
	Adv., Eng. Record, Apr. 1.	
Apr. 15.	Jamestown, N. Y.	Apr. 8
	Adv., Eng. Record, Apr. 8.	
Apr. 17.	Portland, Ind.	Mar. 25
Apr. 17.	Risingsun, Ind.	Mar. 25
Apr. 17.	Bridgeport, O.	Mar. 25
Apr. 17.	Toledo, O.	Mar. 25
Apr. 17.	Goshen, Ind.	Apr. 1
Apr. 18.	Mt. Vernon, N. Y.	Apr. 1
Apr. 18.	Jersey City, N. J.	Apr. 8
Apr. 18.	Buffalo, N. Y.	Apr. 8
Apr. 18.	St. Louis, Mo.	Apr. 8
Apr. 18	Hammond, Ind.	Apr. 8
Apr. 21.	St. Louis, Mo.	Apr. 8
Apr. 24.	Vanwert, O.	Apr. 8
Apr. 24.	Muncie, Ind.	Apr. 8
Apr. 25.	Bond Hill, O.	Apr. 1
Apr. 27.	Meriden, Conn.	Apr. 8
	Adv., Eng. Record, Apr. 8.	
Apr. 28.	Bellefontaine, O.	Mar. 25
May 1.	Benwood, W. Va.	Apr. 8
May 4.	Fort Wayne, Ind.	Apr. 8

POWER, GAS AND ELECTRICITY

Apr. 10.	Dayton, O.	Mar. 4
	Adv., Eng. Record, Mar. 4, 11.	
Apr. 17.	Winnipeg, Man.	Apr. 8
Apr. 18.	San Carlos, Ariz.	Mar. 25
Apr. 18.	Carthage, Mo.	Apr. 1
	Adv., Eng. Record, Apr. 1, 8.	
Apr. 20.	Genoa, Neb.	Apr. 1
Apr. 22.	Jeffersonville, Ind.	Apr. 8
Apr. 23.	Port Louis, Mauritius	Apr. 1
Apr. 27.	Mechanicsburg, Pa.	Apr. 8
May 1.	Franchise, Santa Ana, Cal.	Apr. 1
May 1.	Cullman, Ala.	Apr. 1
May 1.	Franchise, Fairfield, Cal.	Mar. 25
May 22.	Vincennes, Ind.	Apr. 8
	Adv., Eng. Record, Apr. 8.	
——	Pleasantville, O.	Dec. 24

GOVERNMENT WORK.

Apr. 10.	Tank, Washington, D. C.	Mar. 11
Apr. 10.	Kansas City, Mo.	Mar. 11
	Adv., Eng. Record, Mar. 11.	
Apr. 12.	Gas fixtures, Pottsville, Pa.	Apr. 8
Apr. 13.	St. Paul, Minn.	Mar. 18
	Adv., Eng. Record, Mar. 18, 25.	
Apr. 13.	Steam heating plant, Grand Junction, Colo.	Mar. 25
Apr. 14	Louisville, Ky.	Mar. 11
Apr. 17.	San Francisco, Cal.	Mar. 11
	Adv., Eng. Record, Mar. 11.	
Apr. 17.	Cement, etc., Duluth, Mich.	Mar. 25
	Adv., Eng. Record, Mar. 25 to Apr. 8.	
Apr. 17.	Plumbing, etc., Richmond, Va.	Apr. 8
Apr. 18.	Chicago, Ill.	Mar. 18
	Adv., Eng. Record, Mar. 18 to Apr. 8.	
Apr. 24.	New York City	Apr. 1
	Adv., Eng. Record, Apr. 1, 8.	
Apr. 26.	Dredging, New York City	Apr. 1
	Adv., Eng. Record, Apr. 1, 8.	
Apr. 26.	Dredging, Cleveland, O.	Apr. 1
	Adv., Eng. Record, Apr. 1, 8.	
Apr. 27.	Washington, D. C.	Apr. 1
	Adv., Eng. Record, Apr. 1, 8.	
Apr. 27.	Detroit, Mich.	Apr. 8
	Adv., Eng. Record, Apr. 8.	
Apr. 28.	New York City	Apr. 1
May 1.	Duluth, Minn.	Apr. 1
	Adv. Eng. Record, Apr. 1, 8.	
May 1.	Fort Hancock, N. J.	Apr. 8
May 1.	St. Paul, Minn.	Apr. 8
	Adv., Eng. Record, Apr. 8.	
May 2.	Dredging, New York City	Apr. 8
	Adv., Eng. Record, Apr. 8.	
May 3.	Dredging, New York City	Apr. 8
	Adv., Eng. Record, Apr. 8.	
May 6.	St. Louis, Mo.	Apr. 8
	Adv., Eng. Record, Apr. 8.	
May 9.	Chicago, Ill.	Apr. 8
	Adv., Eng. Record, Apr. 8.	
May 31.	Armor plate, Washington, D. C.	Apr. 8

BUILDINGS.

Apr. 10	Oshkosh, Wis.	Mar. 25
Apr. 10.	Carlington, O.	Mar. 25
Apr. 10.	Library, Jersey City, N. J.	Apr. 1
Apr. 10.	School, New York, N. Y.	Apr. 1
Apr. 10.	Bus. Bldg., Watertown, N. Y.	Apr. 1
Apr. 10.	Town hall, Berkshire, Vt.	Apr. 8
Apr. 10.	Grand Forks, N. D.	Apr. 8
Apr. 11.	Lodge hall, Indianapolis, Ind.	Apr. 8
Apr. 11.	Red Lodge, Mont.	Apr. 8
Apr. 12.	Court house, Council Grove, Kan.	Apr. 8
Apr. 12.	Georgetown, Ky.	Apr. 8
Apr. 12.	Court house, Wayne, Neb.	Apr. 8
Apr. 12.	Htg. school, Grand Junction, Colo.	Apr. 1
Apr. 12.	Batavia, N. Y.	Apr. 1
Apr. 13.	Htg. school, Fairmont, W. Va.	Mar. 25
Apr. 13.	Htg. school, Athens, W. Va.	Mar. 25
Apr. 13.	Philadelphia, Pa.	Apr. 8
Apr. 14.	School, Marshall, Minn.	Apr. 8
Apr. 14.	Plans, Bradford, England	Jan. 21
Apr. 15.	Plans, etc., Birmingham, Ala.	Mar. 4
Apr. 15.	Harrisburg, Pa.	Mar. 25
Apr. 15.	Bus. Bldg., Osage, Ia.	Apr. 1
Apr. 15.	School, McIntosh, Minn.	Apr. 8
Apr. 17.	Factory, Lancaster, O.	Apr. 8
Apr. 17.	School, Tarentum, Pa.	Apr. 8
Apr. 17.	School, Lattasburg, O.	Apr. 8
Apr. 17.	School, Bryan, O.	Apr. [illegible]
Apr. 17.	North Braddock, Pa.	Apr. [illegible]
Apr. 17.	School, Sidney, O.	Apr. [illegible]
Apr. 18.	Court house, Madison, Minn.	Apr. [illegible]
Apr. 18.	Laurin, Ont.	Apr. 8
Apr. 18.	Kentville, N. S.	Apr. 8
Apr. 18.	Plans, etc., South Bend, Ind.	Apr. 8
Apr. 18.	Schools, San Carlos, Ariz.	Mar. 25
Apr. 18.	Bank, Lamberton, Minn.	Apr. 8
Apr. 19.	Plans, Nashua, N. H.	Mar. 25
Apr. 20.	School, Epworth, O.	Apr. 1
Apr. 20.	Camden, Ark.	Apr. 1
Apr. 20.	School, Edgwood, Pa.	Apr. 8
Apr. 20.	School, Leando, Ia.	Apr. 8
Apr. 20.	School, Fairfield, Ia.	Apr. 8
Apr. 22.	Asylum, Vasa, Minn.	Apr. 8
Apr. 22.	Peru, Ind.	Apr.
Apr. 22.	School, Springfield, Minn.	Apr. 8
Apr. 24.	School, Dayton, O.	Apr. 1
Apr. 25.	Church, Woonsocket, R. I.	Apr. 8
Apr. 26.	Schools, Washington, D. C.	Apr. 1
May 1.	School, Glencoe, Minn.	Apr. 8
May 2.	Plans, etc., Bus. Bldg., Fargo, N. D.	Apr. 8
May 9.	Htg. court-house, Hallock, Minn.	Apr. 8

MISCELLANEOUS

Apr. 10.	Ditch, etc., Fremont, Neb.	Mar. 4
Apr. 10.	Crematories, Houston, Tex.	Apr. 1
Apr. 10.	Dam, Los Angeles, Cal.	Apr. 1
Apr. 10.	Street cleaning, Washington, D. C.	Apr. 1
	(4 advs.) Eng. Record, Apr. 1.	
Apr. 12.	Dam, Cincinnati, O.	Mar. 18
Apr. 13.	Greatbend, N. Y.	Mar. 25
	Adv., Eng. Record, Mar. 25, Apr. 1.	
Apr. 13.	Repairing wharf, Philadelphia, Pa.	Apr. 8
Apr. 15.	Frances, Colo.	Apr. 8
Apr. 15.	Incinerators, Louisville, Ky.	Apr. 8
Apr. 15.	Wapakoneta, O.	Mar. 25
Apr. 17.	Levee work, West Memphis, Ark.	Mar. 18
Apr. 17.	Garbage disposal, Louisville, Ky.	Mar. 18
Apr. 20.	New Orleans, La.	Mar. 25
June 30.	El. Ry., Shanghai, China	Mar. 4
Oct. 1.	Railroad, Moscow, Russia	Feb. 25

SCHOOLS.

Boston, Mass.—The Board of Estimate and Apportionment on April 1 authorized an appropriation of $475,000 for 7 new schools.

Warrensburg, N. Y.—A. W. Fuller of A..any is said to be preparing plans for a $20,000 school.

Blair, Neb.—There is talk of erecting a $25,000 high school here.

South Bend, Ind.—It is stated that a 14-room school will be erected this year.

St. Charles Ia.—At the annual school election it is stated that $25,000 bonds were voted for new schools.

Goshen, N. Y.—It is stated that plans are being prepared for a $15,000 addition to the high school.

Watertown, N. Y.—The plans of D. D. Kieff, of Watertown, are stated to have been accepted for the $60,000 high school.

Mattoon, Ill.—Chas. Hanker, of Toledo, is stated to have received the contract for the new Central and West schools, at $54,611 for the both buildings.

Grafton, Mass.—The Senate is stated to have passed a bill authorizing the issue of $45,000 bonds for improving and erecting schools.

Des Moines, Ia.—Hallett & Rawson, of Des Moines, are stated to be preparing plans for a new college for the S. S. Still College of Osteopathy to cost about $100,000.

Warren, O.—Albert E. Andrews, City Clk., writes that it was recently voted to issue $30,000 bonds for a school.

Ithaca, N. Y.—A. B. Wood is the architect for a $45,000 addition to the Ithaca High School.

Fairfield, Ia.—Bids are wanted April 20 for a school in sub-district No. 6, Buchanan township. P. I. Labagh, Secy.

Sidney, O.—Bids are wanted April 17 for a school in District No. 6, Van Buren Township. Joseph Kettler, Township Clk.

Bryan, O.—Bids are wanted April 17 for a school in sub-district No. 11. C. T. Wyatt, Township Clk.

Lattasburg, O.—Bids are wanted April 17 for a school in District No. 9, Chester Township. Jesse W. Ebert, Township Clk.

Marquette, Mich.—The House is stated to have passed a bill appropriating $25,000 for a state normal school.

Moline, Ill.—Peter Peterson, of Moline, has received the contract for the 16th St. school, at $22,185.

Leando, Ia.—Bids are wanted April 20 for a school. T. E. Miller, Secy.

Edgwood, Pa.—Bids are wanted April 20 for an addition to a school. F. G. Graighead, Secy. School Dist.

Homestead, Pa.—Bids are wanted April 15 for $35,000 bonds. J. H. Willams, Secy. School Directors.

Nashville, Tenn.—W. K. Vanderbilt has given $100,000 to the Vanderbilt University at Nashville for the erection of a new dormitory.

Syracuse, N. Y.—The Council is stated to have approved the bill providing for the issue of $250,000 bonds for the purchase of a site and erection of a high school.

Washington, Ia.—The citizens are stated to have voted to issue $22,000 school bonds.

Charleston, Ill.—The citizens are stated to have voted to issue $35,000 bonds for a school.

Marshall, Minn.—Bids are wanted April 14 for a school. C. B. Tyler, Secy. Bd. of Educ.

Iowa City, Ia.—Warren Roberts & Co. of Chicago are stated to have received the contract for the collegiate building at the State University at $159,000.

McIntosh, Minn.—It is stated that bids are wanted April 15 for a school. H. L. Hanson, Clk.

Glencoe, Minn.—Bids are wanted May 1 for a school in Dist. No. 12, Rich Valley Township. John Kasper, Dist. Clk.

Springfield, Minn.—Bids are wanted April 22 for a school for St. Raphael's Church. Augustine Wirth, Pastor.

Tarentum, Pa.—Bids are wanted April 17 for a high school. F. C. Sauer, Archt., Hamilton Bldg., Pittsburg, Pa.

Philadelphia, Pa.—The following bids were opened April 4 by the Board of Public Education for the erection of a nine division school building at Girard avenue and Leopard street: Reilly & Faulkner, 6th and Diamond streets, $34,050; Wilkins & Kuemerle, Betz Building, $31,860; Chas. O'Neill, 1216 South Broad street, *$26,883; George W. Pierson, Lippencott Building, $27,888; H. C. Nichols & Co., 2030 Market street, $30,800; Wm. R. Dougherty, 1604 Sansom street, $29,170; Hiram A. Miller & Sons, Erie avenue and Sydinbam street, $29,900; Sam'l Gourley, Jr., 21st street and Ridge avenue, $29,887.

*Contract awarded.

New York City.—The following bids were opened April 6 for the erection of public school No. 181: Mapes-Reeve Construction Co., 150 Nassau St., $108,000; H. Probst, 1180 B'way, $103,500; P. Gallagher, 150 5th Ave., $114,400; Thos. Cockerill & Son, 550 W. 51 St., $119,500; Collier Weeks, $105,975; P. J. Brennan, 63 W. 22 St., $114,200; L. A. Burke, 401 W. 59 St., $112,995; Farrell & Hopper, 215 W. 125th St., $115,629; Jas. J. Loonie, 287 4 Ave., $115,000.

A permit has been issued for a brick and stone school to be erected by the city on 66 St. and 1st Ave., to cost $260,000. C. B. J. Snyder Archt., 585 B'way.

STREET CLEANING AND GARBAGE DISPOSAL.

Newport, Ky.—The City Engineer has been instructed to advertise for bids for the removal of garbage.

Newark, N. J.—The City Wastes Disposal Co. has filed articles of incorporation. Capital stock, $150,000. Its objects are to dispose of waste material and build docks, canals, tunnels, reservoirs, bridges, gas, electric light and water plants. The incorporators are William Lee Church, Frederick W. Garvin and Oscar L. Lefferts. East Orange is named as the principal local office.

Spokane, Wash.—The Spokane Crematory Co. has applied for a 50-year franchise to erect a garbage crematory plant.

Louisville, Ky.—Local press reports state that bids are wanted April 15 by the Board of Public Works for incinerators.

GOVERNMENT WORK.

New York, N. Y.—Bids are wanted May 2 at the U. S. Engineer Office for dredging in Wallabout Channel, as advertised in "The Engineering Record."

New York, N. Y.—Bids are wanted May 3 at the U. S. Engineer Office for dredging in Gowanus Creek Channel, as advertised in "The Engineering Record."

Chicago, Ill.—Bids are wanted May 9 at the U. S. Engineer Office for constructing 13 miles of Feeder of Illinois & Mississippi Canal, south of Tampico, as advertised in "The Engineering Record."

St. Paul, Minn.—Bids are wanted May 1 by the Superv. Archt., Treas. Dept., Washington, D. C., for the interior finish, plumbing and gas piping at the U. S. Postoffice, Court House, etc., as advertised in "The Engineering Record."

Detroit, Mich—Bids are wanted April 27 by the Superv. Archt., Treas. Dept., Washington, D.C., for changes, alterations and repairs in the U. S. Custom House, as advertised in "The Engineering Record."

Chicago, Ill.—The following bids were opened March 28 by Major W. L. Marshall, Corps of Engrs., U. S. A., for dredging and constructing docks in the Chicago River, as advertised in "The Engineering Record": The work includes 231,500 cu. yds. of dredging. Prices given are per cu. yd. for dredging and the total bid: Green's Dredging Co., Chicago, Ill., 16.9 cts., $125,863.17; Lydon & Drews Co., Chicago, Ill., 16.9 cts., $125,863.17; Samuel O. Dixon, Milwaukee, Wis., 16¼ cts., $126,821.76; Chicago Star Construction Co., Chicago, Ill., 23 cts., $144,463.30; Fitz Simons-Connell Co., Chicago, Ill., 18.7 cts., $127,575.27.

New York, N. Y.—The following bids were opened March 31 by the Superv. Archt., Treas. Dept., Washington, D. C., for ventilating apparatus for the basement and sub-basement of the U. S. Court House and Postoffice: Walker & Chambers, $10,500; Gillis & Geoghegan, $13,700; Walters & Carey, $11,999; Blake & Williams, $11,866; G. A. Suter & Co., $9,875. Bidders all of N. Y. City.

Washington, D. C.—Local press reports state that James G. Hill of Washington will prepare plans and specifications for the new Goverment Printing office. Appropriation $2,000,000.

St. Louis, Mo.—Bids are wanted May 6 at the office of the Missouri River Commission for constructing lock and dam No. 1, Brennekes Shoal, Osage River, as advertised in the "Engineering Record."

Washington, D. C.—Bids are wanted May 31 for about 24,000 tons of armor plate for naval vessels. Chas. H. Allen, Acting Secy., Bureau of Ordnance, Navy Dept.

Pottsville, Pa.—Bids are wanted April 12 for combination gas and electric light fixtures in the U. S. Building. H. A. Taylor, Asst. Secy., Treas. Dept., Washington, D. C.

Fort Hancock, N. J.—Bids are wanted May 1 for an ordnance storehouse and a lavatory building. Capt. G. C. Bailey, A. L. M., U. S. V.

Richmond, Va.—It is stated that bids are wanted April 17 for repairs to plumbing and heating apparatus in the U. S. Custom House and Post Office. John S. Bethel, Custodian.

Manila, Philippine Islands.—Press reports state that the following bids have been received by Chief Quartermaster Lee at Chicago for the erection of an ice-making and refrigerator plant at Manila: Fred W. Wolf Co., Chicago, $225,014; De La Vergne Refrigerator Machine Co., N. Y. City, $195,162; Theodore O. Vilter of Milwaukee, $205,820; Frick Co. of Waynesboro, Pa., $215,613, and $225,352.

MISCELLANEOUS.

Philadelphia, Pa.—See "Paving and Roadmaking."

Worcester, Mass.—The Expert Grade Crossing Commission, consisting of Rudolph Hering, Desmond Fitzgerald and Fredk. McClure, in the report recently submitted to the City Council, recommend the complete elevation of tracks.

Frances, Colo.—Bids are wanted April 15 for driving the Ni Wot branch of the Adit tunnel 2,000 ft. Wm. P. Daniels, Mgr., Adit Tunnel Co.

Pueblo, Colo.—The City Council has appropriated $41,000 for the completion of levees in the Arkansas River.

Washington, D. C.—See "Business Buildings."

Indianapolis, Ind.—It is stated that bids will be received about May 1 for a dam, roadways and buildings for Riverside Park. Address Engineer Power, Park Bd.

Philadelphia, Pa.—The following bid[s] were received by the Board of Po[rt] Wardens for dredging docks not belong[-] ing to the city and in front of bulk[-] heads not belonging to the city wher[e] city sewers empty: Philadelphia Con[-] struction Co., Girard Building, 17½ pe[r] cu. yd.; American Dredging Co., Thir[d] and Walnut streets, 18¼c. per cu. yd.

Morgantown, W. Va.—Press report[s] state that the West Virginia & Pittsbur[g] R. R. will this summer construct a tu[n-] nel nearly 2 miles long; estimated [to] cost $200,000.

Albany, N. Y.—The Governor ha[s] signed the bill reappropriating $661,67[...] the unexpended balance of $5,000,000 ap[-] propriated in 1897 for canal improve[-] ment.

Philadelphia, Pa.—The Select Counc[il] has concurred in the ordinance t[o] amend the ordinance providing for th[e] abolition of grade crossings on the lin[e] of the Philadelphia & Trenton Railroa[d.] The amended ordinance provides for [a] connection by way of Lehigh Ave. wit[h] the River Front Railroad, and appropr[i-] ates $900,000.

WHILE THE ENGINEERIN[G] RECORD maintains a cost[ly] organization for the collection an[d] verification of the advance contractin[g] intelligence published each week in i[ts] columns, we are always glad to r[e-] ceive from our readers information [of] projected public and private enginee[r-] ing and building work of which th[ey] may have any knowledge or wi[th] which they are professionally co[n-] nected. Such service is of mutu[al] benefit and is always greatly appr[e-] ciated by us.

When sending information, plea[se] be sure to give post-office address [of] any person mentioned.

WANTED.

PROPOSALS.

Notice to Contractors.

Notice is hereby given that at a meeti[ng] of the Public Improvement Commission [of] the city of Cohoes, N. Y., to be held at t[he] rooms of said Commission, in the City H[all] Building in the city of Cohoes, N. Y., [on] the 26th day of April, 1899, at 3 o'clock [in] the afternoon of that day, sealed propos[als] will be received for the construction of [the] sewerage and drainage, sewers and drai[ns,] man-holes and lamp-holes, and connecti[ons] therewith, and improvements according [to] the map and plan thereof marked "Gene[ral] Plan, Sec. 3, Sewers, Cohoes, N. Y., Ma[rch] 17th, 1899, Edward Hayes, C. E.," now [on] file in the clerk's office of the city of [Co-] hoes, N. Y.

Said proposals to be accompanied wit[h a] bond in the penal sum of two thousand [dol-] lars ($2,000.00), with one surety, owner [of] real estate within this State of New Y[ork,] or the bond of any solvent Surety C[om-] pany, conditioned for the entering into c[on-] tract with said city of Cohoes accord[ing] to such sealed proposals, if the contr[act] shall be awarded to such person or pers[ons] so bidding, or accompanied with the ce[rti-] fied check of the person or persons so [bid-] ding in the sum of two thousand dol[lars] ($2,000.00) for the entering into such [con-] tract.

Estimated approximate quantity is [...] miles of sewer pipe from 24-in. to 10-inc[h.]

The Commission reserves the right to [re-] ject any and all bids that they may d[eem] proper.

WILLIAM J. ELLI[OTT,]
City Clerk and Clerk of the Public [Im-] provement Commission of the City of [Co-] hoes, N. Y.
Dated Cohoes, N. Y., April 5th, 1899.

Proposals continued on pages xi and [...]

THE ENGINEERING RECORD.

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TABLE OF LEADING ARTICLES.

The Engineering Record, conducted by Henry C. Meyer, is published every Saturday at 100 William Street, New York. Its opinions on technical subjects are either prepared or revised by specialists.

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Modern Practice in Steam Heating and Ventilation is the title of a series of articles, begun on page 455 of this issue, by Mr. William S. Monroe, who has been engaged for a number of years in designing and supervising the installation of ventilating and heating plants of buildings. The papers are inteded to supplement the work of Dr. Billings and will handle the subject of ventilation in a rather different manner. The author will pay considerable attention to the mechanical system of ventilation and present information enabling the architect and engineer to design installations of this sort. Important data will be given concerning the design and arrangement of ducts and registers, fan capacities, the efficiency of radiators as determined by many tests, and other topics. Exhaust steam heating will be treated quite fully. The endeavor throughout the series will be to present information in a form intelligible to the student, yet valuable to the expert.

AMERICAN EXHIBITS AT THE PARIS EXPOSITION.

One year from to-day the Universal International Exposition at Paris is to be opened, and American manufacturers who propose to send exhibits have but little time in which to file applications for space. It should be remembered that the grounds for this world's fair will be but half the size of those covered by the Columbian Exposition at Chicago, and of this space France will occupy 55 per cent., leaving to the United States but a small proportion of the remaining area. At Chicago the United States occupied 45 per cent. of the covered space on the ground, so it is evident that the conditions at Paris will be very different from those under which American exhibitors arranged their displays in 1893.

If this country is to make a display in proportion to its resources and commerce, it will require a larger space than that accorded to other foreign nations at the French capital. The eminent English statician, Mr. Mulhall, says: "The United States leads in agriculture, with products greater than Russia and the United Kingdom combined; in manufactures, with a product greater than the aggregate output of the factories of the United Kingdom, France, Austria-Hungary and Belgium combined; in machinery, with a steam power greater than the United Kingdom, Austria-Hungary and Italy combined; in mining, with a product greater than the United Kingdom and France combined, or nearly one-third that of the entire world; in railway transportation with a mileage 40 per cent. greater than that of all Europe; in forestry, with products greater than those of all Europe and nearly one-half of the total products of the world; in fisheries, with a greater product than the United Kingdom, Russia and Germany combined." It is very evident, therefore, that so far as resources, industries and commerce are concerned, the United States is in a position to make a great display. It is now high time to decide upon the character of that exhibit. In coming to any decision on this subject it is necessary to bear in mind certain conditions which make the business world of the United States of to-day very different from that of a decade or so ago. Thomas Carlyle once said that the United States would have to solve no serious financial problems until all its arable land was taken up. His idea evidently was that there could be no serious problems so long as there was a domestic market for all home products. It is evident that the time has now come when manufacturers should begin to look for foreign markets. Mr. Mulhall nas shown that although the United States is $20,000,000,000 richer than Great Britain, the latter, with one-thirtieth the area, and but little more than half the population of the former, has double the foreign trade. Even Germany, which has scarcely one industry comparable with those of the United States, had a greater foreign trade in 1895. Of foreign exports to Australasia and Asia, where there are 852,000,000 people, somewhat over half the total population of the world, the United States supplies but one-seventh. Even those exports were made in answer, in large part, to orders wholly unsolicited. Figures compiled by the Treasury Department seem to indicate that the international expositions in which the United States has been interested have had a marked effect on this export trade. Prior to the Centennial Exposition there were but sixteen annual balances of trade in favor of this country; since that time there have been but three against it. There is a general impression that the Columbian Exposition was largely influential in securing foreign connections for American firms, and it is believed by the officials of the United States who are now arranging for American exhibits at Paris that a good representation there next year will have a still more beneficial result.

The exhibits are to be classified according to the country where they were produced and not according to the nationality of the exhibitor. The fact that an American manufacturer has an office in France will not enable him to place his display in the French section. The exhibitors must bear all the expense of cabinets, railings and other fittings, but will not be charged for space nor for a reasonable amount of power. So far as possible shafting will be dispensed with and power furnished by electric motors. A preference has been evinced for exhibits in which the process of manufacture will be shown side by side with the product. Owing to the limited space at the disposal of the United States, the Commissioner General of this country, Mr. Ferdinand W. Peck, has already announced that it may be necessary for exhibitors to unite in collective exhibits of a national character, although preserving at the same time the individuality of the products of the parties represented. He states that the collective national exhibits made by foreign countries at Chicago have been declared the most effective by the reports of the commissioners of the various nations. Applications for space may be addressed to the Commissioner General at New York, Chicago or Paris, and should state fully the character of the proposed exhibit; no room for the display of United States products can be secured in any other manner.

The exhibits are classified by the French officials into eighteen groups, united into eleven departments, with a director in charge of each to superintend the various installations. A like number of chiefs of departments have been selected to act in a similar capacity for this country. The awards are to be diplomas of grand prize, diplomas of gold medal, diplomas of silver medal, diplomas of bronze medal and diplomas of honorable mention. The exhibits are to be valued by an international jury arranged in three degrees of jurisdiction, class juries, group juries and a superior jury.

For all the classes the number of jurors, French and foreign, are to be about one-sixtieth of the number of exhibitors, and the number of jurors in each class and for each nationality is to be proportioned as nearly as possible to the number of exhibitors and the importance of the exhibits. Each class jury will choose its own officers and is authorized to invite as associates or experts one or more persons well informed as to the subjects submitted for its examinations.

Each group jury will consist of a president, two or three vice-presidents and a secretary, who may be chosen from persons other than class jurors, and the president, vice-presidents and recorders of the class juries in the various groups, of which there are eighteen, as before stated. Group 1, with six classes, is devoted to education and instruction; group 2, of four classes, to works of art; group 3, with eight classes, to the instruments and general processes of letters, sciences and the arts; group 4, with three clases, to the materials and general processes of mechanism; group 5, with five classes, to electricity; group 6, seven classes, to civil engineering and transportation; group 7, eight classes, to agriculture; group 8, six classes, to horticulture; group 9, six classes, to forestry, hunting, fishing and the gathering of wild products; group 10, eight classes, to food stuffs; group 11, three classes, to mines and metallurgy; group 12, ten classes, to the decoration and furniture of public and private buildings; group 13, thirteen classes, to threads, textile fabrics and clothing; group 14, five classes, to chemical industries; group 15, nine classes, to diversified industries; group 16, twelve classes, to social economy, hygiene and charities; group 17, three classes, to colonization; group 18, six classes, to military and naval affairs.

The superior jury will have as its honorary president the Minister of Commerce, Industry, Posts and Telegraphs, and its vice-presidents will be the Minister of Public Instruction and Finance, the Minister of Agriculture and the Commissioner General. Others entitled to membership in this jury are the presidents and vice-presidents of the group juries, commissioners from countries represented by more than 500 exhibitors, the members of the superior committee of revision, the Director-General and the Assistant Director-General, the other Directors and the General Secretary of the exposition, and the delegate of the administration of the colonies to the exposition.

Each class jury is required to prepare a list of exhibitors who are not competitors for award, a list in order of merit without distinction of nationality of the awards which it proposes to make, and a corresponding list of collaborators, engineers, foremen and workmen who have particularly distinguished themselves in the production of noteworthy objects at the exposition. In art industries the list of prize winners is to be divided into a section including the authors of drawings, models, etc., and a section including manufacturers. Distinct sections will also be formed, one for the equipment and methods of production and the other

for products, when the various elements are found together in the same class.

Mr. Peck has prepared a pamphlet giving in detail the classifications which have been adopted by the authorities of the exposition, together with information concerning the methods of shipping exhibits and other subjects which will be useful for those who intend to make displays. A copy can be obtained from any of his offices, and as the general installation of displays will begin on the first of December of this year and must close by the end of February, 1900, arrangements should be made with him for space as soon as possible.

DRAFTING METHODS OF THE NEWPORT NEWS SHIPBUILDING & DRY DOCK COMPANY.

The general conditions imposed on the drawing office and the engineering staff of the Newport News Shipbuilding & Dry Dock Company are to design and order from the shop machinery for all kinds of ships from a tug boat to a sea-going battleship, to prepare specifications for this machinery, to make out requisitions for all material shown by the drawings, to make estimates of the power required and to proportion and design the machinery to furnish such power, and to estimate the cost of building and installing the machinery, which varies in size from the small auxiliaries of tug boats and launches to main engines of from 18,000 to 20,000 indicated horse-power. A description of the manner in which all this work is carried through the offices was recently contributed to the "Journal" of the Worcester Polytechnic Institute by Mr. Charles F. Bailey, a graduate of that school now in charge of the drawing office. The work in hand at this establishment when Mr. Bailey prepared his article comprised 17 main engines for 14 vessels, aggregating 110,000 indicated horse-power, with all the boilers and auxiliaries. Such an amount of work demands careful subdivision of responsibility in the drawing office, and the aim is to have the organization so planned that work may go on uninterruptedly whether or not the chief is present. One man is placed in charge of the drawing room and made responsible for its conduct. Several men may have charge of the different jobs on the different ships, but all work passes through the hands of the chief or his assistant.

As far as possible all work of a complex nature and all the principal features of each undertaking are carefully thought out and settled by the chief before they are given to the leading men. To accomplish this it has been found necessary to establish an estimating and scientific department, and while this is still an experiment at Newport News, Mr. Bailey believes its development will result in a great saving of time. All preliminary estimates and designs are made in this department. The estimates of the weight and cost for all tenders are prepared here, and after a contract is signed the calculations for all parts of the work are made and tabulated in this department, the results being filed on blank forms suitable for each job. If it is an engine design, all the main dimensions are determined here as nearly as can be done without development on the drawing board. A copy of the calculations is then taken to the drawing room and given to the leading men who have charge of the job. In this way the engineer or chief draftsman is enabled to go over all calculations and check them carefully, as the forms are similar for similar work and by the aid of the slide rule all important features can be easily checked. Sketches are often inserted in the note, which are passed by the chief so that when the calculations are placed in the hands of the leading men they are ready for development by the draftsmen. Before the establishment of this department it was often found necessary during a rush of work to give the draftsmen tasks which were not thoroughly thought out; consequently much was left to the judgment of individuals, and when the drawings were completed they often required extensive alteration and sometimes had to be entirely remade. When the job is completed a blank is filled in the estimating department, on which are shown the sizes and strains as finally determined. A careful record of the weights and centers of gravity of all machinery as placed on board is also kept, and a record of the cost of all parts of the machinery. All this material is in the hands of the leading man of the estimating department, tabulated so as to be easily referred to by the engineer or general superintendent, and is, of course, strictly confidential.

It has been found to facilitate the work of the office to hold a consultation each morning of the leading men and plan the work for each man in the department. In this way each draftsman is loaded with work, and he consequently feels a much greater incentive to do his best than when kept in ignorance of what his next job will be. If men are left to take their time in making drawings it is usually the case that much more time than is necessary will be spent on each sheet. It is also a great advantage to require from time to time, of each leading man, a list of all work remaining unfinished on each job under his charge. In this way the important work can be turned out first and the sequence of the work going into the shop can be arranged so as to facilitate erection and completion.

The office is provided with a set of standard tables, giving the dimensions of all standard work, such as stop valves, fittings, bolts, nuts, key seats, flanges, piping, etc. A blue print copy of these tables is given to each draftsman in order to standardize the work of this class.

As the drawings are being developed at the boards it is intended to keep a close run of them, to make any alterations which appear necessary. After the drawing is completed it is placed in a drawer for an examination print, which is taken on cheap paper. The man who has charge of the job checks the drawing from this print, making all the alterations required in red pencil and checking all correct figures and dimensions with a yellow pencil. In this way the drawing is not mutilated, but all of the corrections are plainly seen on the print, and can be made on the tracing. After the drawings are checked by the leading man, they are taken into the chief draftsman's room, where they receive his signature before they are sent to the shop. Accompanying each drawing is a requisition addressed to each shop, which has any work to do from the drawing. The drawings are blue-printed and a copy given to each shop which has any work on the piece shown.

It has been found best, as in other shops, to adopt standard sizes of drawing sheets. In the Newport News office the drawings are made on sheets measuring 40 x 54 inches, 40 x 27 inches, 20 x 27 inches, and 13½ x 20 inches. It is the practice to subdivide the work shown on each drawing, pattern work and casting on one, blacksmith work on another, and coppersmith work on still another. The drawings are printed only for the shop for which they are needed. A general drawing is prepared to show the arrangement of the machinery as erected. For some time it was the practice to use bond paper and ink the drawings in on this, but the sheets soon became worn and did not print well so it has been found cheaper and more satisfactory to use a good quality of tracing linen.

When a drawing is finished it is given to an indexer, who has charge of entering up, recording, and filing all drawings. They are indexed in a running index book, in which the numbers are arranged consecutively, and also in a card index, and are finally filed in a fireproof vault. As blue prints are sent to the shop they are indexed on blue cards kept in a drawer by themselves. The man in charge of the indexing also gets out all drawings for the draftsmen, and sees that they are returned to the drawers where they are kept. Whenever a draftsman obtains a drawing a slip is made out charging him with the sheet; this is destroyed or returned to him on the return of the drawing.

In making requisitions for material, a rough draft is first prepared by the leading man in charge of the job; this is checked by the chief draftsman and then typewritten on regular requisition blanks.

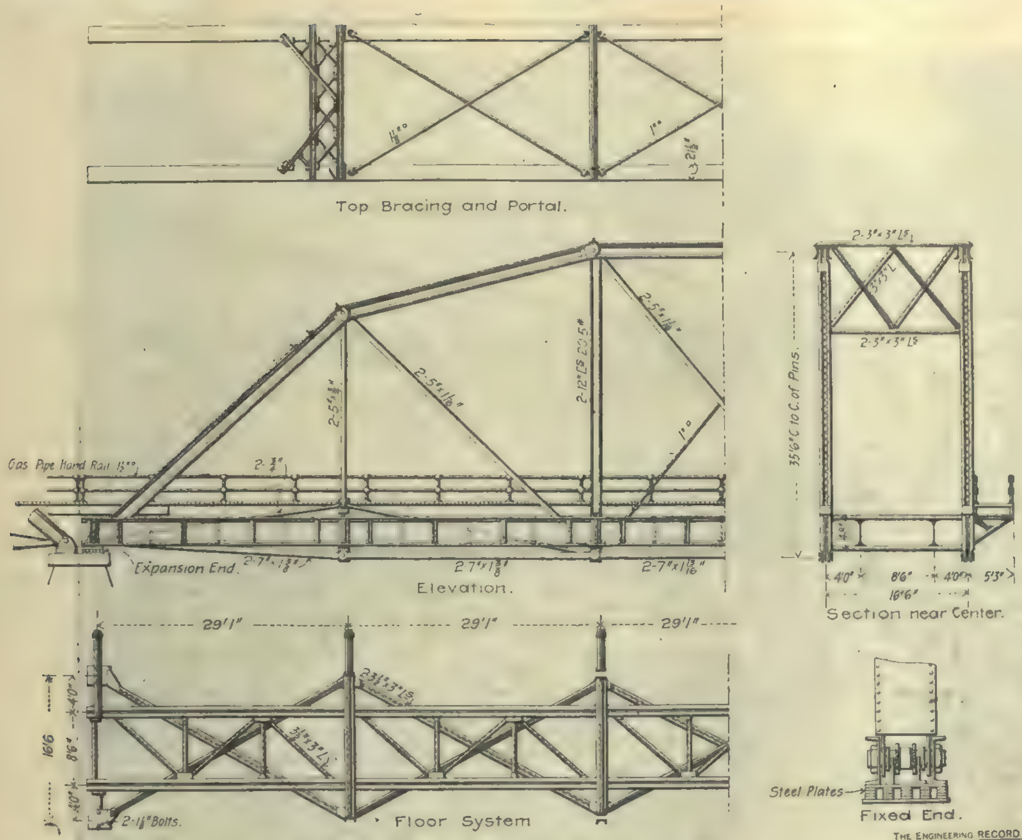
The office hours are from eight to twelve and from one to five during the winter months. During the summer months the hours are from eight to twelve and from half-past one to six, except on Saturdays, when the afternoon is free. A card having a list of the names of the draftsmen is kept in the drawing room, and each man as he enters for work in the morning and after the noon hour checks the time at which he arrives opposite his name. Five minutes after the beginning of office hours, this card is taken into the chief draftsman's office, and any draftsman arriving more than five minutes late must enter this office and check off his time. All draftsmen are given one day leave each month or twelve days during the year. For any loss of time over this amount a deduction is made from their wages.

A KOREAN BRIDGE.

The only railroad in Korea is a standard gauge line 28 miles long from Seoul to Chemulpo. The principal river crossing of this road is over a wide, flat alluvial bottom where the valley and river bed have a width requiring a structure of moderate height a little more than 2,000 feet in total length, which is to be composed of ten spans of steel trusses of nearly equal length. These spans will, when erected, form the first steel bridge ever built in Korea. They have been designed to conform to American railroad specifications and detailed to American shop standards.

There are eight spans of 200 feet each and two of 203 feet 7 inches, all essentially duplicates and built with ordinary details except as shown in the accompanying cut, which illustrates typical features of one of the longer spans. The work was done and the design made in conformity to the specifications of the Denver & Rio Grande Railroad, and provide for an engine load of 125 tons, followed by a live load of 4,000 pounds per lineal foot. Each span consists of two seven-panel Pratt trusses 16½ feet apart and 35½ feet deep in the center. The end posts and end top chord sections are inclined, and the middle three panels of the top chord are horizontal. The single track is supported by one pair of 4-foot plate girder stringers 29 feet long in each panel, and a 4-foot sidewalk is cantilevered out on one side of the lower chord. The main truss connections are pin-connected, all others are riveted except those of the top lateral diagonal rods, which are screwed up with end nuts bearing on vertical seats riveted to the top chord cover plates, and except those of the sidewalk brackets, which are made with ⅞-inch turned bolts.

The floor beam and stringer connections are web riveted and each pair of stringers is braced by two intermediate vertical transverse sway brace frames of single 3 x 3½-inch horizontal and X-brace angles, and by single 3 x 3½-inch horizontal diagonal angles zigzaged between them in the plane of the top chords. The pairs of 3 x 3½-inch angles which form the lower laterals pass beneath and clear of the stringers and are riveted together at their intersections. The pier ends of the stringers rest on anchored bed plates without any masonry floor beams and the end floor beams are web-riveted to short vertical lengths of 12-inch channels in the truss planes. These channels have pin holes bored in their webs 6 feet apart; by the upper ones they



DETAILS OF THE FIRST STEEL BRIDGE IN KOREA.

are suspended to the vertical tension bars from the hip joints, and the lower ones receive the regular bottom chord pins. The upper pins of these floor beam hangers also take longitudinal rods in the planes of the trusses, which are slightly inclined from the horizontal and run to both adjacent lower chord pins to secure the top of the floor beam from possible longitudinal vibration. Each of the three intermediate top lateral cross struts is a very high riveted truss 10 feet deep, and made with pairs of horizontal and single diagonal angles, all 3 x 3-inch, as shown in the center cross-section of the trusses.

In order to provide for possible inaccuracies or settlements of the masonry the fixed-end truss shoes rest on piles of narrow loose shim plates, which can be removed and replaced by others of different thickness if necessary. All chord pins are 5 5/16 inches in diameter, except the middle three in the top chord, which are 3 15/16 inches. The top chords and posts throughout are made of two 2½ x 3-inch top angles, two 5 x 3-inch bottom angles, two 18 x ⅜-inch web plates, and a 21½ x ⅜-inch cover plate. On account of the very remote and inaccessible location of the bridge and the difficulties of erection there, the three center panels of the top chord were assembled and match-marked in the shops before shipment. The two 203½-foot spans had a total net shipping weight of 458,318 pounds, and comprised 732 invoiced pieces, which were forwarded from New York by direct steamer last September, and were due to arrive at the site about January 1. This bridge was built for the American Trading Company, New York, by the Phœnix Bridge Company. Bids were received for the erection of the bridge, but the work was finally assumed by Messrs. James & Company, Chattanooga, Tenn., who are the general contractors for building the railroad.

SUBAQUEOUS PIPE-LAYING AT DELRAY.

During the summer of 1898 an unusually large cast iron main was laid beneath the Rouge River at the works of the Solvay Process Company at Delray, Mich., under the direction of Messrs. Thacher & Shirley of Toledo. It is 190½ feet long, 72 inches in diameter, and terminates in a tee at each end, from which rises a vertical pipe of the same diameter. The main consists of bell and spigot pipe in 12-foot lengths, having a shell 1½ inches thick coated by the Angus Smith process. The lead joints are 7-16 inch thick, 3½ inches or more deep, and made with hemp gaskets in the usual manner, except as described later.

The work was begun by excavating a trench with a dredge of the clam shell type, owned by Carkin, Stickney & Cram of Detroit, Mich., which has been found especially fitted for such work, as it can remove any material except rock from a great depth. The bottom of the cut was made lower than the final grade and was partly refilled with a bed of about 3 feet of gravel to form a firm bearing for the main which was laid directly upon it without special supports. The pipe was laid in two sections, each made of a number of 12-foot lengths joined together in the usual manner on timbers on the bank of the stream. The accompanying illustration shows a section of seven lengths while they were being lowered on skids into the water. Wooden bulkheads were placed in the ends of each section and made it practically water tight; the sections were sunk by removing the bulkhead from one end. The plate iron casks which are shown attached to the section were not used to float the pipe on the surface of the stream, but to support its weight while under water after the bulkhead had been removed. They have a supporting power of about 2,500 pounds each and are covered with wooden jackets to protect them after they are cut loose from the pipe by the diver, for as they ascend to the surface they are liable to be damaged if unprotected by striking against the sides of the scows or tugs.

Near one end of each section an iron band was placed around the pipe to assist in pulling the sections together in making the joints under water. The preliminary preparation for this work consisted in turning the spigot end of the pipe to a taper in a lathe, and then making with this and a bell of another length an ordinary calked joint. The tapered end was afterward drawn out, leaving the lead in place in the bell in a shape conforming to the turned spigot end. This tapered end of one section and the corresponding bell of the other were drawn together under water by a diver by means of draw rods, nuts and washers, held in place by the iron bands around the pipe. This type of joint is patented.

On each side of the river is a vertical uptake, the distance between their centers being 190½ feet, as before stated. Each is connected with the horizontal pipe by means of a tee, and rises to about 3 feet above the average height of the water in the river. The unused bell of each tee is fitted with a plug having rope gaskets pounded around it and finally calked with lead. Each tee rests on a heavy timber foundation. The back filling over the pipe was carried up to the bottom of the river. Messrs. Carkin, Stickney & Cram of Detroit, Mich., were the general contractors for the work, the pipe laying being sublet to Messrs. Thacher & Shirley.

LAUNCHING A SECTION OF 72-INCH PIPE AT DELRAY.

THE NEW FOUNDRY OF THE GENERAL ELECTRIC COMPANY.

There has recently been completed at the works of the General Electric Company at Schenectady, N. Y., an iron foundry which is one of the largest buildings of that character in the world. It is, perhaps, fair to assume that it represents the best modern practice, as no expense was spared in its construction and equipment, and the general arrangement and details of the plant were not adopted until a thorough study had been made of what had been done in the past.

The building, which is shown in plan in Figure 1 and in cross-section in Figure 3, consists of a main structure 140 x 503 feet, with a wing 120 x 103 feet. An interior view of the building is shown in Figure 2. The wing is used as a cleaning and chipping room for castings, leaving the floor of the main building free for moulding work. In a lean-to on the same side of the foundry biulding are the ventilating apparatus, lavatory and flask-making and pattern rooms. To the north of the foundry are the storage bins for moulding sand, coke, scrap and pig iron; and along the north wall of the building are the core ovens and cupola room. The main building is of steel and brick construction. The steel roof is entirely carried by steel columns built in the brick curtain walls. Interior columns divide the building into three bays and the middle one, which is 65 feet wide, is spanned by one 40-ton and one 10-ton Morgan crane. The south bay, 32 feet wide, is served by a 7-ton and two 5-ton cranes. A 10-ton crane spans the cleaning room and it is run on tracks, which lead to the middle of the foundry, so that castings conveyed to the east end of the foun-

FIGURE 2.—INTERIOR VIEW OF THE MAIN BUILDING.

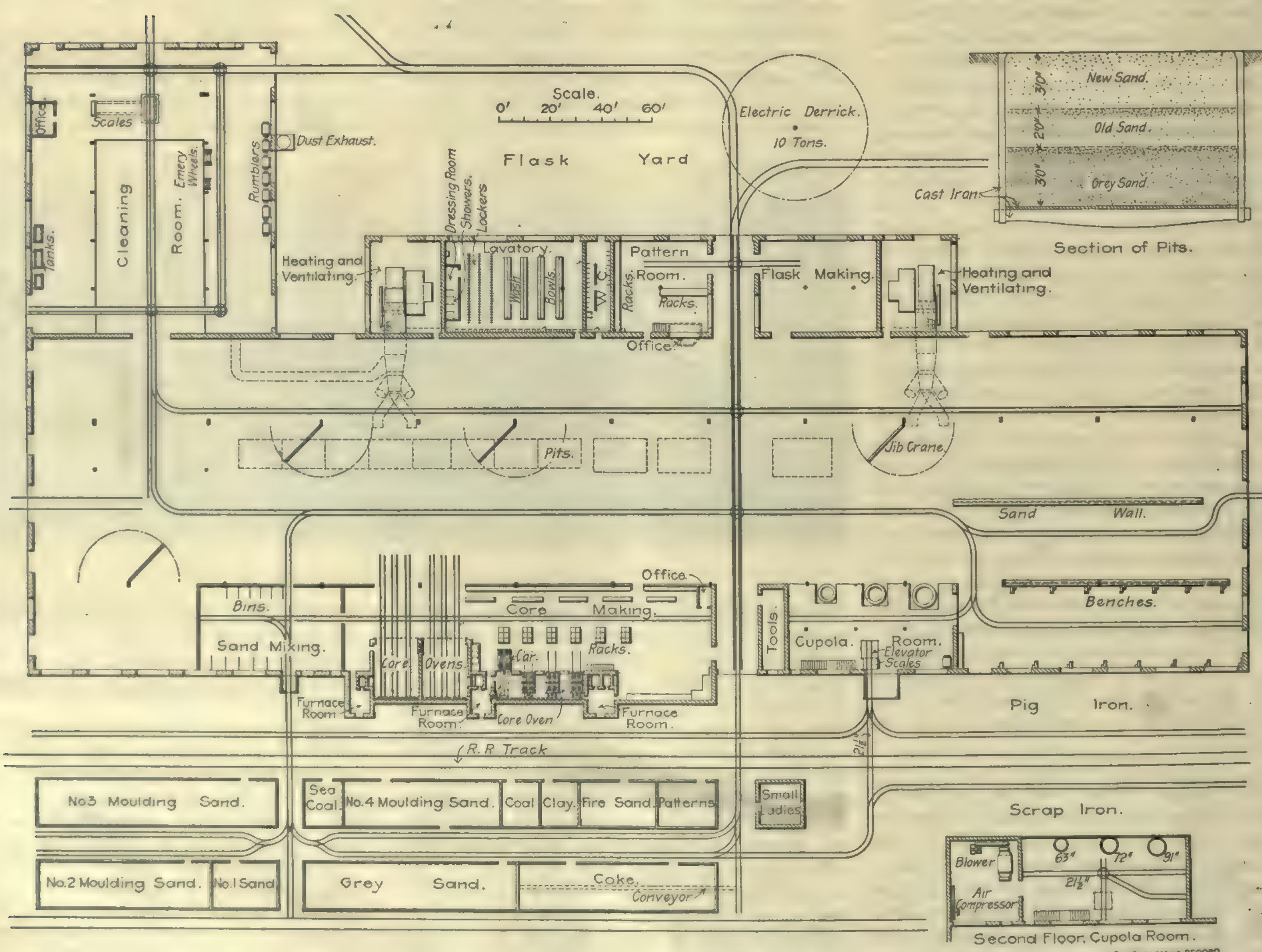


FIGURE 1.—PLAN OF THE BUILDINGS AND TRACKS.

THE NEW FOUNDRY OF THE GENERAL ELECTRIC COMPANY, SCHENECTADY.

MR. W. A. PEARSON, MECHANICAL ENGINEER; MR. G. E. EMMONS, MANAGER.

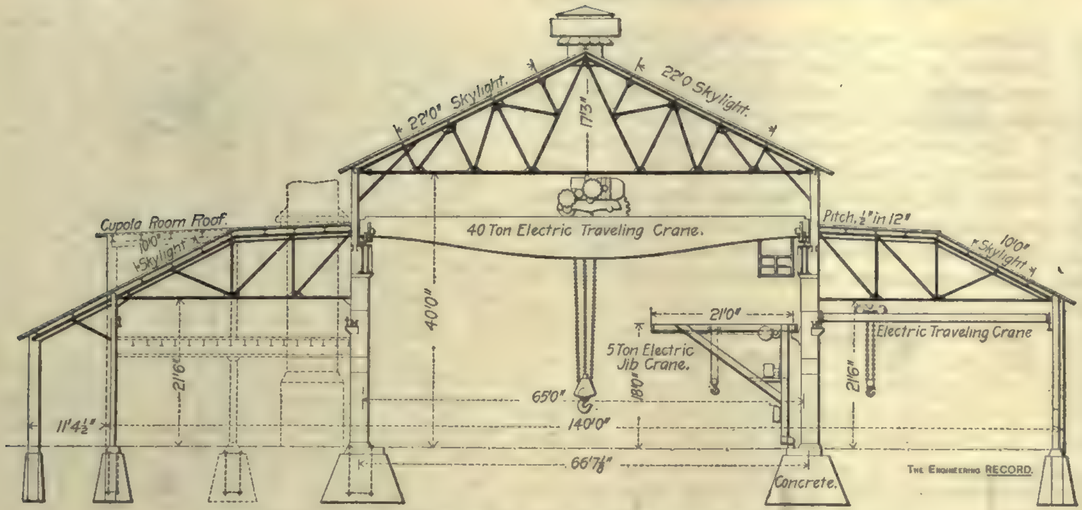


FIGURE 3.—CROSS-SECTION OF THE GENERAL ELECTRIC FOUNDRY.

dry by the cranes in the middle or south bay may be reached by the cleaning-room crane. There is also a 5-ton crane on the north side to serve the core making. In addition, there are six portable jib cranes, of 21-foot swing and 5 tons capacity, which may be transported by the traveling crane and attached to any of the interior columns, so that they may serve the greater part of the middle bay of the foundry. The extensive system of narrow-gauge tracks, shown in Figure 1, practically connects all parts of the foundry, and these, with the cranes, make the manual handling of castings and materials unnecessary.

Iron and coke are raised from the ground level to the spacious charging platform in the cupola room by a hydraulic elevator. The cupolas are of the Calliau type of 18, 11 and 7 tons

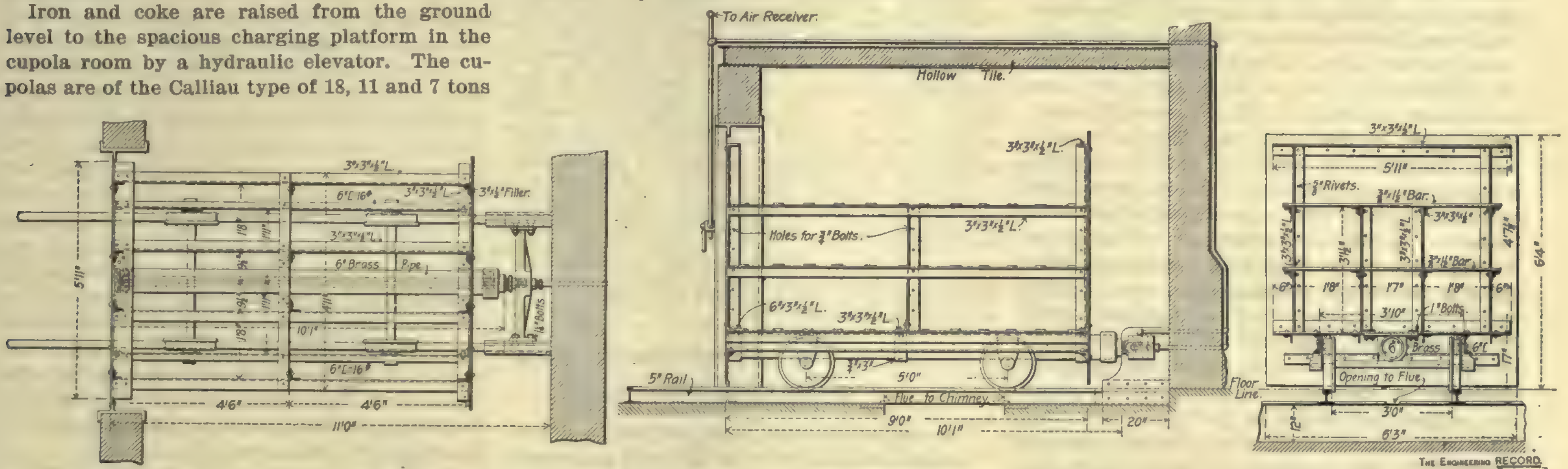


FIGURE 4.—CORE OVENS AND SPECIAL CARS WITH PNEUMATIC MOVEMENT.

capacity per hour. They are supplied with blast by a Root blower driven by an electric motor and located in a separate room, as shown. The cupolas are located to favor small work, which is mostly done in the corner of the building adjacent to the cupolas. All heavy casting is done in the middle bay and for specially large work moulding pits with iron bottoms are provided. Moulding sand is mixed, cut and transferred in the main building and delivered to the moulders by the narrow-gauge cars. The flask making is accomplished in the lean-to and this and the pattern room are both convenient to the foundry. Patterns are stored in a separate building and only those about to be used are kept in the pattern room. The office of the foreman of the foundry is in the pattern room and his desk is placed in a bow window some feet above the floor of the foundry, giving him an uninterrupted view of the entire building.

The core ovens present some novel features. There are two about 18 x 38 feet in size and four smaller ones at the present time constructed. Each is heated by a furnace at one end fed with hard coal and sending the products of combustion through the core ovens to an outlet chimney in the opposite end. The walls of the core ovens are of red brick and the roof consists of steel beams with a flat hollow terra-cotta arch between them, similar to a fireproof floor. The cores are placed for baking on cars which are run on trucks into the ovens. The cars are moved in and out by compressed air by a novel system designed by Mr. W. A. Pearson, mechanical engineer of the Schenectady works. Bolted to the bottom of the car is a cylinder 6 inches in diameter and of about the length of the car. A piston within is connected by a hollow piston rod with an anchor in the rear of the oven. By means of suitable valves and pipes, compressed air may be admitted on one side of the piston or the other, thus moving the car into or out of the oven. The space on either side of the piston may be connected with the atmosphere. The car for the small core ovens is shown in Figure 4. Another interesting feature in these ovens is the door by which they are closed. A sheet-iron door is fastened at each end of the car and this is made to fit closely in the cast-iron door frame. With this device the opening is closed whether the car is in or out of the oven. The doors of the large core ovens swing on vertical shafts supported on ball bearings at the top and bottom, as shown in Figure 5. These doors are of double thickness of iron with an air space between. Racks for storing the cores are placed immediately outside of the core ovens.

The foundry is ventilated by a hot-blast system supplied by the Buffalo Forge Company, Buffalo, N. Y. The contents of the foundry is 3,250,000 cubic feet, and it is warmed by two fans drawing air from out of doors through coils and forcing it into the building. The total surface in steam coils is 27,500 square feet. Both blowers are 14 feet in diameter; one is 6 and the other is 7 feet wide. The works officials state that the plant has given the best of satisfaction throughout the cold weather of the past winter. The rattlers in the cleaning room are connected to an exhaust fan for removing the dust and discharging it out of doors. In the roof of the building there are nine ventilators of Star pattern. The windows in the monitors may be opened and the completeness of the ventilating system makes it possible to clear the building of smoke and dust very quickly.

The building is lighted by day by unusually extensive skylights and a large number of windows. Some 23,300 square feet of skylights and 12,286 square feet of windows being provided. For lighting the building at night arc lights are provided for every 2,600 square feet of floor surface. A covered conduit extends across the entire width of the building for all piping and electric conductors. Cast covers are made for this to provide tracks for both 36-inch and 21½-inch gauge cars, which cross the two principal crane spans. The lavatory contains a wire locker for each workman, wire being used to insure cleanliness and ventilation of the clothing and to prevent the spread of fire. Water closets, urinals, wash basins and shower baths are provided.

The 1,200 tons of steel work in the building was supplied by the Hilton Bridge Company of Albany, N. Y., the erectors of the building. Mr. Andrew Kinum of Schenectady was the contractor for the masonry and carpenter work. The building was designed by Mr. W. A. Pearson, the designer of the core ovens. The general arrangement of the foundry was planned by Mr.

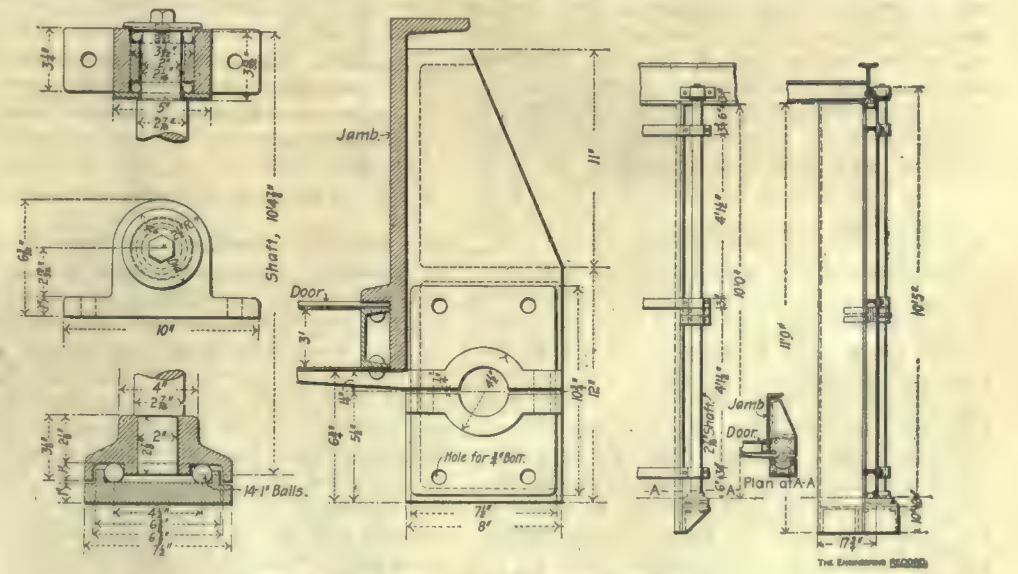


FIGURE 5.—DETAILS OF BALL-BEARING DOORS.

G. E. Emmons, manager of the works and his associates. "The Engineering Record" is indebted to these gentlemen and to Mr. E. H. Mullin, all of the General Electric Company, for data from which the preceding account has been prepared.

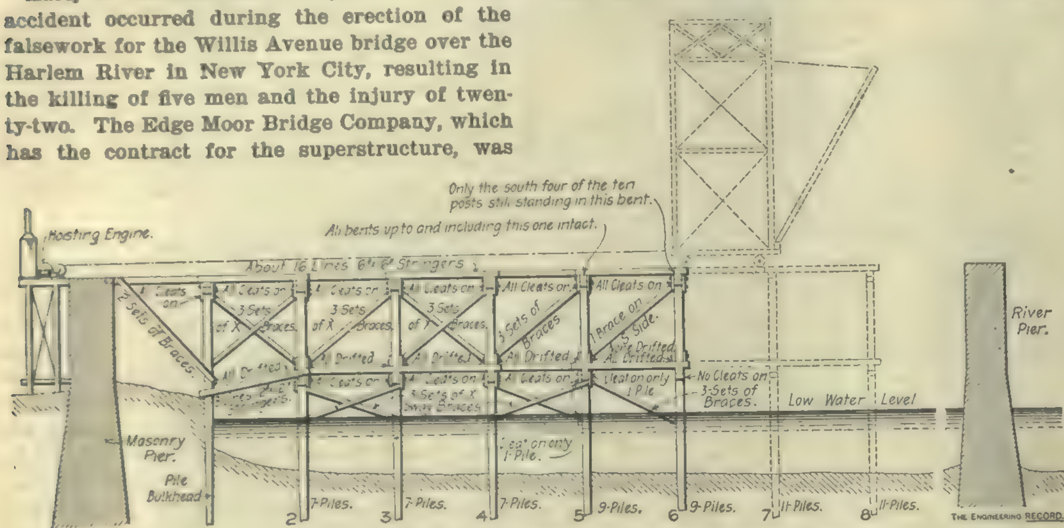
FAILURE OF FALSEWORK OF NEW YORK BRIDGE.

Early in the afternoon of April 11, a serious accident occurred during the erection of the falsework for the Willis Avenue bridge over the Harlem River in New York City, resulting in the killing of five men and the injury of twenty-two. The Edge Moor Bridge Company, which has the contract for the superstructure, was erecting the falsework for the 250-foot span from the bank on the Bronx side of the Harlem River to the first pier in the river. The falsework was a combination of trestles on pile bents about 25 feet apart. The first bent rested on the bulkhead wall on the river bank. The second, third and fourth bents contained, each, seven piles 55 feet long; the fifth and sixth, each, nine piles 60 feet long; and the seventh and eighth, each eleven piles 60 feet long. The piles were driven with a maximum refusal of 2 inches by a 3,000-pound hammer falling some 20 feet, and would have been considered safe, the engineer of the company says, when loaded up to 15 tons each. They were capped with 12 x 12-inch pine, drifted to the piles. The sills of the second-story bents, which were framed complete on the shore, were set on the caps and scabbed and bolted to every pile up to the fifth bent. At the time of the accident all the trestle bents were erected, the stringers on the tops had been placed over all the spans except the last, and a traveler 60 feet high, 28 feet long and weighing nearly 30 tons, was standing on the track with the front end over the seventh bent, in the act of raising a stringer for the last span. The track on top slopes slightly downward towards the river pier and the traveler was anchored with adjustable chains to keep it from running ahead. Two small booms were placed on the front of the traveler for lifting the timbers up to place, but the traveler otherwise was not rigged. Just before the accident occurred the foreman had given orders to the men to run the traveler back and rig it, preparatory to erecting the iron span. Three lines of 12 x 12-inch stringers ran lengthwise of the bridge on the double caps on the piles, and these were drifted at each end with the long bolts to hold the feet of the bents from yielding. The bridge men say that all these stringers had been secured.

The accompanying sketch shows in full lines the portions of the falsework still standing and in dotted lines the portions which were also erected but are now in the river, as well as the approximate position of the traveler at the time the accident occurred. Eye witnesses say that bent No. 7 first settled a little and then fell towards the shore, and that the traveler tipped forward without sliding, and crashed over the river pier, knocking over bent No. 8. None of the piles of bent 7 are visible in the wreckage, but several in bent 8 still stand, all of which are pulled over towards the shore. The traveler evidently fell without sliding forward, because the front wheels, parts of the uprights and sills are now directly under their respective positions at bent 7, with the broken sills standing vertically. The rear posts also lie closely.

The immediate cause of the disaster is believed to be the failure of bent No. 7. Just before this gave way, the rope from the boom was attached to one of the 6 x 16-inch stringers 32 feet long, which was to be raised to the top.

An examination of the portion of the works



FALSEWORK OF THE WILLIS AVENUE BRIDGE, NEW YORK CITY.

still standing showed that all the 12 x 12-inch stringers between bents 1 and 2, 2 and 3, 3 and 4, and 4 and 5 are securely drifted to the caps on the piles. The 12 x 12-inch stringers between bents 5 and 6 are drifted to bent 6. The piles and posts above them in bents 5 and 6, and those shoreward from these stand as nearly vertical as such works usually do, and the three diagonal braces between the piles of bents 5 and 6 are still in place intact. The falsework was well designed and built of heavy sound timber, thoroughly braced. It was erected by two gangs of experienced men, one handling the timber and the second bolting it in place at the time of the accident.

ELECTROLYSIS IN BATTLE CREEK, MICH.

[By W. W. Brigden, Chief Engineer, Board of Public Works.]

The original electric street railway in Battle Creek was constructed with flat rails and bonded with single bonds of galvanized iron wire about one-eighth of an inch diameter. It had about six miles of track and did a small business. The bonds were not large enough to carry the current and were nearly all burned entirely off inside of two years. The company examined the line by means of electrical instruments and found there was a loss of one-third of the power developed, due to the imperfect returns; but as the road was evidently built to sell and it was the hope of the owners that it would soon go out of their hands, they took no steps to remedy the evil. All the service pipes in front of the power house and some nearby were completely ruined, as was also the wrought iron gas pipe 2 inches in diameter. The 8-inch water main was also damaged to a small extent, but escaped much injury, at the expense of the service pipes. Strong objection was made to this state of affairs on the part of the city, and after much trouble and some expense renewing the water and gas pipes, the company finally carried the currents on the water pipes to the negative side of the generators by large copper wires. This gave very substantial relief, but not long after permanent relief came when the company, no longer able to keep its poor plant going and unable to sell, stopped running and the officers left the city. The damage the railway would have done, had they continued the use of the same plant until the present time, would not have fallen short of $10,000, in my opinion.

The present company built a very good road compared with the old one, with T rails and the larger part of the track bonded with two No. 0 copper wires and the balance with one wire. No supplementary return wires were put in, however, and some of the bonds have become defective, so that some of the returns are not in first class order at all places.

The present line was constructed in 1895. Return wires were carried along Division street, which was not on the line of the railway, to the power house, a distance of about 600 feet. Four No. 0 wires (about one-third of an inch diameter) were used. These returns are in the street gutter about 1 foot deep and are only about 7 feet from a 4-inch water main. A 2-inch water pipe of galvanized iron formerly ran into the power house. This pipe was so injured by the return currents that it leaked so much water that it had to be repaired. It was afterwards abandoned and a 4-inch pipe put in from the street, with branches of 2-inch wrought iron inside the building. These 2-inch pipes already show the effect of electrolysis plainly, although they have not been in place more than two or three years. A three-fourth inch service pipe running out from the 4-inch main along Locust street has been completely used up where it passed under the return wires about 400 feet from the power house. The 4-inch main running to the power house is entirely covered with small holes about one-sixteenth of an inch diameter and the surface looks as though the tar had been roasted until the life was all taken out of it. Most of the pipe is also covered with oxidized iron and sand to a depth of an inch. In places the iron of the surface is like a piece of plumbago and can be easily cut with a knife.

The 4-inch pipe near the power house is often, under good loads, from five to ten volts positive to the return wires. The instruments at the power house show about 500 volts and 120 amperes. For a half mile east and west of the power house the water pipes are from one-fourth to three volts positive to the rails and, no doubt, are being slowly but surely injured.

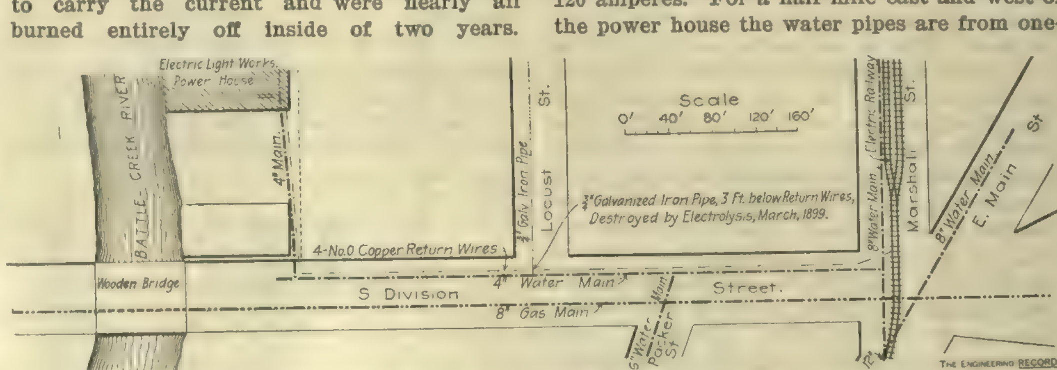


DIAGRAM OF THE PIPES MAINLY AFFECTED BY ELECTROLYSIS IN BATTLE CREEK.

As to the remedy, the street railway company seem unwilling to do anything. It rents power by the year from an electric light company, so does not feel directly the loss of current due to electrolysis. We are asking it for a conference and shall urge it to proceed at once to connect our nearest 12-inch water main with its return wires or track, so that the current will have a free passage back to the power house. This will greatly reduce the currents from the pipe through the ground, which do the injury. Somewhat greater currents will then come in over the water mains from the

outer parts of the railway system, but our experience and that of other cities assures us that the injury will be much less. In time we hope to have the company take out the heavy ground wires that are placed at about six stream crossings and to have supplementary return wires placed either underground or overhead, so that the water and gas systems shall be placed beyond danger. The city is getting a section put in the city charter which it is expected will clearly define the responsibility of the railway for damages to pipes, etc., and to require the best known methods of prevention.

I desire to protest against the apathy in regard to damages from electrolysis which rules with most municipal water-works officers, and to say that it will be far better to settle the questions of responsibility and prevention now than to leave them for the future, when the damage has greatly increased and the street railway companies will have more than they can afford to lose at stake, making them much more ready to stand a suit through all the courts.

THE OWNERSHIP OF UNDERGROUND WATER IN NEW YORK.

A correspondent has asked for an explanation of the apparent discrepancy between the decision of the Supreme Court of New York, which was recently rendered by Judge Smith and granted an injunction against the operation of the Spring Creek driven-well pumping plant in the Borough of Queens, New York City, and that reviewed in these columns on September 10, 1898, which refused to restrain the city of Brooklyn from operating a pumping station intercepting underground water percolating toward the plant of the Merrick Water Company. The difference is readily seen if the two cases are examined carefully. The recent suit, Forbell vs. City of New York, 56 N. Y., Supp. 790, was brought by the plaintiff to restrain the city from operating its plant mentioned and for damages for loss of crops by reason of the drying of his land, caused by pumping the ground water in it. The decision reads as follows:

"The evidence in this case satisfies me beyond a reasonable doubt that the operation of the pumping at the Spring Creek pumping station lowered the water level under the land occupied by the plaintiff several feet, and that the direct effect thereof was to prevent the plaintiff from growing upon his land the crops to which it was peculiarly adapted, and from which he had previously made a large profit. The substantial question to be decided is whether the defendant is legally responsible for the loss inflicted upon the plaintiff by the operation of these pumping stations. Previous to the decision of the Appellate Division of the Supreme Court in the second judicial department in the case of Smith vs. City of Brooklyn, 46 N. Y. Supp. 141, the tendency of the decisions of the courts of this State was against the contention of the plaintiff in this case, and in favor of the proposition that an action would not lie against the owner of the land who interecepted or diverted underground currents of water to the injury of another. In the Smith case the operation of a pumping station lowered the spring level of the surrounding country, and dried up a stream and pond belonging to the plaintiff. The court held the city liable for the damages. The court, in its decision, distinguished the case from other cases previously decided in this State, on the ground that in the case at bar the cutting off of the source of supply of the plaintiff's stream and pond was not done in the exercise of the legal right of the defendant to improve its land, or in connection with the enjoyment of the land itself, but for the sole purpose of gathering and conveying the water to a distant place for the use of the inhabitants of the city. The reasoning of the court in the case so appeals to a sound judgment and keen moral sense as to be unanswerable. The defendant seeks to distinguish this case from the Smith case because in the Smith case a running stream and pond were dried up by the operation of the pumping station, and in this case the underground water level was lowered upon the plaintiff's land. In my judgment there is no difference in principle between the two cases. The underground water on plaintiff's land was a part of his land. He had a property right in it. Its use was indispensable to the enjoyment of his land, and he was deprived of the water as effectively by means of these pumps as he would have been by a direct entrance upon the land itself. The property rights in waters which flow upon the surface of the ground is no more sacred than the property rights in waters, which flow underground. There can be no escape from the conclusion that the acts of the defendant were injurious to the plaintiff, and that an action will lie for the damages he has sustained by reason thereof.

"I think the plaintiff has made out a cause of action for the equitable relief demanded in his complaint. Upon the question of damages, after making such deductions from the plaintiff's claim as may be properly attributable to other causes than the wrongful acts of the defendant, I assess his damages at the sum of $6,000, and I hereby direct judgment against defendant in favor of the plaintiff, enjoining the operation of the pumping station, and for the sum of $6,000 for his damages, with the costs of the action."

In the Merrick case the interests involved were both distinctly commercial. Neither party intended to use its land for any other purpose than to gather and distribute water. Under these conditions the court ruled: "When both seek to use their land for exactly the same purpose, and neither seeks to improve it for the purpose of beneficial enjoyment, but to make a profit from the business carried on, the right to such use must also be equal. Under such circumstances, if one gets more than the other there can be no more ground of complaint than would exist if both sought to improve their land and one secured more than another, or one was damaged and the other was not."

SEWER REPAIRS, CINCINNATI, O.

Repairs are now being made to a large sewer at Cincinnati, O., and the following description of this interesting work was obtained through the courtesy of Mr. J. W. Harper, first assistant city engineer, from a paper read by him before the local Engineers' Club. The sewer is 9 feet 6 inches in diameter, and was carried under a canal in a tunnel 162 feet long, the remainder of the work being constructed in open cut. It was constructed in 1868 and 1869. In building the tunnel a shaft 8 feet square on the bottom was sunk to a depth of 42 feet, the material encountered being very fine sand. A frame building was erected over the shaft and a steam hoist used to raise the material to the surface in cars holding about one cubic yard each which were run out on a trestle and dumped. The supports of the tunnel were composed of 12 x 12-inch uprights, set on 3 x 18-inch bed plates and 12 x 12-inch horizontal transverse caps were placed on top of the uprights. Forepoling 2 x 8 inches and 8 feet long was then driven into the bank ahead, on top and outside of these timbers which were spaced 4 feet apart. The bank ahead supported one end of the poling, which was driven at an upward angle until the next bent of supports was placed in position. There was settlement in the surface of the street which in some places amounted to 2 or 3 feet. A track was laid in the tunnel and all the materials were handled in cars. Light was furnished by the old-fashion lard oil lamp fastened on the caps of the workmen. The excavation was carried on during the day and the brickwork at night.

The sewer was built with four rings of hard-burned hand-made sewer brick, laid in Louisville Black Diamond cement mortar mixed two to one. The space between the crown of the sewer and the timbers overhead was filled solidly with brick of a softer character. The top of the tunnel is 25 feet below the bed of the canal and the work of driving at this point was done while the water was drawn off. The abutments of a bridge across the canal near the tunnel settled several inches during the progress of the work. The superstructure was jacked up, additional masonry was placed on the walls, bringing the roadway and sidewalk floors to their original level, and no further trouble was experienced. Fresh air was forced into the tunnel by a blower through a 12-inch tin pipe. The grade of the sewer is 0.50 per cent. for a part of its length and 0.78 per cent. for the remainder.

In 1877, eight years after the sewer had been put in use, an inspection showed that the invert was in bad condition. For a width of 2 or 3 feet it had been abraded to such an extent that the first course and a considerable portion of the second was entirely gone, and even the third course at points showed some wear. Steps were taken by the assistant engineer then in charge of the sewerage division to remedy this condition. Blocks of Dayton limestone about 4 feet long, 12 inches wide and 8 inches thick were dressed on the sides, ends and face, cut to the radial line, to a perfectly smooth surface and were laid in pairs in the invert. In 1878 a change took place in the head of the division and the rest of the repairs were made by using one block 20 to 24 inches wide, dressed as before, but only 4 inches thick.

In 1898, under Mr. T. B. Punshon, the present chief engineer, an examination was made and it was found that the 4-inch blocks were nearly worn through, and that nearly 4 inches had been worn from the 8-inch blocks. At the longitudinal joint between the two 8-inch blocks a V-shaped opening 6 or 7 inches wide on top had been cut nearly to the bottom of the stones. In making the repairs, most of the 8-inch blocks used in the bottom have been left in place, the opening in the center being filled with a quick-setting cement, but the 4-inch blocks are being replaced with vitrified paving brick. The action of the sand, carried in the sewage, on the bottom and sides to a height of about 18 inches, moving as it did with a velocity of about 15 to 18 feet per second, is worthy of attention. Long striations were cut into the lines of the brick, hardly any two of them showing exactly the same proportion of wear. Deep arcs were also cut in the faces of single bricks, while the faces of many of the stone blocks contained well-shaped depressions.

The repairs are being made in sections of about 100 feet, and the sewage is carried past these sections in wooden flumes on the sides. A wooden dam or bulkhead about 4 feet high is wedged and braced into the sewer at the upper end of the section, a small gate working in slides being placed in the center and bottom of the bulkhead. This permits the sewage to flow through until the dam is properly wedged, braced and calked, and the flumes on each side placed in position. Pieces of lumber 2 x 6 inches, spaced 4 feet apart, are then wedged against the brickwork on one side inclined at an angle of 30 degrees with the vertical diameter. On the opposite side the sticks are shorter and have the upper ends spiked to those first put in place. Matched flooring made in sections 4 feet long, battened together, is laid and nailed on these inclined posts with the bottom resting against the side of the brickwork, the space between the flooring and brick ring being tightly calked with oakum. The flow being thus divided, ample working space is left.

At the beginning of the repair work open coal oil lamps were used, which gave off a large amount of smoke and soot, and were the

cause of much complaint. As a result, electric lights were introduced by letting a wire down a manhole and through a branch sewer into the large sewer, the wire being carried in a 1½-inch lead pipe. This work is now being carried on in double shifts, night and day, under the direction of Mr. T. B. Punshon, chief engineer, and Mr. Evan Evans, engineer in charge.

THE CONSTRUCTION OF HIGH EARTH DAMS.

The construction of high earth dams is a subject about which much has been written ever since such structures gave way at Bilbury and Sheffield, England, and the attendant loss of life made engineers study the principles of safe designs with greater diligence. Yet in spite of all that has been said and put in print, a paper was presented on the subject at a meeting of the Institution of Civil Engineers some months ago that called out a discussion in which many new ideas were formulated and some old ones restated in a new manner. The paper was by Mr. William Lumisden Strange and was essentially a discussion of the methods applicable in Western India. As Mr. Clemens Herschel stated in his contribution to the discussion, there is probably no greater contrast than that between the methods of construction of similar engineering works in India and in the United States. "In the one, native labor, not infrequently pauper labor, including women and children, did the bulk of the work by semi-civilized methods for a few cents daily wages; in the other, native labor scorned to do any such work, but allowed sturdy male immigrants to grow rich in their own estimation in one working season by doing it with the aid of labor-saving machinery. And yet the forces to be overcome were the same in the two places and earth that would puddle in India would do the same in the United States."

The construction of reservoir works in the Bombay Presidency, which was mainly the subject of Mr. Strange's paper, depends on the season. The rainfall is practically limited to the portion of the year between the first of June and the middle of October, but during that time as much as 300 inches may fall at some places in the highlands, although the famine districts are fortunate to receive more than 20 inches. During the rainy season the weather is cool but fever-producing, while the hot weather is the most healthy period, unless cholera breaks out.

The climate is an important factor, because the dams are constructed almost wholly by manual labor, as many as 20,000 people being engaged on one undertaking during some famines. The soil is loosened by picks, scraped by means of large hoes into basin-shaped iron baskets holding a third of a cubic foot each, and the loaded baskets carried as head-loads to the site. These people work in gangs of twenty to fifty, under the charge of a headman, and are most usefully employed on task work. There are also itinerant gangs of trained workmen who are usually employed by the piece-work system. Donkeys, oxen and buffaloes are employed as beasts of burden, but it is only within a comparatively short time that carts, portable tramways and light trucks have been introduced.

The materials with which these high earth dams of Western India are constructed vary considerably. The decay of trap rock has produced "murum," a friable stony material, and various argillaceous soils, of which the best known and most widely distributed is the "black cotton soil." The latter material is treacherous, absorbing water easily and cracking when dry. Moreover, its frictional resistance to slipping is small, owing to its unctuous character and freedom from binding grit. Sir Guilford Molesworth described an occurrence which illustrates very forcibly the expansion of which it is capable. A failure had been reported in the foundation of a bridge, but when the engineers levelled from the last bench-mark up to the bridge to ascertain the amount of settlement of the foundations, it was discovered that instead of the latter sinking the black cotton soil of the embankment on each side of the structure had absorbed enough moisture to raise the permanent way sufficiently to cause the apparent sinking of the bridge.

In describing the peculiarities of Western Indian dams, Mr. Strange took up their several features in detail, beginning with the puddle center, for concrete is too expensive there to be considered an available material for a core wall. In the country where these works are built, there is no timber larger or better than firewood. If staging is absolutely necessary, it must be built of Moulmein teak or Oregon pine, brought hundreds of miles by rail from Bombay and then carted scores of miles uphill to the site. Hence it is customary to take the puddle trench down with a base width of between 6 and 10 feet and with as steep side slopes as it is possible to use without shoring. The trench is carried well into sound clay or at least a foot into good rock. Mr. Strange advances a theory of the action of puddle in holding back water to show that the wedge-shaped core, which the sloping sides of the untimbered trench make necessary, may be of actual advantage; it is stated as follows:

"The rate of filtration of a soil depends upon its porosity, which governs the frictional resistance to flow, and the slope and length of the filamentary channels along which the water may be considered to pass. It is evident, therefore, that the direct rate of infiltration in a homogeneous soil must decrease from the top to the bottom of the puddle trench. The best section for a puddle trench is thus a wedge, such as an open excavation would give. It is true that the uppermost infiltering filaments when stopped by the puddle will endeavor to get under it, but a depth will eventually be reached when the frictional resistance along the natural passages will be greater than that due to the transverse passage of the puddle trench, and it is when this occurs that the latter may be stopped without danger, as the filtration to it will be less than that through it. This depth requires to be determined in each case, but in fairly compact Indian soils 30 feet will be a fair limit."

In excavating the puddle trench, Mr. Strange said, the greatest care should be taken to avoid all sudden steps in its longitudinal section and vertical sides in its cross section. On both sections it is essential that the trench should be bounded by slopes. The reason for this is that, because the material is compressible, a step would tend to cause a crack above it while a vertical side or one sloping downwards away from the center line would tend to form a hollow.

For river crossings some engineers divert the main puddle trench about 20 feet upstream and construct a concrete trench 5 feet wide on the center line of the dam across the bed of the river and well into the bank, where the puddle trench is thickened to receive it. The author considers the practice of having two trenches across a river bed open to the objection that in case both are filled with water-tight material there will be a mass of sodden foundation between them into which some water must leak. The presence of this sodden area tends to cause bulging of the foundations and settlement of the embankment. A better plan would be to widen and deepen the main central trench at the river crossing and, if necessary, use a central core of concrete in it. The depth to which the trench should be carried varies of course very greatly. It should be recognized in every case that the maximum subsurface flow occurs along the top of the impermeable stratum, and care should be taken to intercept it by keying the trench well into this stratum. Sir Robert Rawlinson once stated that 30 feet depth of puddle trench is sufficient if a thick bed of concrete is placed at its back with a well for collecting water and a pipe leading this off to the downstream side of the dam. In India the inflowing water is always heavily charged with silt, which very rapidly diminishes any tendency to leakage, although it would be wrong to depend entirely upon it for stopping percolation. One of the best instances of this action is afforded by the Muchkhundi tank, Bijapur Collectorate, formed by a masonry dam on a vertical schistose formation. This held but little water at first, but it has become more water-tight, and the loss from leakage is now very small, although the work has been completed only 12 years.

The material which Mr. Strange uses in filling the puddle trench is a mixture of three parts of black or argillaceous soil and two parts of sand. The bottom layer, about 1 foot thick, is formed of carefully kneaded balls of the mixture, which are thrown on the bed and trodden to form a water-tight junction. The bed of the trench is left rough to aid in securing this end. For the subsequent layers, the mixture is inserted dry, then well watered and worked by treading, and each layer is covered, when completed, by the dry material of the next to prevent its being cracked by the sun. The Indian practice is to carry the puddle only about a foot above the ground into the body of the dam. In the discussion on the paper, Mr. G. F. Deacon stated that the best puddle clay in England had about the same proportion of argillaceous material and silicious sand that the author adopted in India. So long as the sand was not more than half the total material, this puddle stood well and was quite satisfactory in stopping water. Mr. Deacon agreed with the author that the best place for the puddle was in the center of the dam. In that situation it would be free from the danger of drying and cracking, to which it would be exposed if laid on or near the inner slope. Mr. Baldwin Latham stated another reason why it was undesirable to place a puddle facing on the inner slope of a dam. A clay of sufficiently water-tight character could not be maintained on the inner slope at an inclination of 3 to 1, ordinarily used in Great Britain. Some clays will not stand at a slope of 7 to 1; so if a material of this nature is placed on the inner surface of a dam it is liable to slip off. Telford made a practice of using clay on the inner face of the dam, but he invariably mixed with it round washed gravel, which gave the clay a greater stability than it would have by itself, and overcame its tendency to slip to some extent. The difference between earth dams in Bombay and in Great Britain was stated by Mr. David Gravell to lie mainly in the height of the puddle walls; the puddle being confined in India to the foundation trench, in contradistinction to the almost universal practice in Great Britain of carrying the puddle wall nearly or quite to the top of the dam. To reconcile this important difference in practice, he said, it was presumably necessary to regard the black cotton soil largely employed in the embankment itself as a sort of puddle. The depth of the trenches in India was also much less than generally found necessary in England, so that the geological conditions of Bombay might be considered more favorable to dam construction.

A recommendation in the paper which aroused considerable discussion related to a proposed method of draining the puddle trench after it was filled. For this purpose a dry-stone drain, measuring perhaps 4x6 inches, is laid along the foot of the down-stream side of the trench. It is then surrounded by a mass of sound clean broken stone having a cross-section of about 4x3 feet, and this is covered in turn by a 1-foot

layer of clean gravel, coarse sand and similar materials to keep the superincumbent earth from entering the interstices. This drain is connected at intervals by side cuts and drains with some outlet below the dam or on its flanks. "The base of the puddle trench should be wide enough to prevent a direct leakage being induced along it into the drain. In a well-constructed puddle trench the subsoil water will tend to descend along the upstream face of the puddle to the base, and will then endeavor to force itself up, thus rendering the clay more absorbent and permeable. Where, however, a means of escape is provided, as by the drain above described, the small amount of percolation will be led harmlessly away, and the puddle material kept as compact as possible."

In the discussion on this matter, the use of such drains was severely criticised except when they are necessary to intercept water in the foundation material into which the trench is sunk. For example, Mr. G. H. Hill said that in cases where there was fissured rock and the entire escape of water could not be prevented, he generally carried up, on the outside of the trench, in a groove cut into the side of the trench, a vertical pipe through which any water passing below the trench would escape without causing injury to the work. From the top of the vertical pipe he carried another to the outside of the embankment, where the water was discharged. He had used this system in many cases and the pipes were frequently completely silted up in the course of time. Mr. Baldwin Latham looked with very great suspicion on all drains which were brought up near a puddle wall. In case Mr. Strange's method of draining were carried out, if any fine material were washed into the drain, a settlement would occur at a point where it could be remedied only with great difficulty. In his opinion to put drains alongside the puddle wall was a proposition likely to lead to failure. Mr. E. P. Hill believed that if water passed through the puddle into such a drain it would probably carry some of the material with it. If this occurred, either the puddle wall would settle or a cavity would be left, making a worse leak than before. Mr. A. Fairlie Bruce believed that the expense of forming the elaborate system of drainage proposed by Mr. Strange should be avoided and the money spent in obtaining a better result in the dam itself. If the English practice were more closely followed of only aiming at making half of a dam water-tight and forming the inner half of hard material, mixed with a certain amount of small stones well consolidated, he believed that Indian engineers would experience less difficulty in making dams tight and the slips so often complained of would not take place. Mr. J. James R. Croes believed Mr. Strange's mode of construction would facilitate a leakage of water through the dam, the creation of currents, a steady flow through the saturated upstream half of the embankment, and the washing out of the finer particles of the bank. "If such particles were carried out through the drains, the flow of water would continually increase. If they were carried only part of the way to the outfall and clogged the drains, the result would be that the water above the point of stoppage would rise and saturate the bank above and come out on the slope of the down-stream face much sooner and with more disastrous effect than if the old-fashioned method of interposing every possible obstacle to its progress through the whole of the bank had been followed. If the author's theory were correct and the water which had penetrated to the center of an embankment had better be carried off in the quickest way, a drain ought to be laid to the center of the bank about 8 or 10 feet below the flow line of the reservoir and carried off to the natural surface at the ends of the dam. In an embankment not thoroughly water-tight, that was the point where the danger of saturation of the outer slope causing slides was the greatest, and such a drain might lower the surface of saturation in the bank." Mr. W. Fox believed the very last place for laying a drain should be along the bottom of the puddle trench, although at times it was necessary to bring up vertical stand pipes to relieve the trench of any springs which might be found. On one or two occasions he had surrounded the bottom of the stand-pipe with a small quantity of dry rubble stone, but around this he invariably placed the best concrete he could make. He sometimes continued these vertical pipes to the drains below the outer part of the embankment, but if the water should cease to rise in them, he filled them with cement grout.

The preparation of the foundation for high earth dams in India is rendered particularly difficult because the heavy rainfall during the monsoons and the great evaporation during the hot weather produce considerable movement in the surface soil. When black soil dries, numerous cracks, often several feet deep, are produced, and the lines of cleavage probably go considerably deeper. With brown soils this cracking is not so marked, and with those consisting of murum it is hardly apparent. The whole bed of the dam, outside of the area occupied by the puddle trench, is stripped of unreliable surface soil and then excavated into large furrows, parallel to the center line of the dam.

It is usually specified that the foundation shall be stripped of all silty soil for a depth of 1 foot, all plants rooted out, all slushy or sandy material removed from the site and all steep slopes benched to receive the earth work. No excavation is generally allowed in the bed of the reservoir within 200 feet of the upstream toe and 150 feet of the down-stream toe. The author believes it would be a better plan to make these distances multiples of the height of the dam. There does not seem to be any harm in making small excavations a short distance from the down-stream side of the dam, provided they are drained and the formation of swamps is prevented. The general line of thrust due to the weight of the dam must be inclined downwards and the natural surface in the rear does not act as a buttress. As its only useful property must be its weight, tending to prevent bulging upwards of the subsoil, a slight removal of the surface soil will have an inappreciable effect. It is far more important in the opinion of Mr. Strange to secure thorough drainage of the ground immediately down-stream from the dam, and for this purpose it is advisable to slope off the natural surface at the rate of 1 foot in 10 for 30 feet from the toe. This slope will prevent water lodging, even should weeds and rushes grow on it. Beyond the toe of this slope it is advisable to have a dry stone drain 10 to 15 feet below the surface of the ground and connected with an outlet farther down stream. Shallow drains are found to be of little use in India.

After the foundation of such a dam has been prepared it is wet by a hose from a pump or by means of leather water-bags carried by oxen. After this is done the earth is spread in small quantities on the site, all the clods are broken up, and the layer is finally carefully leveled and rolled. At the base of the dam the layers do not exceed 3 inches in thickness as a rule, but as the embankment is raised the courses are gradually increased in thickness up to 6 inches. The present practice in Western India is to make the hearting of black soil or clay and the two slopes of earth having a greater frictional resistance. It is found in practice somewhat difficult at times to arrange for carrying up the layers of different materials simultaneously. This has led to the fear that the dam may be composed of three distinct portions having different rates of consolidation and acting differently under the infiltering action of the water when the reservoir is filled, whereby internal stresses are set up in the mass. Mr. Strange states that there is in India as a rule little difficulty in getting argillaceous material, while that containing more grit is secured with greater trouble. There is, therefore, no economy in limiting the use of clay to the hearting. "Where, however, clay is deficient, it should be chiefly used in the up-stream two-thirds of the section, a smaller quantity being reserved for mixture with the grit or dry material forming the down-stream one-third. With careful construction there is no difficulty in consolidating a natural or artificial gritty but still clayey soil to a practically water-tight mass. It is therefore, better to make the dam of one consistence throughout, and a good proportion to adopt would be two parts of pure black soil to one part of pure murum or other dry material or such proportions of the existing soils as would result in an equivalent mixture, which is really an earthen concrete. The admixtures of the dry material, besides increasing the frictional resistance of the mass, effects a means of sub-drainage. As the vertical height of the dam is only about one-fifth of its width, excess percolation into the dam, at least on the down-stream side, would be carried off more rapidly by the base drainage than it is produced by the hearting, and the mass would always be drier and more compact than if it were made of pure clay, which, when it has once admitted water, parts with it extremely slowly. Such a dam should have protective facings formed with about double the amount of grit and having normal widths varying from about 5 feet at the base to 3 feet at the top, to prevent solution on the reservoir side and weathering on the down-stream side."

The conditions in India naturally make the method of constructing an earth dam very different from those elsewhere. Where the material is a mixture of black soil and murum, the layer of the first is spread on the work and then covered with a layer of the second. The best method of mixing them has been found to be by hand with a large hoe, but as this is very expensive, sharp pointed native wooden plows and harrows may be used. The next best plan is to employ a light metal plow which inverts the earth. Layers are consolidated mainly by hauling iron rollers over them by buffaloes or oxen, a light roller being used first, followed by a three-ton roller 4 feet wide, which is hauled back and forth until the wheels of a loaded cart make but a faint rut in it. On one dam a 10-ton steam roller was employed, while in other parts of India the earth has been consolidated by marching elephants back and forth over it. Where water is plentiful it has been found a good plan to water the finished slope with a hose for several days until it becomes so compact that the water runs off it. With the same object in view the top part of the dam should be formed of porous materials to absorb the rainfall as far as possible and keep it from running down the slopes in little streams.

The subject of watering the layers of the bank during construction is naturally very important in India, and the author's statements under this head are quoted in full: "Naturally damp earth, where available, should be used in the forming of the dam. Where it is not procurable it is a good plan to wet the borrow pits over night to produce it artificially. It is essential to secure complete union between the different layers that the finished one should be moistened before the next is put on it, so that the latter may be rolled into the former. Where moist earth is used, the wetting should be slight and done just in advance of the new layer. Where dry earth is used, more water may be employed and for a longer period before placing the new layer. The test of the sufficiency of the watering is that the new layer is quickly consolidated, but yields only slightly before the roller. If there is any decided mo-

tion it is an evidence of the formation of slush. The defective part should be at once cut out and remade with dry material. For the reasons already stated it is imperative that only the minimum amount of material required for consolidation should be used. A dam formed of too wet material will remain green for a long time, and if the reservoir water is admitted to it while it is still wet, a very undesirable amount of percolation may be set up."

Wherever the material of the dam is joined with natural surfaces or with older portions of the dam, great care should be taken to make the abutting surfaces of such a form that the effect of settlement will be to consolidate the structure. If the flank against which the dam presses is cut into a series of benches like a flight of steps, there will be a tendency for the new puddle to leave hollows or poorly consolidated material against the vertical faces of the steps. Mr. Baldwin Latham took great care to have everything in the embankment wedge-shaped, so that as it settled it would wedge itself tighter and tighter, and Mr. D. H. Deacon expressed the same preference.

Mr. Strange concludes the portion of his paper on the embankment proper with an interesting account of earthwork slips and the methods of repairing them. It is far better to prevent the occurrence of such slips at some extra first cost than to run the risk of subsequent high damages. Foundations may be faulty from two causes; they may be compressible or they may be badly seated. Most dry soils can withstand the weight of the dam while argillaceous soils are likely to yield when saturated. A deep clayey seat is therefore undesirable for a dam, and where it exists it must be rendered as compact and dry as possible on the downstream side by a series of deep dry rubble drains parallel to the center line, with cross outfalls as frequently as can be arranged. Both slopes of the dam should be flattened so as to secure a wider base. Berms may also be added at the bases of the slope to prevent the rise of the subsoil. If the dam is founded on a stratum which is tilted and rests on a lower one, with which it is not firmly united, the extra weight on it may cause it to slide and carry the embankment with it. Careful geological investigation is necessary to avoid this source of danger.

The use of too permeable materials will cause a breach rather than a slip, but with ordinary care in construction they become too compact to allow of dangerously excessive percolation. Friable materials too loose to bind and totally wanting in cohesion may form a slipping plane and lead to failure. Pure clays are dangerous in that their cohesive and frictional resistances become very largely reduced when charged with water, and too liberal use of water during construction is, therefore, to be strongly deprecated. Through a defective design the earthwork may be unable to support its own weight and will slip so as to assume more suitable slope. The profile which is only just sufficient for a dry embankment will prove too slight when it is subject to water infiltration. The infiltration of water is the principal cause of slips, as it operates in aiding all the others to produce failure. Thorough drainage of the earthwork and of its foundation is, therefore, essential to secure stability.

When a slip occurs in pure black soil, its surface presents a smooth, unctuous appearance, striated by the small particles of contained grit and parallel planes of similar surface are formed for some feet on both sides of it. It is doubtful if these will ever disappear of themselves; the result is that the fallen mass rests on a series of steeply tilted, smooth, lubricated planes, and the slightest additional weight, produced either by adding more materials to it or by the soakage of rain-water, will tend to cause further motion. The whole of the slipped earth has also lost all the consolidation artificially given to it during construction. It is traversed by minor slipping planes and by fissures, all of which will admit rainwater and cause it to have a greatly reduced frictional and cohesive resistance to motion. No dependence can, therefore, be placed upon it, and a sound system of repairs consists in entirely removing it and in replacing it by trustworthy material.

The first thing in all repairs is to drain the slipped earthwork by drains at right angles to the axis of the dam. Of these, one should be at the center of disturbance, and two should be along the junctions of the slip with the solid embankment; others should be inserted at convenient intermediate distances. They should be taken out, in timbered trenches, from the toe to a little beyond the innermost slipping plane, and should extend vertically throughout the mass. As soon as the excavation of each is completed, a longitudinal base drain with 4-inch breadth and 6-inch depth vent should be laid, and the trench should be filled with dry stone having gravel casings at the sides and a 2-foot cover of fine stuff and earth at the top; otherwise it will rapidly choke. Not only do these drains serve their initial purpose of passing out soakage water harmlessly, and thus allowing the fallen mass to consolidate itself, but they also divide it into independent sections. It is unlikely that all these sections will tend to slip at once, and thus each at the time of initial motion is supported by the resistance of a length of the toe works considerably longer than itself. Where practicable, and when the fallen mass has been drained, the whole line of the slip should be followed up and cut out so as to get rid of the slip planes. This may be done in difficult places by means of a timbered trench. The refilling should consist of gritty clay, with a good base drain communicating with those of the cross drains above mentioned.

The next step is to construct a strong, well-drained dry stone wall parallel to the axis of the dam, and with good batters against the slip, to give the new earthwork the needful increased stability, for it wil not have, bulk for bulk, the resistance of the original construction. If the fallen earthwork is to be entirely removed, this wall may be placed about the center of the slip; if that is to be allowed to stay it should be at its toe. To add to the stability of the repair, a strong earth berm should be placed just below the original base, and the toe of this should be secured by a second dry stone wall. All these drains and walls should, if possible, be founded on rock, but where this is not to be found at a reasonable depth, they should be carried well into the natural soil and beyond the limit of disturbance. Earthwork usually fails at one point, and, as soon as it commences to move, drags the adjacent parts with it. The dry stone walls, instead of transmitting the pressure directly behind them, distribute it over a certain increased area and thus tend to prevent the initial motion. They thus act like the timbering of a trench, which, although incapable of resisting the full lateral pressure of the earthwork, provides sufficient support to prevent the first tendency to slipping.

All excavations should be carefully taken out in sections, with sufficient width of undisturbed material between them to act as buttresses, and should be filled as quickly as possible. This, of course, results in the filling not being so well compacted as if a large area were dealt with at once, but time will remedy this. It also leads to the formation of numerous junctions, but as the sections will be constructed within a short time of each other, the earthwork on each side will eventually unite in a practically solid way.

In contrast with this method of constructing high earth dams in India reference may be made to the discussion of Mr. Clemens Herschel on the paper. He viewed an earthwork dam as essentially composed of an unstable water-tight curtain fastened across the water-tight surface of a valley, extending up to a horizontal line and held up or supported on each side by an earth fill. The slopes of the earth fill must be protected on the one side against wave action, on both sides and top against the destructive effects of rain.

Of the materials which are employed for such embankments he regarded clay as sticky, treacherous and mud producing. It encumbered the site of the works and he had never found a use for it except to make clay rolls for pouring lead joints. When present on the ground it must be endured, but he never allowed it to be brought to the site of the works. By gravel he designated a natural mixture of earth, sand and pebbles of various attributes and consistencies, some of which is good for building earth dams and some not. The best for that purpose is gravel which will puddle, or binding gravel. To tell whether any given gravel will puddle and to judge of its fitness for use in the dam, it should be mixed with water in a pail to the consistency of moist earth about to be used in the dam or before rolling. If, on turning the pail upside down, the gravel remains in the pail, it is fit for use; but if it drops out it should be discarded. Good gravel or binding gravel makes the best of cofferdams or filling for sand bags to be used in cofferdam work. It remains water-tight where clay runs out and disappears like soap or sugar. Good earth or gravel, stone and other materials being provided, the method he advocates for the construction of an earth dam is as follows:

The site should be cleared of perishable material and a trench dug down to water-proof strata. If good rock is found within 25 to 35 feet, a start should be made upon it; but if not, excavation should proceed with some sort of stopwater until there is no danger of water passing out from the reservoir down the valley below the bottom of the trench. This is a matter of judgment. The concrete or masonry core wall should be constructed in this trench, say 4 or 5 feet thick at the bottom, 8 feet thick at the original ground level, and 4 feet thick at the top. These are dimensions for first class work; but such core walls have been built only 2 feet thick from top to bottom.

At the same time with it should be built up the earth dam on each side of it, using good binding gravel in horizontal layers 4 to 6 inches thick. These should be constantly sprinkled with a hose, rolled frequently with grooved rollers until a hole dug in the gravel holds water like a pail. The grooved rollers are made of cast iron disks strung on an axis, the alternate disks being of the same diameter and the contiguous disks varying 2 inches in diameter. Such rollers can be turned easily and their total weight is concentrated on an aggregate bearing surface equal to only half the length of the whole roller.

Slopes of 1 on 2 are sufficient for both sides of the dam; both steeper and lighter slopes have been used. Berms are advantageous during construction as level trackways from one side of the valley to the other, but their use is largely a matter of fancy. Mr. Herschel favors them and uses them for earth dams over 40 feet high. A gravel walk should be made on the top of the dam and a vacant strip left on each side of it to the edges of the dam. These top strips and the berms should be sown with grass. The back or downstream slope might be sown or sodded or covered with a 2-foot layer of stones 8 or 9 inches in diameter. The water slope is paved.

ENGINE SPECIFICATIONS.

Two weeks ago "The Engineering Record" printed a protest against too elaborate specifications for engines for private parties when dealing with reputable engine builders. It was asserted that the call for tenders should give the steam and back pressures, number of revolutions

and maximum piston speed. If a simple engine is desired it should be required to develop its rated horse-power at a given cut-off, and if a compound engine, the number of expansions should be specified. The bidders should be asked to state the cylinder dimensions, the proportions of the main and crosshead bearings and the crosshead and crank pins, the size and weight of the fly wheel, and the weight of the complete engine. It was shown that with these data the engineer could readily select an engine adapted to the purposes in view without requiring elaborate guarantees as to the running qualities of the engine. It was further claimed that guarantees as to the efficiency should not be asked for unless the engine is to be tested, for such a course provokes extravagant guarantees. Two communications on this subject which have been received since the publication of the article are presented herewith:

From Dr. R. H. Thurston.

The discussion in your issue of April 1 seems to me a very excellent one, and the points made are well worthy of careful consideration by all who have to do with the writing of specifications or the prescription of the requirements to be embodied in such documents. May I be permitted to suggest two or three other points, and, perhaps, one or two thoughts that may be novel to some readers of "The Engineering Record," if not to many members of the profession engaged in steam engineering and related branches?

The simplest form of specification is one which, so far as my observation goes, is rarely, if ever, adopted, although it is coming to be the fact that the principle underlying it is more or less recognized by the most far-sighted of the profession. This form of specification requires:

1. That a stated power, say 1,000 horse-power, shall be delivered from the machine in a prescribed place and under circumstances carefully indicated.

2. That the materials of the machine and its accessories are to be of the best quality and that the workmanship and finish of the equipment shall be first class and subject to approval by the purchaser or his representative.

3. That the contractor shall furnish all needed accessories under similar restrictions and at a stated time, as under 1.

4. That the cost to the purchaser, directly or indirectly, shall be such a sum that, adding the interest on first cost to the payment, annually, on account of sinking fund reckoned for a stated number of years, and including every item of ordinary operating expense, apart from accident or mismanagement fairly attributable to fault on the part of the purchaser, his agents or employees, and including, further, every incidental as well as direct cost, the total cost shall not exceed a stated sum, annually; or, otherwise stated, when all operating costs, direct and indirect, are capitalized and added to first costs, direct and indirect, their total shall not exceed a stated amount, as specified in the bid.

5. That fair and equitable amounts shall be determined, and held for a stated period, as guaranty of the complete performance of the undertaking.

6. That a stated limit of time shall be agreed upon, or, otherwise, sufficient bond and guaranty shall be held for a limited period, such as may be deemed ample to give the required assurance of successful fulfilment of the pledges made in the contract; after which time the purchaser is to assume all responsibility.

The gist of this scheme is that the purchaser is not at all concerned with the details of the bargain if only he can be assured that the result of his contract will be to give him a plan and arrangement of motive machinery that shall be certain to perform its part in the earning of dividends. For him, incidental losses are as serious as direct wastes, and losses on the interest account as telling as those due to uneconomical performance of boiler, or engine, or independent condenser if he have one. He wishes a plant that will burn in its boiler that grade of fuel, which, in his market, will prove most economical on the whole, and which will give him a minimum total cost of steam delivered, when the interest account and the insurance account and all incidentals are considered with the direct costs of purchase of fuel and of its handling. He desires, if he knows what he should require, that his engine shall use that steam in such manner as to make the total costs of power delivered from the machine a minimum; those costs including every indirect and most obscure account or cost as well as those always observed by the most unintelligent user of such machinery. His whole problem is summed up in the statement that he desires to obtain a stated amount of power at least total cost, on all accounts, annually.

The briefest specification that will make certain that he shall obtain this one result is the best. Such a specification, further, as is at once seen, may be safely thrown open to all bidders, if properly written; although special precaution may be found necessary in revising the preliminary computations by proposing bidders, as many builders are not familiar with any other system of purchase than that which demands simply maximum economy in use of fuel.

Where, as in our naval specifications, for example, emanating from the Bureau of Steam Engineering of the Navy Department, special reasons exist for the complete working out of the whole problem of power-development and continuous production, including weights, displacements and "radius of action" of the vessel to be powered, the details of this problem, including those of finance and maneuvering, must necessarily be solved completely by the representatives of the purchaser. Hence the remarkable and encyclopedic form of the plans and specifications of that famous Bureau. They constitute a builder's as well as a buyer's specification, and are a model of that sort of document. Your article states admirably the reasons for such elaboration, and that completeness is entirely justified by the conditions of that peculiar case.

The essentials of any specification and contract are: Absolute accuracy and rigidity of economic requirements; the greatest elasticity possible, consistent with the preceding requirement, in regard to design and structural details, apart from quality of materials and of workmanship, which are rarely capable of being made too good. This does not mean that high finish is to be regarded as an element of good workmanship, necessarily, or that costly materials are necessarily to be preferred to those less expensive. There is always a "best for the place and purpose," and this is very generally not the most costly. The specification is written to secure the solution of the highest form of engineering problem—that, in fact, which constitutes the engineer's problem in practically all cases—the provision of a defined result at minimum cost and with maximum favorable influence upon the dividend-paying power of the enterprise. This is just as true of the wealthy client as of the most hard-pressed and as true of the engineering of a government as of an individual.

I like your method of statement of the fact that, before acceptance and final settlement, it should always be ascertained whether the terms of the contract have been fully complied with. Too much business has been done on the slipshod basis of extravagant pretense and promise in contract and specification, and, in the end, absolute ignoring of actual results.

From William H. Bryan, M. Am. Soc. M. E.

The subject of engine specifications discussed editorially in "The Engineering Record" of April 1 is one of the most difficult with which the consulting engineer has to deal. It cannot be treated in the same manner as other kinds of engineering construction. The steam engine is a specialty, and no two builders embody the same features. Neither are there any generally accepted standards as to proportions of cylinders and rotative or piston speeds. In addition, each builder has some special features which may or may not be desirable. For these reasons proposals on steam engines are not strictly comparable, and the contract cannot be safely awarded to the lowest bidder. It is desirable to use a standard pattern of engine, of established reputation, because, first, such engines are usually more reliable in their operation, as they embody more or less extended experience in actual service; second, there is usually a material saving in time of delivery; and third, such engines are much cheaper than those requiring special patterns, or changes from existing designs.

For some years my own practice has been in general along the lines recommended in your editorial. I specify the general type of engine, whether horizontal or vertical, condensing or non-condensing, simple or compound or triple, high or moderate speed, automatic or throttling, center or side crank, right or left-hand, direct connected or belted. I then state the indicated horse-power required, and the conditions under which it is to be developed, such as initial pressure, piston or rotative speeds, point of cut-off, and back pressure, if any. Also the amount of overload the engine must be capable of carrying continuously in emergencies.

I also specify the type of governor, and the closeness of regulation desired for both varying load and varying steam pressure, as well as for combinations of the two. I also require that the engine must operate smoothly and noiselessly, and without undue heating or wear, at all loads and pressures. Such details as the kind and material of shaft, lubrication, tools, base and fittings, should also be taken care of, and a clear statement made as to whether the foundations, pipework, and erection are to be handled by the purchaser or the builder. The terms of payment should be clearly stated, and the engineer should see that his client lives up to them.

The builder should guarantee the capacity, regulation, and satisfactory operation of the engine, and in special cases its water rate, and its mechanical efficiency.

I frequently furnish a blank form for the bidders, requesting them to state on same the cylinder dimensions of the engine proposed; its speed, weights of engine, base, and fly-wheel, diameters of shaft, crosshead and crank pins, bearing surfaces of crosshead and main bearings, and diameter of steam and exhaust openings. Each proposal should be accompanied by an outline drawing of the engine, showing its general characteristics, the space it will occupy, and the foundations required. The proposal should also state time of delivery or completion, and—in important cases—the guaranteed water rate per indicated horse-power per hour, the mechanical efficiency, and the percentage of clearance.

Your statement that exact dimensions of cylinders are immaterial so long as the volumes are the same, is only partly true, because of the limitations either in piston or rotative speed imposed by the work to be done. For instance, if the engine is to be direct connected to a dynamo of fixed speed, the lengthening or shortening of the stroke would carry us outside the limits of good practice in piston speed. In engines of the Corliss type, shortening the stroke would mean excessive rotative speeds or low piston speeds.

I am not sure that your suggestion that capacity be based on pressure at release rather than on initial pressure and point of cut-off is an

improvement. My own observation is that release is usually harder to locate on the card than cut-off, as the change in direction is much less. The characteristic cards of standard engines of all the different types are now fairly familiar, and we know in a general way the effect of compression, clearance, and change of initial pressure and cut-off in each. We also know approximately what the clearance is for each type, and it is not difficult, therefore, to determine in advance, with reasonable accuracy the point of cut-off which will give best results, giving due weight to steam pressure and clearance.

I agree with you that the engine should be tested sufficiently to ascertain whether every guarantee—including water rate—has been met. This latter, however, is sometimes exceedingly difficult to determine, and it involves an expense which cannot always be provided for. Neither is it always possible to tell in advance whether such a test can be made or not, and I see no objection to requiring such a guarantee, even if circumstances develop later preventing its actual determination. In such cases the water rate can be computed from the indicator cards, and a correction applied, which in most cases will be sufficiently accurate to determine whether there is any material divergence from the guaranteed rate.

Such terms as "ample" and "satisfactory to the engineer" should, of course, be avoided as far as possible. They cannot always be omitted, however, as many matters must after all be referred to the judgment of the engineer, such, for instance, as the general performance of the engine, its noiselessness, smoothness of operation, heating of bearings, etc.

Many engine builders are, as you say, quite jealous of their reputation. Others, however, are not so careful, and still others, usually of limited experience, do not hesitate to guarantee anything that any other maker will, with results which are often unfortunate.

The above suggestions will be found to work out satisfactorily on private work, where it is not necessary to give the lowest bidder the contract, and where the bidding can be limited to a few selected firms of established standing. On public work, however, the problem is much more difficult, and it is not always possible to get the best engine for the purpose.

STEAM PIPING.

A paper treating of steam pipes was read before the Institution of Naval Architects recently by Mr. J. T. Milton, chief engineer surveyor of Lloyd's Register of Shipping. It supplements another paper on the subject by the author delivered in 1895, and deals largely with accidents which have arisen with different forms of steam piping. The author made the statement early in his discussion that when dealing with matters in general use, there was no doubt but that a few failures taught their lessons more emphatically than a large number of successes. A summary had therefore been made of the accidents to steam pipes which had been publicly inquired into under the provisions of the Boiler Explosions Acts of 1882 and 1890. It was found that in none of the cases had failure occurred through original weakness of the pipes themselves; that is to say, through their being originally too thin. He said that the trouble in the majority of the cases was due to the faulty design of the piping. He found that about a fifth of 68 cases referred to occurred through the lack of providing for draining the condensed steam collecting within them. More than one-half of the accidents, he said, was due to insufficient provision for expansion and contraction, and for motion due to vibration; in a few cases the explosions had occurred either through original defective workmanship or through defects which subsequently developed in the pipes.

The author then went into a consideration of the different materials used for pipes. He said that want of confidence was felt in copper pipes by the Admiralty and by some engineers, as shown by their wrapping them with copper wire, or by steel wire rope, or by fitting wrought iron bands at short distances apart along their whole length. He believed that copper probably owed its present extended use mainly to custom, its first selection no doubt having been due to its non-liability to corrosion and to its great ductility. He pointed out, however, that the latter was a variable quantity, depending largely upon the treatment to which it was subjected. He said that a very low stress, even less than two tons per square inch, would produce a slight permanent set; that as the stress was increased, the deformation increased more rapidly, and that at a tensile stress of from 13 to 14 tons per square inch calculated from the original section, fracture would take place. He said that the elongation in 8 inches would be about 30 to 40 per cent. He then mentioned the fact that when copper is stressed by any less amount than its ultimate strength, and the load is released, the stress will be found to have hardened the copper, and that the metal will then be practically elastic nearly up to its original load. After the hardened copper is again annealed, it will behave, he said, as it did in the original annealed state.

The author also referred to the general belief that brazing solder was not liable to corrosion and mentioned that in the majority of cases, the brazing in copper steam pipes was found in as good a condition as the copper. In a few instances, however, it was found to have deteriorated in use to an alarming extent. He referred to the fatal explosion of a steam pipe on the steamship Prodano in June, 1897, and gave the results of Prof. J. O. Arnold's investigation of the case, which was reported in "The Engineering Record" of July 30, 1898, and showed that the whole of the zinc in some parts of the solder had been oxidized, filling the pores of the copper which remained in the form of a spongy metallic mass.

On the use of iron and steel for pipes he said in part that experience with steel lap-welded tubes had shown that as reliable welds could be made with steel as with wrought iron with mild qualities of material. "It need hardly be pointed out that butt straps add considerably to the weight and cost, and that every needless rivet hole is a possible source of leakage and trouble, so that if the welds are really efficient, and if they could be tested so as to practically eliminate the probability of defective workmanship, butt straps would soon be dispensed with. To put such a high hydraulic test upon welded steel as would really stress the material to nearly its elastic strength is impossible, except with the largest pipes, owing to the thickness adopted being much greater than is needed from the requirements of strength alone, and the fact that such pressures would strain the flanges and flange fastenings; but tests of three or four times the working pressure can always be made. It has been suggested by some pipe makers that to give confidence in the welds each steel pipe should be made somewhat longer than is actually required, and that test pieces should be cut off from one or both ends before flanging and opened out and tested in a testing machine across the weld."

The author said with reference to copper-pipe manufacture, that when bends are to be made and the material is taken one or two gauges thicker than the copper used in strength lengths, to provide for the thinning of the material in working, it must not be lost sight of that the extra thickness remains over the greater portion of the pipe, which is therefore rendered more rigid than it would be if it were uniformly of the minimum thickness.

"Regarding questions of strength only," he continued, "it is well known that in cylinders subjected to internal pressure, the circumferential stress produced in the material is double that in longitudinal direction. . . . A reference to the failures which have actually occurred in practice, however, . . . shows that most of the fractures occur circumferentially at or near the flanges, and are obviously due to longitudinal stresses. The causes of these must, therefore, be looked for from other than internal pressure." He pointed out the fact that pipe lines were put up at a temperature ranging possibly from 350 to 390 degrees below that at which the pipes would be used, and that to allow for the expansion, which would occur, the necessary alteration in form had to be provided for either by the use of expansion joints, or by making the pipes of such form that the movements could take place owing to the ductility of the material, without producing undue stresses on the pipes themselves, or on their connections at the stop valves and engines. The author said also that it was more often considered that copper pipes would be sufficiently flexible and the material sufficiently ductile to permit of repeated contraction and expansion. "It must be borne in mind," said Mr. Milton, "that the hollow cylindrical form is one naturally possessing great strength and rigidity in proportion to its weight. . . . This property is often forgotten when dealing with pipes and they are often credited with far more flexibility than they possess." The author then showed how the forces set up by expansion have to be borne by the thin metal of the copper pipe at the parts where it is brazed to the flanges. "If the copper is at first well annealed, these forces being more than sufficient to produce stresses beyond the limits of elasticity, will doubtless permanently alter the shape of the pipe. At the parts where deformation takes place the copper will be somewhat hardened. When the pipe is cooled down it will tend to regain its original shape and length, and strains will be set up in it of opposite character to those caused by heating it. Each raising and lowering of steam will therefore bring alternating stresses on the pipe, each time tending to harden the material and decrease its ductility at those parts where most deformation takes place. There is no wonder, therefore, that in time the whole of the ductility is destroyed, and the pipe cracks round near one or both flanges."

The author showed that it would appear to be desirable that copper pipes, which have to take up expansion deformation, should be periodically annealed. This, however, was considered as possible only with the greatest difficulty and involved a great risk of some parts being left hard, while the remainder was annealed. "An unhomogeneous pipe," he said, "might be in a worse condition that one wholly unannealed."

The author did not think that there was any absolute necessity in most cases for using bent pipes. He considered that straight pipes could nearly always be designed to meet all requirements and that the expansion of these could be provided for by expansion joints.

The discussion which the paper elicited was printed in "Engineering," London, of March 31, and showed that the concensus of opinion was that copper steam pipes in these days of higher steam pressures would eventually disappear. Sir John Durston pointed out that twenty years ago Mr. Alfred E. Seaton had said that as salt water was no longer being taken into boilers on shipboard, steel might be used with advantage in place of copper for steam pipes. He believed that the fear that steel pipes would corrode prevented their use. Mr. A. T. Dee of the marine department of the London and North-Western Railway did not seem disposed to condemn copper pipes absolutely. He thought that when the short time in which it was pos-

sible to tackle and repair a copper pipe was considered, the troubles that would be increased with repairs of steel pipes would speak for copper. Mr. List, superintending engineer of the Donald Currie Line, thought that it would be enough to test copper pipes every four years. He related his experience with iron pipes. In iron steam pipes in use two or three years, he had only found in them the slightest brown deposit, which had been attributed to rust. Mr. Alexander Taylor, of Newcastle, said that a right-angle bend taken from a wrought-iron pipe, which had been in service for some time, had been sawn through lengthwise of the pipe, so that the inside could be examined, and it was found to be covered with the scum or dirt of the boiler, giving the surface the appearance of a piece of cloth with the particles all laid one way, towards the engine. When this was scraped off, the pipe was found to be untouched beneath, the original blue scale being seen.

Some data were presented on brazing. Mr. Pilcher said he had discovered the importance of getting pure copper, and used electrically-deposited copper. He had made a brazing solder of equal parts of copper and zinc with good results. He had obtained a much stronger brazing material with 90 per cent. copper and 10 per cent. tin than could be got by the use of zinc. Mr. Wingfield mentioned a coppersmith who had always objected to the use of tin in soldering. He exhibited a sheet of copper which had had molten tin dropped upon it and the globule had eaten its way through the sheet, forming a hole. In another case the tin had not time to get through before it was cold on account of the greater thickness of the copper; but it had eaten deeply into the metal of the plate. The author of the paper said that much information was desired with reference to the half per cent. of tin used by some makers. His inquiries had shown that about half of the makers used the tin, and about half did not. He spoke of the fact that though 50 per cent. copper and 50 per cent. zinc might be put into a pot, the composition that absolutely performed the brazing operation might be of very different proportions. Zinc evaporated in a fire, and the resulting proportion of the constituents depended largely upon the care and expedition used by the coppersmith.

The subject of flange atttachments was also brought out at some length. Mr. Rounthwaite described a form of a flange which he had been using. The flange was tapped, or a series of grooves were cut in it, and the end of the steel pipe was expanded into the flange by an expander. It was not always easy to produce a tapered screw thread, he said, and he considered this arrangement as answering very well. The author referred to methods of brazing flanges on pipes. A plain flange with a hole slightly tapering gave an opportunity for the brazing stuff to run down between the end of the pipe and the flange. Sometimes flanges were made with a collar, but in that case he thought the brazing might not run down to the bottom, that is to say, the attachment of the pipe to the flange might only be at the thin collar instead of at the solid disk of the metal. He described another method which had ben proposed for the purpose of strengthening the flanging of copper steam pipes and of preventing fracture under high pressure or on account of vibration. In this case the pipe was fitted with a band or sleeve-piece. The flange was made with a recess at the pipe surface, the pipe passing through the flange and the sleeve-piece. The recess was filled with the brazing material and the sleeve-piece was stopped short of the flange dipping into the brazing and expanded or opened out somewhat at this end to allow the brazing material to run between the pipe and the sleeve. The drawback to the arrangement, Mr. Milton said, was that there was no certainty that the brazing material would flow between sleeve and pipe.

MASSILLON STATE HOSPITAL.

The Massillon State Hospital is the last addition to the institutions for the care of the insane, organized by the State of Ohio. It is the seventh of its kind, and, like the others, is a district hospital, having an allotment of certain counties from which it is expected to receive all the cases of insanity that may develop. It is located on a tract of land comprising about 300 acres, on a ridge and table-land on the east side of the Tuscarawas River, about two miles south of Massillon, Ohio. About 100 acres are set apart for garden land and the remainder is devoted to the building sites, landscaping and a wooded park. The ridge runs north and south, and the buildings overlook a wide valley to the west.

FIGURE 2.—VIEW OF THE HOSPITAL BUILDING.

FIGURE 1.—PLAN OF GROUNDS, MASSILLON STATE HOSPITAL.

The general plan which has been followed in the development of the hospital is known as the cottage system; and the central idea in its organization has been the purpose to separate, as far as possible, the curative treatment of the insane from the general custodial care of the chronic cases. The cottage plan naturally necessitates much more outdoor life, and in inclement weather would seem to bring undue exposure; but experience has demonstrated, it is asserted, that this exposure is not prejudicial, and that, as a class, patients are kept in better health, and generally speaking, are better satisfied in detached buildings where outdoor exercise is compelled in all kinds of weather, than was the case formerly in large buildings where there was no necessity oftentimes for a patient to be out of doors for a week at a time. The plan of detached buildings is considered more natural, the light and ventilation is liable to be better, and on account of the greater subdivision, a better opportunity is said to be afforded of keeping the different classes separate.

There will be about 30 buildings in all, 16 of which will be cottages accommodating from 50 to 70 patients each, two infirmary buildings accommodating 140 each, two hospital buildings, each accommodating about 140, and other buildings, now already completed, devoted to the various domestic purposes, including a general dining hall for employees and all able-bodied patients, a central kitchen, including bakery and scullery, a store building with cold storage and ice-making machinery, a power house, a boiler house, a laundry and a work shop. The financial officer of the hospital resides on the western boundary of the farm lands, over which it is intended he will have supervision, and at this point all of the farm buildings and farm operations are concentrated. In addition the plans contemplate a residence for the superintendent, an auditorium and employees' quarters combined, and an office building where all the office work of the hospital may be brought under one roof. The buildings of the hospital are grouped about an axial line upon which are located the dining and kitchen buildings, and the store, power and boiler houses. A plan of the grounds is shown in Figure 1, indicating those of the buildings already completed.

The most attractive building of the colony, without doubt, is the hospital building. It is

one of the two buildings originally planned for the treatment of the acute and presumably curable cases, one for each sex, and the two together accommodating about one-sixth of the entire population of the hospital. The present building is quite apart from the rest of the buildings, and the inmates are thus brought much less into contnct with other patients than is sometimes the case in other institutions, and an independent kitchen and dining room are included in the building for the preparation of whatever special diet is required. It is a two-story and basement building of brick and iron construction, with stone trimmings and tile roofing, and is fireproof throughout. The walls rise from stone footings below the basement floor, 8 inches in depth, and are faced above the grade line with Massillon sand stone. Steel beams are supported on brick walls and the concrete filling between them is carried on iron straps. Where the beams are 8 inches or more in depth the filling is made to form the ceiling, but for beams of less depth wire cloth is suspended from the beams to receive the ceiling plaster. The floors are mainly of wood, but tiling is extensively used in dining rooms and lavatories. The roof is supported on an iron frame work. The building was erected at a cost of nearly $90,000.

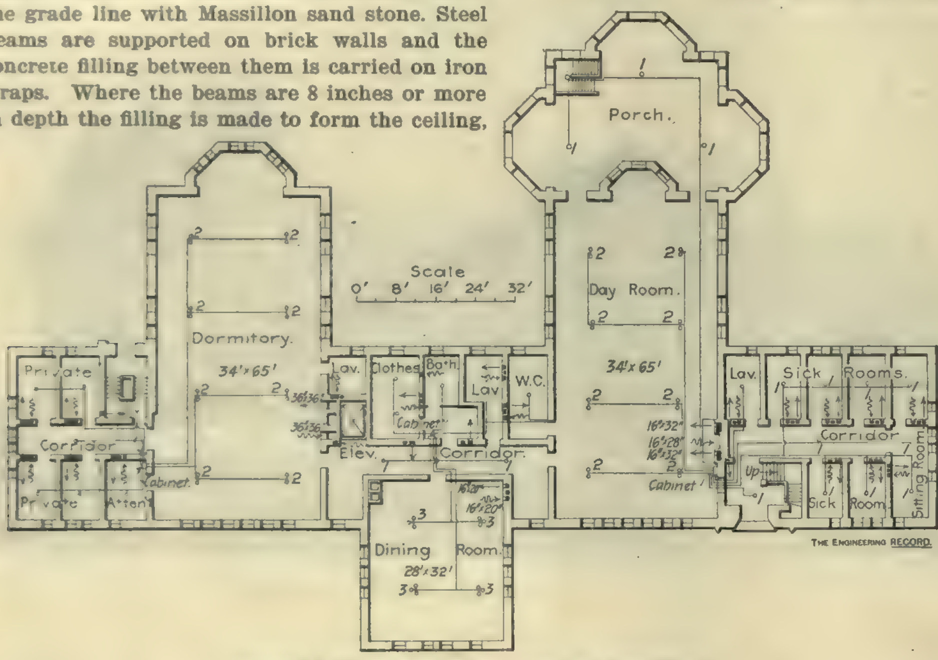


FIGURE 5.—FIRST FLOOR, INFIRMARY BUILDING.

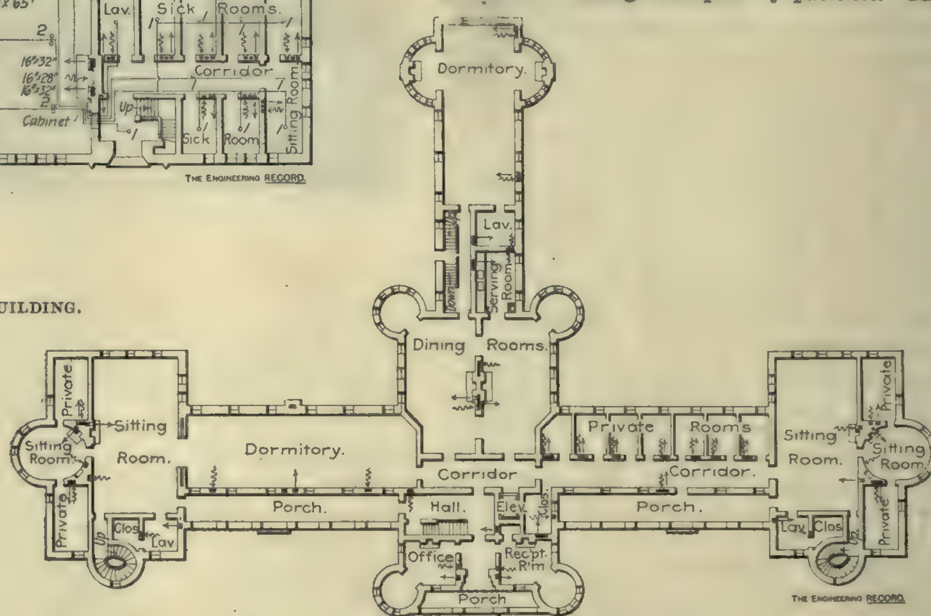


FIGURE 4.—FIRST FLOOR, HOSPITAL BUILDING.

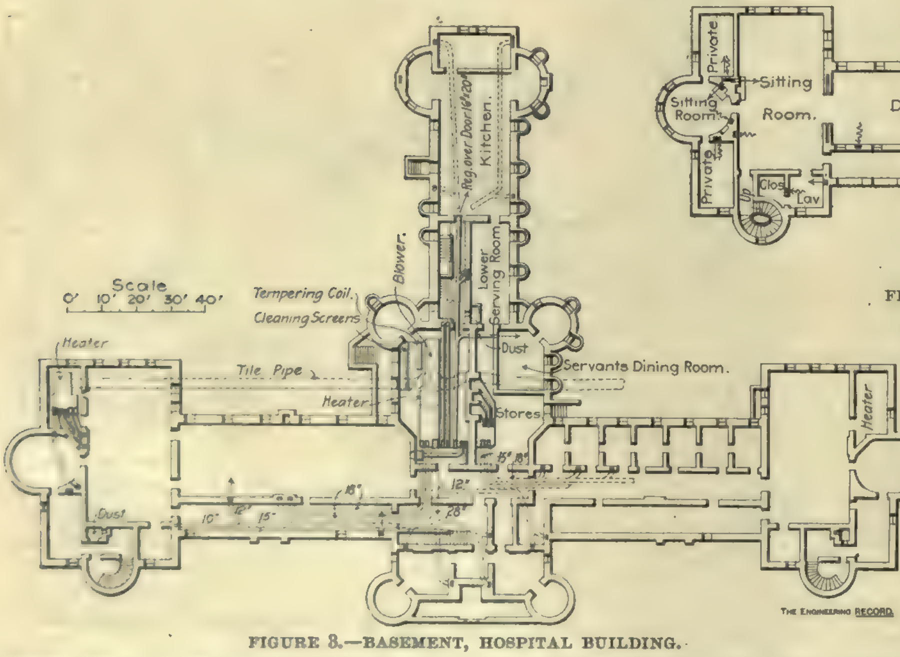


FIGURE 3.—BASEMENT, HOSPITAL BUILDING.

The exterior of the building is shown in the accompanying reproduction of a photograph, and the basement and first floor plans are shown in Figures 3 and 4. It has a frontage of about 256 feet, with a long wing running back from the entrance and giving the building at the center a depth of about 162 feet. There are in effect, therefore, three wings converging at the center, in one of which the melancholy and suicidal classes may be found, in another the disturbed and excited cases and in the third the sick and feeble. Each of these are capable of subdivision, in the two stories, into at least two general classes. An extensive use of semi-circular projections on the building corners adds to the comfort of the rooms opening into them, and with their conical tiled roofs lend much to making the exterior attractive. On either side of the entrance, the front of the building on each floor has a porch arcade. The arrangement of rooms on the second is similar to that shown in Figure 4 for the first floor, and in the front part of the attic story is located an operating room constructed with tile floor and walls to give it aseptic properties. It is reached by an elevator rising in this part of the hospital.

Another building in which the inmates are of necessity confined to their own building is the infirmary. It is intended for demented and untidy patients, those that require night attention, and those who are either unable to care for themselves or cannot be taken from the building to the common dining rooms. The infirmary is a two-story building of brick, with stone trimmings and tile roof, according in this respect with the general design of all the hospital buildings. The building has a front of nearly 200 feet from end to end with two extensions on the rear and a single smaller one on the front. One of the rear extensions on each floor is used as a dormitory, terminating in a bow window, and the other opens into an enclosed porch and is used as a day room. The plan of the first floor may be seen from Figure 5. The front projection is near the center and is used as a dining room, standing out in a well-lighted room about 25 feet beyond the front of the building. In the basement of the building rooms have been fitted up as a morgue, including a reception room and an autopsy room. The subsequent arrangement is to set apart one infirmary building to each sex, just as with the hospital. The cost of the building was about $45,000.

Practically all of the remaining patients of the hospital are to be accommodated in the cottages which are designed for the different classes of able-bodied chronic cases. These all consist of two stories, the first being divided into sitting rooms with the necessary domestic rooms attached, and the second story comprising a large dormitory with a few single rooms, including one or two rooms for nurses. Two cottages have been completed at a cost of about $50,000, capable of accommodating sixty patients each. Not more than 10 per cent. of the whole number of patients will sleep in single rooms, the remaining 90 per cent. being congregated in the large dormitories. It is said that experience has demonstrated that this arrangement is more satisfactory, and that intelligent night supervision even for a considerable portion of the disturbed cases, is found to insure better care.

The buildings are heated and lighted from a central station. The hot-blast system of heating is pretty generally employed, with the Johnson method of automatic heat regulation in all the buildings occupied by patients. The air is supplied by blowers to the various rooms through ducts and flues and is heated by heating coils using steam carried from the boiler plant through tunnels. Steam is distributed at low pressure throughout the plant and all blowers are belt driven by electric motors. Electrical power is also used for lighting, incandescent lamps for interior illumination and arc lights upon the grounds.

The hospital building is heated almost entirely by the hot-blast system, a few direct radiators being placed in stairways where a supply of air is comparatively unessential. Steam from the tunnel supplies three sets of heating coils, one in the center of the basement, and one in each end as shown in Figure 3. The air enters the building through windows near the central heater and is filtered through a cleaning screen. It then passes through a tempering coil, which it may bypass, underneath, and is discharged by a blower into a chamber from which a portion of the air is diverted downward to a brick trench. This connects at either end with a tile pipe which leads to one of the two distant coils. The rest of the air passes directly through the main heating coils. Each of the three heating coils is built with cold-air bypass and hinge dampers, which are controlled by the regulating thermostats, providing for a mixing of cold and hot air. The blower was made by the Buffalo Forge Company and has a capacity of 38,000 cubic feet of

air per minute when run at a normal speed of 200 revolutions per minute, delivering to the rooms sufficient air to change their volumes 6 times per hour on the average. The air is carried from the heating coils by galvanized iron ducts at the basement ceiling, and through tile pipes underground; the overhead ducts are used where the connections to the hot-air flues are not very long. The supply for the rear wing is carried partially overhead, as shown.

The flues rise in the building walls directly to fresh-air registers about 8 feet above the floor. Vent registers are placed at the floor, and the continual flow of air into the rooms maintains an outflow of the more or less vitiated air, which rises to the space under the roof, diffusing into the atmosphere through vent openings. The automatic control is used largely for groups of rooms. This may be seen from Figure 3, as the controlling dampers are located at the heaters and hence can vary the temperature of each main duct only. Whatever branches there are from these ducts, the rooms so grouped by them are near together and the thermostat is in such a place that the controlling temperature is very nearly a common one. The fresh-air registers are provided with leaves in such rooms, however, so that the inflow of air may be varied independently as desired by the occupants. Where a single room has the automatic control there are no leaves on the registers. All vent registers are provided with leaves and in all cases are made with a locking device to prevent being tampered with by some perverse lunatic.

The buildings were erected from the plans of Messrs. Yost & Packard of Columbus, Ohio, under the superintendence of Dr. A. B. Richardson of Columbus, with Mr. Geary F. Richards of Columbus as assistant superintendent. The contractors for the work were Messrs. J. W. Myers & Company of Ashland, Ohio, and Messrs. Robt. H. Evans & Company of Zanesville, Ohio. The heating and electrical work was designed by Messrs. E. P. Roberts & Company of Cleveland, Ohio.

(To Be Continued.)

PUBLIC LIBRARIES.

At a recent meeting of the Royal Institute of British Architects, papers were read on the subject of public libraries by Mr. J. M. Brydon, Fellow of the Institute, and Mr. F. J. Burgoyne, librarian of the Central Library at Brixton. The subject was treated from two view points, Mr. Brydon confining himself for the greater part to the architectural features of the buildings and Mr. Burgoyne treating of the general arrangement of books, and the fittings and furniture most suitable for the work of a public library. Some of the matter is likely to be of interest to American readers and an abstract of the paper is given herewith.

Mr. Brydon's paper dealt largely with reproducing examples of modern public libraries, making extended reference to the Congressional Library at Washington, the Public Library at Boston, the Columbia University Library, New York, and the public library to be erected in New York. He said in substance that a site to be suitable for the purpose, or for the locality the building is destined to serve, must be central and yet at the same time quiet; it must be ample in area to allow for future extension, nothing growing so fast as a library. The site must have a good light all around, and, not of the least consideration, it must be dry. Its shape should, if possible, be rectangular; angular sites are to be avoided, because for their size, they are both costly to build upon and wasteful to work. He divided libraries in two classes—the purely reference library, where the reading room is the architect's great opportunity for design; and reference and lending libraries, combined with reading rooms for newspapers and magazines. The latter, he said, was the truly popular library—everybody read the papers nowadays, and therefore rooms had to be provided where a man might walk in and out when he pleased, to peruse any or all of the papers he had a mind to. The author brought up the point of the importance of proper supervision in such a free and open system as this and the difficulty usually met with in the smallness of the official staff available for the purpose. He considered that the ideal plan would seem to be one providing for all the public rooms on one floor. Where sites of restricted area made such an arrangement impossible, he considered it imperative that those rooms requiring most frequent and rapid access, such as the news room and the lending library, should be placed on the ground floor, leaving the reference rooms and possibly the magazine rooms to be accommodated on an upper floor. The author did not consider the planning of a public library a complicated problem. "Simplicity of access and ease of supervision are the keynotes on which the whole system is worked out" The public rooms should be lofty, well lighted and thoroughly ventilated. "The reading rooms, which are of no mean size, readily lend themselves to nobility of treatment, and give ample scope for the designer's knowledge of proportion—all such excrescences as fussy little bay windows and other nooks and corners are utterly uncalled for."

Mr. Burgoyne prefaced his discussion of the subject with a statement of the limited incomes which are accorded municipal libraries in Great Britain, and in view of the interest which attaches to the figures he gave, they are herewith briefly reproduced. He said that the income of such a library was limited to the proceeds of a rate of one penny in the pound, on the rateable value of the district concerned. Some half dozen towns had obtained parliamentary powers to levy a higher rate, and generally speaking, three-halfpence in the pound might be said to be the outside limit. As an example of the wide variation, he said the proceeds ranged from about \$95,000 per annum in Manchester to \$75 in Drumoak, a little Scotch village which characteristically considered a halfpenny rate sufficient for its needs. He divided municipal libraries into three kinds: small, medium and large. A small library, he thought, should have a place for newspapers and periodicals and a lending department for the loan of books for home reading. The staff of such a library would probably consist of a librarian and a lad. The librarian would in turn be caretaker, librarian, stoker, and, on occasion, "chucker out." The plan generally adopted for such a building was a rectangular room, lighted chiefly from the top; newspaper stands and tables were in the center; the walls on one, two or three sides were shelved for books, often to a height of 15 to 18 feet; and a counter ran around the room at a distance of 6 or 8 feet from the books. He thought the noise incident to the work of the lending department was objectionable, as disturbing the attention of the readers at the newspaper stands. He described a library in which the lending department was separated by glass screens from the news room, where there were separate rooms for the magazines and for the study of the books of reference; the supervision from the lending library through the glass screens, he said, was perfect. Of the third class, suitable for towns of 150,000 inhabitants and upwards, he said that the work done in the reference department was of the most valuable character, and that it was advisable to have, in addition to the ordinary reference reading room, a smaller room for the use of students of special subjects. The librarian would require a room for his own use, which in the smaller libraries should be adjoining the lending department. In the larger libraries, he thought it better situated in conjunction with the reference department, of large size, for monthly committee meetings, if necessary, but by no means permitting the public to have direct access. He advocated a fireproof strong room, on the same floor as the reference department, in which the rarer books and manuscripts could be stored. He said that in most of the London libraries a residence for the librarian is included in the building and considered it economical. In lending-library work the author said that there were three methods of issue; namely, with an indicator, without an indicator, and "open access," or allowing the readers to go to the shelves and select their books. In each case the arrangement of the room and the space required were different. If an indicator was used, a counter not more than 2 feet 9 inches in height should be provided. For the "open access" system a central enclosure for the librarian was necessary, with inlet gate at one side and outlet at the other.

The author gave a section through the stack-room of the University Library at Grieswald, showing a sub-basement underneath for dryness and lighted by a skylight over a stairway rising through the center of the room. There is no skylight over the books, for fear of damage by water leaking through. The author described the stack rooms at the British Museum. The stacks are three tiers in height and an average of about 9 feet apart. In front of each bookcase two steel girders with flanges are bolted to the iron of the floor above, about three feet apart and at right angles to the case. A bookcase of the same width hangs from the girders, extending to within a few inches of the floor. It can be filled with books, and is readily pulled away from its normal position, which is close against the front of the fixed bookcase. The weight of the hanging case when full of books averages 1,000 pounds. A somewhat similar system adopted in the newly arranged library of the India office was also described. The iron bookcases hang from girders as at the British Museum, but they are packed close together, and if a book is wanted the case containing it is pulled out into the central gangway, which is of the same width as the sliding case. This is the closest method of shelving a large number of books that the author ever knew of, and he considered that it would be very useful in libraries where the books were not much in use. The cases average 3 feet 6 inches in length and 8 feet 8 inches high. They have eight shelves on either side and will carry 600 ordinary octavo volumes. The weight of the case when empty is about 350 pounds, and when filled with books about 1,300 pounds. The system is invented by Mr. W. Lambert. Whatever system of shelving is adopted, the author thought it important to make all the shelves of the same length, and stated that experience had shown that 36 inches was the most suitable. No bookcase should be higher than 8 feet, he said, and 7 feet was preferable.

MODERN PRACTICE IN STEAM HEATING AND VENTILATION.

[By Wm. S. Monroe.]

Chapter I.—Introductory.

The first really practical treatise on heating and ventilation seems to have been published in 1824 by Thomas Tredgold, and in this volume much space is given to the importance of securing adequate ventilation, and also to the merits of heating by systems of steam pipes. Mr. Tredgold gives accounts of several buildings which were successfully heated in this way. It is cited that the first factory in which steam was used for heating was a cotton mill of Mr. Neil Snodgrass, in which a steam heating system was installed in 1799. This was doubtless about the first instance of the employment of steam primarily and systematically for the purpose of heating. Mr. Tredgold describes a factory which was equipped with a steam heating system in 1817 as a substitute for stoves which had been previously used. The

building was 90 feet by 30 feet, exposed on all sides, and four floors high. Each floor was warmed by a single pipe running the length of the building at the ceiling and midway between the sides. The system carried 30 pounds steam pressure, but besides the most inefficient location of the radiating surface, the system, as described, figures not over 450 square feet of heating surface for a building with 91,800 cubic feet of contents. Mr. Tredgold states that the system showed great improvement, both in economy and results over the previous method, adding that the employees suffered much less from "chaps and chills," so that one can only imagine the wretched condition of factory employees in cold weather previous to that time, even in the comparatively mild climate of England.

The problem of artificial ventilation antedates that of steam heating by more than half a century, though, of course, it does not antedate the heating of buildings by various methods more primitive. Mr. W. F. Butler, in a handbook on ventilation, published some years ago, states that the first scientific consideration of the subject of artificial ventilation occurred in 1723, when a certain Dr. Desaguliers was commissioned to institute some means for making the atmosphere in the House of Commons more habitable, and the doctor seems to have installed a system which proved satisfactory, although it had been previously attempted by no less a person than the celebrated architect, Sir Christopher Wren. Since that time the question of ventilation has occupied increasing attention from the minds of physicians, architects and other scientific men interested in the public welfare, but even to this day what may be called "artificial" or forced ventilation remains to a large extent a luxury.

From the earliest times in the latitudes of northern Europe and North America, some form of heating in cold weather has been a necessity for all buildings, whether caves or palaces, but even to this century such a thing as a uniform temperature in heated rooms in severe weather was never expected, while ventilation was invariably secured only by such means as would be "naturally" accomplished by the circulation of air through doors and other openings. In the early days of our forefathers when houses were built with large rooms and great, high ceilinged halls, and when people spent a large part of their time in the open air, there was in reality but little need of artificial ventilation, and in the rude homes of the poorer classes that which was secured through poorly constructed walls and through loose windows of oiled paper was generally much more than desired. With the improvement of transportation facilities, however, and the gathering of large numbers of people into small spaces, and comparative large numbers in single buildings, the need of artificial ventilation, in order to secure anything like a wholesome atmosphere, gradually became apparent, and it is natural that the first demand for such ventilation should be recognized in a building like the House of Commons.

Out of the same economic conditions arose the necessity of heating buildings by steam. Buildings of all kinds had from the earliest days been heated by open fire places, in which logs, and later coal, were burned in profusion, while the larger proportion of the heat escaped out the flue. But forests were in time reduced, cities grew, and buildings were built larger and with a much larger proportionate number of rooms; and people were forced to find more economical ways of heating than by laboriously carrying expensive fuel to separate fires in each individual room. Stoves were built to get more uniform combustion, and save some of the heat lost, and gradually various forms of distributing heat through many rooms from one central fire, were developed to economize labor. Heated air, heated water and steam were all in turn experimented with as a means of distributing heat, and have been rapidly and scientifically developed to meet various requirements, and all to this day are very widely used. But since the time of Tredgold, heating by steam has increased in extent and popularity year after year, especially since the increase in size of buildings began to be very rapid, and its economy of operation and incidental advantages of convenience and simplicity have become more and more apparent until at the present day, in some form or another, it is used almost universally in all installations requiring distribution of heat over any considerable area. In this country it is well within the memory of most men in active life when even our largest factories and office buildings were heated by means of open fires and stoves, but the development from a primitive life to a congested and complex civilization has been phenomenally rapid. However, in Europe as here, the greatest development in steam heating has been accomplished in the last quarter of the century, and has been due very largely to the almost universal application of steam power and the tremendous economy effected by the use of exhaust steam for heating.

The problem of mechanical ventilation, therefore, though growing out of much the same economic conditions, developed, to a large extent, independently of the question of heating. With the development of heat distribution by steam much was lost in the way of ventilation. The old-time fire place and stove implied a certain amount of ventilation, to say nothing of the mental exhilaration of the former, but heating by steam was accomplished with no ventilation whatsoever. Hygienically, therefore, it was a step in the wrong direction, but economically the lack of ventilation made it more advantageous, as ventilation requires the heating of all incoming air. Heat in cold weather was the prime essential, and the demands of economy invariably prevail, and it was always possible to obtain some amount of ventilation by what might be called the "natural circulation" of air through doors and windows. The fallacy of resorting to such methods exclusively has been pointed out in many tracts and treatises published since the latter part of the last century, but the fact remains that even to the present day a vast majority of our buildings, a large proportion even of our factories, churches and schoolhouses, and most of our fine office buildings with their boasted modern improvements, have no mechanical means for insuring an adequate ventilation.

At the present day we have arrived at a considerable degree of advancement, however, and buildings might now be divided into two quite distinct classes—those which are "densely peopled" and those which are "sparsely peopled"—and our advancement is such that mechanical ventilation is generally looked upon as a necessity for all buildings of the former class, which may include schoolhouses, churches, hospitals, theaters, and other audience halls. In buildings of the second class, such as residences, office buildings and hotels, we have been as a rule satisfied with sufficient heat, and have relied upon such ventilation as is secured by the natural circulation methods of the preceding generations. In such buildings, therefore, the system of heating most used is that known as "direct radiation," in which radiators, or some form of radiating surface is located in each room, and connected by an arrangement of piping to a central source of steam or hot water. The rooms are heated by radiation from the hot surface, and by contact of the air with it, but no provision is made for any fresh air.

Several adaptations of the ordinary "direct radiation" system of steam heating have been developed, however, with a view to regaining the advantage of ventilation which was secured in the old-time stoves and fire places. The principal one of these is what is known as the system of "indirect radiation," in which the radiators, instead of being located in the rooms to be heated, are all placed below them, generally in the basement of the building, and are inclosed in boxes, which are provided with air inlets from the outside of the building, and with flues running to the room to be heated. Fresh air coming through the inlet in contact with the radiator is heated and rises through the upright flue by the natural upward tendency of hot air. Both heat and ventilation are in this way provided to the rooms by the incoming hot air. This system has been much used in residences, and also to a small extent in some buildings of the "densely-peopled" class, such as hospitals and hotels. But the system has a decided disadvantage, in the fact that the amount of ventilation secured is practically proportional to the amount of heat required, and in warm weather but little, if any, ventilation is obtained. Furthermore, experience shows that in order to ensure reliability it is necessary to have a separate flue for almost every room, and to locate the radiators directly beneath the vertical flue, so that in buildings of any size, especially those more than one or two stories in height, the arrangement of radiators in the basement becomes difficult and the space occupied by the air flues, which are necessarily large, is complex and expensive of space and also in construction.

In order to avoid the difficulties of the system of "indirect radiation" and yet secure some ventilation, a combination has been developed which goes under the significant title of "direct-indirect radiation." In this the radiators are located in each separate room, but are of special construction, and provided with air connections through the walls of the building, so arranged that a certain amount of air can be let in through this connection so as to pass around the radiator, becoming heated by contact with it. The room is therefore heated both by direct radiation and by the incoming current of fresh hot air and considerable ventilation is secured.

In this system, as in the "indirect," ventilation in warm weather is dependent upon open windows and doors, and it has been as yet but little used. It has, however, in a few cases been adapted to office buildings and hotels, and in the opinion of the writer we may look for a very decided development of the "direct-indirect" during the immediate future in buildings of the more "sparsely-peopled" character, where the amount of ventilation required per square foot of floor area is comparatively small. But for such buildings this system only achieves its best results if combined with a mechanical system for exhausting the air.

As mentioned above, we have perhaps arrived to-day at a point in the advancement of the broad field of hygienic science, where some system of artificial or mechanical ventilation is looked upon as necessary for all buildings of what the writer has called the densely-peopled class. It is difficult to place a numerical limit on such buildings as the height and nature of the room and length of time occupied affect the consideration, but in general any room or apartment in which each individual occupies less than 30 square feet of floor area should be included, especially if occupied more than two or three hours at a time. The systems which may be employed for mechanical ventilation are numerous and varied, but they all embody the use of fans of one kind or another for forcing the air into the rooms or exhausting it, or both, with proper provision for heating the incoming air in cold weather, and some one of the three heating systems is frequently, if not generally, employed in connection with a system of mechanical ventilation.

(To be Continued.)

TRADE PUBLICATIONS.

Some months ago an engineer who has long held a prominent position in his special field found time to write a book on a professional subject. In due time it was printed and a copy sent to "The Engineering Record" for review. Now reviewing a book is a delicate matter, which requires time and careful thought, particularly if the author's opinions are not those of the reviewer. In this particular case, after waiting for what seemed an unconscionable time, the author remarked, with an evident desire to be mildly sarcastic, that there seemed to be no such celerity in noticing really good professional works in these pages as was shown in the preparation of the column devoted to trade publications. As a matter of fact, the critic was right in this view, and the reason will be self-evident to any engineer acquainted with the trade literature of the present time.

Trade publications are now one of the most important sources of information at the command of the engineer, and the fact that this information can be obtained for practically nothing should not be allowed to influence the judgment as to its value. During the period of business depression which recently passed, one of the engineers of a large manufacturing corporation spent many months in preparing a work, since issued by his company, which has been adopted as a text-book in several schools. The pocket-books of steel companies are placed in the hands of most of the students of civil engineering as regular text-books, and the annuals issued by manufacturers of surveying instruments have been used in a similar manner for many years. Moreover, there are some schools where the students are now taught to refer to these commercial publications as the real source of much of the matter in their school manuals, and there is a manifest intention on the part of their compilers to make catalogues of still more value as reference books of engineering data.

The reason for this peculiar character of the American trade publications is to be found in the knowledge that they will be read by men who are trained to deal with the hard cold facts of natural laws in a business way. It is manifestly impossible to appeal to them with any degree of success in the same manner that a manufacturer of soap or feminine wearing apparel has found useful in reaching the public eye. The manufacturer of apparatus useful to the engineer and architect has learned that a mere catalogue of his goods, with a few testimonials from users of them, is not kept on the shelves of the people he wishes to reach, but disappears at once into a waste basket. So it has become necessary to make the trade publication something more than a mere catalogue, and, in its present form, as issued by the most progressive firms, it has become a book of useful information, free from extravagant claims, and worthy of a place in the working library of any professional man. It is for this reason that publications of this nature are noticed at once in these columns.

The R. M. Wilson Manufacturing Company, Rome, N. Y., has published a large pamphlet descriptive of its different classes of baths and plumbing fixtures.

The Waterhouse-Forbes Company, 220 to 222 South Fifth Street, Philadelphia, has prepared a pamplet describing a water sterilizer which it manufactures. In this interesting device the water is boiled and then cooled nearly to its original temperature.

The Roney mechanical stoker, as recently improved, is described in a new catalogue issued by Westinghouse, Church, Kerr & Company of New York. The advantages of the mechanical system of stoking boilers are thoroughly discussed and the particular points of merit in the new Roney stoker are pointed out. The Roney coal crusher is also described. The work is handsomely gotten up.

The Ingersoll-Sergeant Drill Company, 26 Cortlandt St., New York, has issued a little brochure containing an engraving of each of its various types of air compressors with a description of the leading features of each. The pamphlet shows in an unusually clear manner the wide variety of air compressing machines which is needed by the demands of manufacturers of the present day.

The New York Filter Manufacturing Co., 26 Cortlandt St., New York, has published a valuable pamphlet containing a paper by Dr. G. T. Swarts, secretary Rhode Island State Board of Health, on "Man's Imitation of Nature in Purification of Water," and extracts from an article on alumina as a coagulant, from a report on coagulants made by a committee to investigate the purification of the Providence water supply, from the report of Mr. George W. Fuller on the purification of the Cincinati water supply, from the report of Mr. Allen Hazen on the Loraine filter plant, and letters from numerous users of mechanical filters.

NOTES.

Rapid Building Erection was accomplished recently in constructing the Vincent Building at the corner of Duane Street and Broadway in New York, a fifteen-story structure on a 110 x 51-foot lot. The building was erected from foundation to roof and the exterior walls finished in four months. The architect is Mr. George B. Post, and the contractors for the steel framework were the Pencoyd Iron Works.

A Description of Irrigation Works near Merced, Cal., written by Mr. C. E. Grunsky, M. Am. Soc. C. E., of San Francisco, has been published in the series of irrigation monographs of the United States Geological Survey, which is edited by Mr. F. H. Newell. It describes the engineering features of a number of interesting systems and also gives valuable data concerning the manner in which the water is applied to the land.

Rules and Suggestions as to the plumbing, drainage, sewerage, sewage disposal, water supply and fire protection of the New York State hospitals, prepared by Mr. Wm. Paul Gerhard, New York, were adopted by the New York State Hospital Commission December 1, 1898. These rules comprise a substantially complete set of general specifications, giving examples of approved types of construction and forming a basis for the preparation of specific requirements and details for individual cases in almost any public institution.

PERSONAL AND OBITUARY NOTES.

Mr. N. C. Phillips has been elected city clerk of Council Bluffs, Ia.

Mr. M. M. Maxon has been elected city engineer of Waukesha, Wis.

Mr. F. A. Coleman has been appointed city engineer of Rome, N. Y.

Mr. J. E. S. Pryor has been elected city engineer of Hagerstown, Md.

Mr. H. M. Redd has been elected city engineer of Chillicothe, Ohio.

Mr. August Bobme has been elected city engineer of Kewaunee, Wis.

Mr. J. E. Meagher has been elected water commissioner of Burlington, Vt.

Mr. John F. Stevens has been appointed chief engineer of the Great Northern Railway.

Mr. William Taylor has been elected engineer of the board of water commissioners, Tarrytown, N. Y.

Mr. John F. O'Rourke, engineer and contractor, has removed his offices to the Park Row Building, New York.

Mr. J. H. Squires and Mr. S. S. Wyandt have been elected city clerks of Topeka, Kan., and Abilene, Kan., respectively.

Mr. L. M. Hastings has been confirmed as the city engineer of Cambridge, Mass., for the ensuing year, thus entering upon the eleventh term of his office.

Mr. O. H. Crittenden was appointed chief engineer of the Kansas City, Pittsburg & Gulf Railroad Company April 1 and will have his headquarters at Texarkana, Tex.

The following have been elected water-works trustees of cities of Ohio: Mr. W. F. Baur, Springfield; Mr. H. C. Brown, Gallipolis; Mr. A. Stewart, Toronto; Mr. B. B. Childs, Dayton; Mr. J. E. McGowan, Steubenville.

Mr. G. F. Greenwood has resigned the position as general manager of the Consolidated Traction Company, Pittsburg, and will devote himself to a consulting practice, acting as consulting engineer for the traction company.

The following have been elected water commissioners of towns in Massachusetts: Mr. Arthur Fenner, Ayer; Mr. Chas. A. Rice, Brookfield; Mr. John W. D. Fifield, North Brookfield; Mr. Lyman R. Eddy, Webster; Mr. A. G. Pease, Spencer.

The following have been elected clerks of Wisconsin cities: Mr. Percy Cochrane, Eau Claire; Mr. William L. Kerr, Green Bay; Mr. Gustav Jacob, Kenosha; Mr. F. J. Olle, Kewaunee; Mr. Daniel Witzel, Oshkosh; Mr. Henry Schroff, Racine.

Prof. J. B. Johnson, M. Am. Soc. C. E., sailed April 15 for Naples on the "Saale," to spend four months in Europe studying commercial and industrial schools. On his return he will assume charge of the college of engineering of the University of Wisconsin, Madison, Wis.

Mr. Arthur Hay, a graduate of the engineering department of Columbia University and for several years past manager of the Abbott Mining Company, California, has entered the firm of Gillette & Gillette, Rochester, N. Y., the new firm name being Gillette, Hay & Gillette, civil engineers and contractors.

Mr. Charles Evan Fowler, M. Am. Soc. C. E., who was with the Youngstown Bridge Company as chief engineer for over six years, has opened an office at 11 Broadway, New York, for professional work and will represent the Osborn Company of Cleveland, Ohio, for the inspection of iron and steel construction.

The following have been elected in Colorado: William Peach, for past eight years assistant city engineer of Pueblo, city engineer; Mr. J. B. Hunter, city engineer, Denver, for two years; Mr. George Q. McNeil, city clerk, Pueblo; Mr. S. B. Remsen, city surveyor, Creede; and Mr. Burwell, city engineer, Durango.

The following have been elected clerks of cities in Michigan: Mr. Richard Chaddock, Benton Harbor; Mr. C. L. Toan, Big Rapids; Mr. W. J. Smith, Cadillac; Mr. H. O. Van Eyck, Holland; Mr. Thomas Kirby, Grand Haven; Mr. Asa G. Milton, Greenville; Mr. Cassius Mishler, Lansing; Mr. Henry Lardner, Niles; Mr. Ash, re-elected, Owosso; Mr. Henry Taylor, Manistee; and Mr. Elmer E. Hymers, Pontiac. Mr. M. Weber, St. Joseph.

Mr. Menard K. Bowen, president of the Chicago City Railway Company, died April 9 after an operation for appendicitis. He was born in Jefferson Barracks, Mo., in 1856, and was a son of the Confederate General John S. Bowen. In 1877 he served as assistant engineer on government surveys and in 1880 became chief engineer and superintendent of construction of the Kansas City Railway. Soon after he came to New York City as the representative of the Short Electric Railway and finally went to Chicago to take a position with the city railway, of which in course of time he became president.

CONTRACTING NEWS

OF SPECIAL INTEREST TO
CONTRACTORS, BUILDERS, ENGINEERS, AND MANUFACTURERS
OF ENGINEERING AND BUILDING SUPPLIES.

For Proposals see pages xi, xii and 464.

WATER.

Peekskill, N. Y.—Bids are wanted for furnishing and delivering about 2,800 ft. of 4 and 6-in. cast-iron pipe, as advertised in "The Engineering Record."

Colfax, Wash.—W. J. Roberts, of Pullman, Wash., is the engineer in charge of proposed improvements to the water system, estimated to cost $12,000.

Binghamton, N. Y.—D. Felter, Supt. of Water Works, writes that plans and specifications are being prepared by the Engineering Contract Co., 71 B'way, N. Y. City, for proposed improvements to the water system.

Lisbon, O.—The Council is considering the issue of $20,000 bonds to improve the water system.

Ishpeming, Mich.—Press reports state that the city proposes to establish an additional water supply.

Rockyford, Colo.—At a recent election the issue of $17,000 bonds was authorized.

Brooklyn, N. Y.—The Board of Public Improvements has authorized the erection of an additional pumping station at the Milburn reservoir to increase the water supply and passed a resolution requesting the Board of Estimate to authorize the issue of $100,000 bonds for this purpose and for additional supply sheds and elevated coal hoists.

Warren, Me.—Fred A. Allen, of Union, Me., Pres. and Secy. of the Warren Water Co., writes that bids will soon be asked for 2 miles of 6 and 8-in. pipe. Estimated cost of improvements, $15,000.

Minneapolis, Minn.—The U. S. Cast Iron Pipe & Foundry Co. has received the contract for furnishing 7,116 lin. ft. of 16-in. pipe, at $24.90 per ton if paid for July 1, 1899, and $25.15 per ton if ½ is paid July 1 and ½ paid Nov. 1, 1899.

Yonkers, N. Y.—A. W. Kingsbury, Clk. of the Board of Water Commrs., writes that R. D. Wood & Co., of Philadelphia, Pa., have secured the contract for furnishing a quantity of 6 and 8-in. water pipe at $24 a long ton.

Rochester, Minn.—The Provident Water Co. has been granted a state charter. Capital stock, $25,000.

Frederick, Md.—Press reports state that the Board of Aldermen have under consideration plans for the increase of the water supply. Bonds to the amount of $35,000 have been authorized.

Tacoma, Wash.—The Palouse Ditch Co. has filed articles of incorporation with Joshua Peirce, Robert P. Bradley and T. L. Stiles as incorporators. The object of the company is to operate irrigating ditches, flumes, reservoirs and all other means of irrigating lands in the counties of Whitman, Adams, Franklin and elsewhere in the State. The capital stock is $20,000.

Jacksonville, Fla.—The Board of Water Works Trustees has been authorized to expend an amount not to exceed $5,000 for the purpose of increasing the water supply.

Ellenville, N. Y.—The Governor has signed the bill authorizing the trustees to enlarge the village water supply.

Phoenixville, Pa.—Press reports state that a vote of the people will be taken on the question of purifying the water supply.

Hopewell Junction, N. Y.—The Southern Duchess Water Co. has been incorporated with a capital of $5,000. Directors: Storm Evans, East Fishkill; John Ogden, Stormville; E. H. Travis, Poughkeepsie.

Bloomfield, Ind.—Cavins & Henderson, Town Attorneys, write that G. C. Morgan of Chicago has been employed to prepare plans and estimates for the proposed water-works and electric light plant. Probable cost, $20,000.

Benderville, Pa.—Press reports state that the proposition to construct a system of water-works will probably soon be voted [illegible]

Punxsut[illegible]

Sun Prairie, Wis.—Charles Alberts, Town Clk., writes that it has been voted to construct water-works.

Chicago, Ill.—Bids are wanted April 19 for laying water pipe in several streets. L. E. McGann, Pres. Bd. Local Improvements.

Springfield, Mass.—An order has been passed allowing the Water Department to expend $20,000 this year in laying new distributing mains.

Michigan City, Ind.—Press reports state that a company has been incorporated for the purpose of building a $75,000 water-works system. The directors are John H. Barker, Philip Zorn, Walter Vail and others.

Morton, Minn.—It is stated that J. N. Anderson will make preliminary survey for water-works.

Belgrade, Minn.—Press reports state that a water-works and electric light system will be put in this season.

Rome, Ga.—Press reports state that a filtration basin with a capacity of 4,000,000 gal. is to be built. Estimated cost, $25,000.

Toulon, Ill.—A vote will be taken April 18 on the proposition to construct water-works.

Milford, Ind.—The lowest bid received for the construction of water-works and an electric light plant is said to be that of C. L. Olds Construction Co., of Fort Wayne, at $17,590.

West Bay City, Mich.—A bill has passed the Senate amending the city charter and authorizing the issue of $140,000 water-works bonds.

Salt Lake City, Utah.—The Bear River Water Co. has filed articles of incorporation. The incorporators are David Evans, J. E. Dooly, Leah Evans and others. The capital stock is $250,000.

Dyer, Tenn.—Local press reports state that the town is considering the advisability of putting in a water plant.

Martin's Ferry, O.—At the election held April 3 it was voted to issue $35,000 bonds for water-works improvements.

Windsor, N. Y.—Press reports state that Ray B. Lewis has secured the contract for the construction of water-works, at $20,000.

Long Island City, N. Y.—The Board of Public Improvements has authorized the extension of water mains in the Borough of Queens, also the driving of 22-in. wells and the issue of $65,000 bonds to pay for same.

Holly Springs, Miss.—A vote of the people will be taken on the proposition to issue $18,000 water-works bonds in addition to the $43,000 bonds already issued.

Blooming Prairie, Minn.—Press reports state that it has been voted to construct water-works.

Mayville, N. D.—Local press reports state that all bids received April 5 for the construction of water-works and an electric light plant have been rejected.

Hudson, S. D.—Press reports state that it has been voted to construct water-works.

Grand Forks, N. D.—Bids are wanted April 18 for laying water mains in 2 streets. F. A. Brown, City Aud.

Tyler, Minn.—Bids are wanted May 1 for $5,000 bonds to be used in constructing a system of water-works. W. J. Huddleston, Village Recorder.

Hamilton, Ont.—The Council has adopted the recommendation of the Water-Works Committee to lay mains on Wellington and Barton Sts. at an estimated cost of $13,500.

Orange, Cal.—It is stated that bids are wanted May 8 for the purchase of a franchise for putting in works. The Santiago Land & Water Co. has applied for a franchise. H. Z. Adams, City Clk.

Cincinnati, O.—Local press reports state that the Water-Works Commissioners will soon ask for bids for 6,000 tons of water pipe for the new plant.

Washington, Ga.—Press reports state that $30,000 bonds have been voted to purchase the water-works and electric light plant and establish a sewerage system.

New York, N. Y.—Bids are wanted April 27 for the removal of the 42d St. reservoir and other work in the 19th ward. George C. Clausen, Chmn. Commr. of Parks.

Pima, A. T.—Bids are wanted May 8 for a school and sewer and water system at the Pima Agency, A. T. W. A. Jones, Commr. of Indian Affairs, Dept. of the Interior, Washington, D. C.

Lowell, Mass.—M. J. Drummond & Co. of N. Y. City have secured the contract for 700 tons pipe, for $15,687.

Dunkirk, N. Y.—The Snow Steam Pump Wks. of Buffalo have secured the contract for a horizontal triple expansion pump, with a daily capacity of 6,000,000 gals., for $17,490.

Pomeroy, Ia.—E. B. Lannon, Recorder, writes that it was voted, April 10, to construct a system of water works.

Spencer, Mass.—At a recent town meeting it was voted to appropriate $7,000 for a stand pipe.

White Plains, N. Y.—Bids are wanted April 17 for $25,000 water bonds. Howard E. Foster, Treas.

Newark, N. J.—Local press reports state that the following bids were opened April 6 for driven wells near the Belleville pumping station: The first bid is for a supply of 5,000,000 gals. daily, the second is for 8,000,000 gals. daily; A. J. Connolly, Newark, $30,000, $48,000; P. H. & J. Conlon, Newark, $28,500, $45,000; Phillips & Worthington, $27,750; $42,750.

Philadelphia, Pa.—The following bids for pumping engines at Roxborough and Spring Garden Stations were opened April 11 by Thos. M. Thompson, Dir. of Pub. Wks.: a, 2-5,000,000 gal. pumps, each; b, 3,000,000 gal. pumps, each; c, one or more 2,000,000 gal. pumps, each; d, pump chamber and valves, each; Lake Erie Engineering Co., Erie, Pa., a, $34,675; Barr Pumping Engine Co., Germantown Jct., Philadelphia, a, $25,500; d, $4,500; Robt. Wetherell & Co., Chester, Pa., a, $32,050; b, $20,200; d, $2,350; Henry R. Worthington, 720 Arch St., Philadelphia, a, $30,000; Holly Mfg. Co., Lockport, N. Y., a, $41,900 vertical, and $29,500 horizontal; d, $1,495; I. P. Morris Co., Beach and Ball Sts., Philadelphia, $36,950; c, $10,000; d, $3,225.

Boston, Mass.—The following bids were opened April 4 by the Metropolitan Water Board for laying water pipes in Medford and Arlington, as advertised in "The Engineering Record." The work includes the laying of 3,200 lin. ft. of 24-in. cast-iron pipe, 9,100 lin. ft. of 20-in. and 345 ft. of 16, 12 and 6-in. pipe, a small amount of rock and earth excavation, also setting a few valves and chambers: Coleman Bros., Charlestown, Mass., $8,247.50; Bruno & Salomone, E. Boston, $9,126.50; Baker & Judson, Gloversville, N. Y., $9,715.75; Chas. G. Craib, Winthrop, Mass., $10,930; Edw. A. Clark, Boston, $10,985.90; C. E. Trumbull & Co., Boston, $11,245.35; Long & Little, Leominster, Mass., $11,470.50; Geo. M. Bacon, Boston, $11,762.25; H. A. Hanscom & Co., Boston, $12,049.05; Richard Falvey, Somerville, Mass., $12,936.50; John J. Dorey, Somerville, Mass., $13,100; Mirick & Wentworth, Malden, Mass., $14,451.25; Michael Russo, Boston, $15,061.65; Donovan & McCarthy, Roxbury, Mass., $20,486.

The contract was awarded to Bruno & Salomone, who bid 74 cts. per lin. ft. for 24-in. pipe and 67 cts. per lin. ft. for 20-in. pipe.

Wm. H. Ryan & Co. of East Boston have received the contract for furnishing water pipe boxes and siphon for $4,584.

Boston, Mass.—The following bids were opened April 4 by the Metropolitan Water Board for excavating soil from Section 4 of the Wachusett Reservoir and excavating and refilling at the Easterly Portion of the North Dike at Clinton, as advertised in "The Engineering Record":

Bidders and Prices.

Items and Quantities.		Moulton & O'Mahoney, Boston, Mass.	Jos. D. Gennare, Boston, Mass.	Nawn & Brock, Boston, Mass.	Coleman Bros., Charlestown Mass.	Cenedella Bros., Milford, Mass.	Long & Little, Leominster, Mass.	Bruno & Salomone, E. Boston, Mass.	Newell & Snowling Con. Co., Uxbridge, Mass.	Holbrook, Cabot & Daly, Boston, Mass.
Clearing and grubbing	245 acres	$70.00	$10.00	$75.00	$75.00	$150.00	$75.00	$75.00	$150.00	$50 00
Soil excavation	275,000 cu. yds.	.33	.37	.33	.31	.31	.36½	.40	.37	.63
Earth excavation	40,000 "	.20	.30	18	.33	24	36½	.35	.15	.27
[illegible]	45 "	5.00	6.00	5.00	7.00	4.50	6 00	5.00	7.00	6.00
[illegible]	17 "	14 00	13.00	13.00	14 00	18.00	15 00	15.00	15 00	15.00
[illegible]	9 "	12 00	10 00	9.00	10.00	10 00	10.00	12.00	10.00	12.00
[illegible]	25 "	3.00	2.00	3 00	4 00	1.00	3.00	4.00	5.00	2.00
		$116,546	$116,831	$116,927	$117,568	$132,223	$134,040	$143,063	$145,285	$196,983

[illegible] forms of distributing heat [illegible] many rooms from one central fire, were developed to economize labor. Heated air, radiation" system of steam [illegible] developed, however, with a vie[illegible] the advantage of ventilation which

Baird, Tex.—Mayor Arthur Yonge writes that the following bids were opened April 3 for the construction of a system of water-works: A. J. Gorman of Dallas and Kelly & Steele of McKinney bid $17,112; J. W. Moore of Dallas and J. N. Johnson of Callahan Co., Tex., bid $17,282. Plans were revised and new bids were received, as follows, for a system without reservoir and with a reduction of mains: Gorman & Steel, $9,680; Moore & Johnson, *$9,318.

*Contract awarded.

SEWERAGE AND SEWAGE DISPOSAL.

Niagara Falls, N. Y.—City Engineer Walter Jones writes that bids for sewers, to cost $15,000, have been ordered advertised.

West Hammond, Ill.—Bids are wanted April 21 for a tile pipe sewer in State St., also for a main brick and cast-iron sewer and outlet in Lincoln Ave. John Hessler, Chmn. Bd. Local Improvements.

Scranton, Pa.—Local press reports state that 10 miles of main sewers and 9 miles of house connections are to be constructed this year, at a cost of $139,666.

Monticello, Ia.—Plans are being prepared for a sewer system. O. G. Meyer, Mayor.

Brookfield, Mo.—D. F. Howard, City Clk., writes that it was voted on April 4 to issue $13,500 bonds for the construction of a sewerage system.

Utica, N. Y.—The City Surveyor has prepared plans for several sewers, contracts to be let during April.

Grand Junction, Colo.—The City Clerk writes that a sewerage system is to be built at a cost of $6,000. David R. Crosby, Engr. in Charge.

Fargo, N. D.—Bids will probably be asked about the first of May for the construction of sewers, estimated to cost about $25,000. S. F. Crabbe, Engr. in Charge, Fargo, N. D.

Syracuse, N. Y.—The City Engineer has been directed to make necessary surveys and estimates for 36, 32 and 30-in. brick sewers in three streets, also for 18 and 15-in. pipe sewers in two streets.

Chester, Pa.—Surveyor Damon estimates the cost of an 18-in. pipe outlet sewer at $7,500.

Springfield, O.—At a recent meeting of the City Council it was decided to lay sewers in Woodlawn and Ferncliff Aves.

Williamsport, Pa.—Mayor Williams in his annual message recommends the construction of a storm water sewer to the Susquehanna River through Locust St.

The Dallas, Ore.—N. H. Gates, Recorder, writes that the construction of a sewerage system is under consideration. Probable cost, $25,000.

Delphi, Ind.—It is stated that the City Council has under consideration the matter of constructing a sewerage system.

Macon Ga.—The contract for the construction of a sewer system has been awarded to Lynch & Sanderson, of Moberly, for $21,762.

Bridgeport, Conn.—Bids are wanted May 5 for brick sewers. Bernard Keating, Clk. Bd. Pub. Wks.

New Haven, Conn.—It is proposed to dispose of the sewage of Springside home by the method of intermittent filtration, estimated by City Engineer Kelly to cost $5,000.

Clinton, Mass.—It was recently voted to appropriate $5,000 for the construction of sewers.

Buffalo, N. Y.—The Board of Aldermen has ordered 54, 45, 30 and 27-in. brick and 16-in. pipe sewers constructed in Sprenger Ave.

Jersey City, N. J.—Bids are wanted April 18 for 1,195 lin. ft. of 18-in. vitrified pipe and 490 lin. ft. of 24-in. brick oval sewer. Geo. T. Bouton, Clk. Bd. Street & Water Commrs.

Salem, O.—See "Paving and Roadmaking."

St. Paul, Minn.—Bids are wanted April 17 for sewers on 2 avenues and 3 streets. C. H. Bronson, Clk. Bd. Pub. Wks.

Toledo, O.—Bids are wanted April 17 for a 24-in. cylindrical brick sewer and a 15-in. cylindrical pipe sewer. Wm. O. Holst, City Clk.

Logansport, Ind.—Bids are wanted May 1 for 22,504 ft. of 8 to 24-in. vitrified pipe and 7,273 ft. of brick sewers. Austin D. Fansler, City Clk.

Dayton, O.—Bids are wanted April 20 for sanitary sewers and storm water sewers, catch basins, etc., in several streets. J. L. Baker, Pres. Bd. City Affairs.

Lexington, Ky.—The Council is considering the matter of issuing $50,000 bonds for the construction of main sanitary sewers. The proposition will probably be submitted to a vote of the people.

Washington, Ga.—See "Water."

Fayetteville, N. C.—The citizens are reported to have voted to issue $15,000 for an electric light plant and $6,000 for a sewerage system.

Taunton, Mass.—Bids are wanted April 17 for 6,500 ft. of 8, 10 and 24-in. sewers. Geo. A. King, City Engr.

Detroit, Mich.—Bids are wanted April 17 for vitrified crock lateral sewers in several alleys. D. W. H. Moreland, Pres. Bd. Pub. Wks.

Cambridge, O.—It is stated that bids are wanted April 20 for sewers. O. M. Hoge, City Engr.

Birmingham, Ala.—Bids are wanted April 19 for storm and sanitary sewers; also for macadamizing. Julian Kendrick, City Engr.

Buffalo, N. Y.—The Board of Public Works recommended that the contract for constructing a brick and tile sewer in Hopkins and adjacent streets be awarded to John Harrer of Buffalo, at his bid of $25,000.

Cranston, R. I.—An appropriation of $20,000 has been voted to provide for the drainage of a portion of the town.

Washington, D. C.—The following bids for the construction of sewers "A" and "B" were opened April 8 by the District Commissioners: a, excavation; b, brick masonry; c, 21-in. pipe; d, 18-in. pipe; e, 12-in. pipe; f, 10-in. pipe; E. G. Gummel, a, 49c.; b, $9.50; c, 59c.; d, 52c.; e, 42c.; f, 40c.; J. P. Larguey, a, 60c. and 43c.; b, $8.75; c, 65c.; d, 55c.; e, 37c.; f, 32c.; A. McCandlish, a, 48c. and 40c.; b, $8.50; c, 47c. and 50c.; d, 37c. and 43c.; e, 33c. and 30c.; f, 26c.

Bidders all of Washington.

BRIDGES.

Hartford, Conn.—Press reports state that bids will soon be asked by the Bridge Commissioners for a stone or steel bridge on East Hartford causeway.

Redcliff, Colo.—A bill has passed third reading in the Senate, appropriating $5,000 for a bridge across Grand river.

Northampton, Mass.—The Engineers of the Northampton and Amherst R. R. estimate the cost of rebuilding the Hadley bridge at $39,000.

Addyston, O.—County Engineer Krug estimates the cost of repairing the iron bridge over the west fork of Muddy Creek at $3,105.

Novelty, Wash.—The County Commissioners have decided to build a steel bridge over the Snoqualmie river.

Concord, Mass.—The following bids were opened April 10 for completing the construction of a system of sewers, as advertised in "The Engineering Record." Leonard Metcalf, Engr., 89 State St., Boston, Mass.:

Items.		T. W. Kinser & Sons, Terra Haute, Ind.	Michael Russo & Co. Boston, Mass.	Sam'l W. Frescoln, Reading, Pa.	Bruno & Salomone, E. Boston, Mass.	Lucian A. Taylor, Boston, Mass.	Frank L. Allen, Worcester, Mass.	Chas. G. Craib, Winthrop, Mass.	C. E. Trumbull & Co., Boston, Mass.
		Rate.	Rate.	Rate	Rate.	Rate.	Rate.	Rate.	Rate
Earth excav. (0-8) c. y.	16,500	$0.43	$0 42	$0.80	$0.65	$0.75	$0 85	$1.25	$1.50
Earth excav. (8-14)	6,400	.59	.65	1.10	1.00	1 25	1.50	1.50	1 50
Earth excav. (14-20)	1,570	.85	2.25	2 00	1.75	1 80	3.00	3.00	3 00
Earth excav. (20-26)	60	1.25	2.00	3 00	2.25	2.40	5.00	3 50	3.00
Refill below grade, c. y	50	1.20	.80	50	1.00	.80	2.00	1 00	1 00
Ledge or bowlders, c. y	50	1.50	6.00	1.00	4 00	5.00	5.00	1.00	2.00
Sewer pipe laying, ft	18,900	.10	.25	.10	.18	.20	40	.25	.25
River crossing, ft. c. i. pipe	421	6.00	4.00	8.00	9.75	6.00	23.00	12 00	12.00
Portland concrete	100	3.50	4.00	3.00	6.00	4.50	4.50	5.00	5 00
Brickwork, c. y	385	10.00	10.00	9 00	12 00	10 50	10.50	11.00	11 00
Macadam, c. y	70	2.00	1 75	1.50	2 00	3 00	2 50	6 00	6 00
Gravel fill, c. y	650	.35	.50	.50	40	.60	.60	.50	.50
Force main, ft	4,700	.40	.70	.20	.30	.38	.45	.75	75
Total		$23,279	$29,515	$34,028	$34,794.25	$36,819.50	$53,490.50	$51,027	$58,172

Cleves, O.—The cost of repairing the bridge over the Miami river is estimated at $3,000.

Omaha, Neb.—The City Engineer is preparing plans for a steel viaduct to be built over the Union Pacific and B. & M. R. R. tracks on 16th St. Length of bridge, 1,500 ft., roadway 40 ft., probable cost $150,000.

Columbia, Tenn.—The County Court has ordered a new steel bridge. Address A. Luther Thomas, Clk.

Macon, Ga.—Press reports state that the City Council has adopted the recommendation of the Board of Public Works to reject all bids received for the iron bridge over the Ocmulgee river, at 5th St.

Toronto, Ont.—The York County Commissioners have approved the plans for a bridge across the Humber, between York and Etobicoke Townships.

Kemblesville, Pa.—The Jury appointed to consider the building of a bridge over the west branch of White Clay Creek, in Franklin Township, have reported in favor of a bridge.

Columbus, O.—Local press reports state that the Cleveland, Cincinnati, Chicago & St. Louis R. R. contemplates the construction of a bridge over Deshler Ave., near Harper road.

Stillwater, Minn.—Press reports state that the Chicago, Milwaukee & St. Paul R. R. will build a bridge across the St. Croix river.

St. Paul, Minn.—The Joint Committee on Streets from the City Council has approved the plans and specifications for widening the south end of the Wabash St. bridge, and recommended that they be approved by the Council.

Portland, Me.—The erection of a bridge from the foot of State St. to the Portland bridge, to take the place of the old Clark St. bridge, is stated to be under consideration. Probable cost, $125,000.

Schenectady, N. Y.—Press reports state that the N. Y. C. & H. R. R. R. will build a bridge across the Mohawk river to connect with the West Shore Line.

Pittsburg, Pa.—According to press reports, 3 steel plate girder spans, to cost about $40,000, are planned by the Pittsburg, Cincinnati, Chicago & St. Louis R. R. for the east end of the Temperanceville viaduct.

Chicago, Ill.—Bids are wanted May 31 by the Sanitary District, for one railroad bridge crossing the Desplaines river in Joliet, as advertised in "The Engineering Record."

Dundee, Mich.—According to press reports the Ann Arbor R. R. Co. is preparing to erect a steel bridge over the Raisin river, to take the place of the wooden structure now in use.

Portsmouth, O.—Plans are being prepared, according to press reports, by the Cincinnati, Portsmouth & Virginia Ry. for a bridge across the canal.

Millville, Mass.—The construction of a bridge to replace the bridge across the Blackstone river at Central St. is stated to be under consideration. Probable cost $6,000.

Syracuse, N. Y.—The City Engineer has been directed to prepare plans and specifications for a steel girder bridge across Onondaga Creek, at West Fayette St.

Buffalo, N. Y.—The sum of $15,000 has been appropriated for the bridge at Seneca St., over the Buffalo river.

Albany, N. Y.—Bids are wanted, April 21, for lift bridges over Erie Canal, in Brighton and Utica; also for steel plate girder bridge over the Erie Canal in Pittsford, and for a steel plate girder bridge over Glens Falls feeder in Sandy Hill, as advertised in "The Engineering Record."

Chicago, Ill.—Bids are wanted, April 26, (change of date), by the Sanitary District of Chicago for a railroad bridge across the Chicago river, near Taylor St.; also a bridge for Taylor St., across the Chicago river, as advertised in "The Engineering Record."

Toronto, Ont.—Bids are wanted April 24 for putting in falsework and taking down the present Eastern Ave. bridge and pile supports, also for new concrete and stone abutments. John Shaw (Mayor), Chmn. Bd. of Control.

Randolph, Utah.—Press reports state that the County Commissioners invite bids for a steel bridge across Bear River, near Oak Bridge Crossing. John Kennedy, Chmn. Co. Commrs.

Little Rock, Ark.—Press reports state that McGee, Kahmann & Co., Kansas City, Mo., have received the contract from the Choctaw & Memphis R. R. to build a $200,000 bridge across the Arkansas river.

Bradford, Pa.—Press reports state that bids are wanted for a steel truss bridge. Estimated to cost $5,000. P. B. Winfree, City Engr.

Pittsburg, Pa.—Bids are wanted April 21 for rebuilding Main St. bridge across Saw Mill Run. Edw. M. Bigelow, Dir. Dept. Pub. Wks.

Columbus, O.—Local press reports state that the County Commissioners have awarded contracts for the Winchester bridge over Big Walnut creek as follows: Substructure to J. A. Swingle & Co. for $9,384; superstructure to New Columbus Bridge Co., Columbus, O., for $9,394, and approaches to C. C. Swisher at $3,230.

Smithton, Pa.—The County Commissioners have under consideration the construction of a bridge across the Yonghiogheny river.

Bay City, Mich.—Bids are wanted April 22 for reconstructing the swing span over west channel of Saginaw river at Cass Ave.; also for paving west approach to 3d St. bridge. John H. Bloomshield, Engr. Bay County Bridge Com.

Williamsport, Pa.—Lycoming County will rebuild 6 iron bridges, longest span 175 ft.

Iowa City, Ia.—Local press reports state that an agreement has been made between the city and the Chicago & Rock Island R. R. for the erection of a viaduct across its tracks at Dodge St., the city to build the approaches.

PAVING AND ROADMAKING.

Boston, Mass.—City Engineer Jackson has received the following bids for paving, with granite block, the roadway of the new bridge on Summer St. extension across Fort Point Channel: Bell & Co., $11,119; James Doherty & Co., $11,392; Patrick McGovern, $9,740; H. Gore & Co., $10,479.15; Daniel Lynch, $11,000; Coleman Brothers, $11,600; James Lahey, $11,930.

Williamsport, Pa.—Mayor Williams recommends the repaving of as many of the streets, reported by the City Engineer in a poor condition, as funds can be obtained for. Total length of proposed paving, 29,496 sq. yds.

Syracuse, N. Y.—The City Engineer has been directed to prepare a new set of plans and specifications for repaving East Genesee St. with asphalt, asphaltina, brick or sandstone block, 5-year maintenance guarantee to be required.

Ashland, O.—E. B. Westover, City Clk., writes that petitions have been received and favorably reported, for about 4,000 yds, of brick paving.

Utica, N. Y.—A correspondent writes that bids will soon be asked for asphalt paving on a number of streets.

New Paltz, N. Y.—The New Paltz Turnpike Co. has been reorganized with a capital of $14,000. Directors: D. A. Hasbrouck and Charles M. Harcourt, New Paltz; C. W. H. Arnold and Alexander Dow, Poughkeepsie.

Shelby, O.—J. B. Weddell of Mansfield, O., Engr. in charge, writes that contracts will be let early in the summer for over 2 miles of paving. Estimated cost, $40,000.

Bradford, Pa.—Bids are wanted May 1 for paving Elm St. with brick, as advertised in "The Engineering Record."

Greenville, Pa.—Bids are wanted April 25 for grading, curbing and paving with brick, a distance of about 4,427 lin. ft., as advertised in "The Engineering Record."

Saginaw, Mich.—The City Engineer has been instructed to prepare plans for the proposed 5th St. brick pavement, which is to be 24 ft. wide.

Chicago, Ill.—Bids are wanted April 19 for asphalt, macadam, granite and cedar block pavement in several streets. L. E. McGann, Pres. Bd. Local Improvements.

Scranton, Pa.—According to local press reports 4 miles of new pavement will be laid this summer. Total cost, $171,559.

Winnipeg, Man.—Local press reports state that the following bids were received for furnishing 330 tons of asphalt: Warren Chemical and Manufacturing Co., New York City, $11,896.70; California Asphalting Co., Pittsburg, Pa., $13,332; Sicilian Asphalt Paving Co., New York City, $13,794.

Cincinnati, O.—Local press reports state that matters are now ready for the advertising for bids for paving Spring Grove Ave. with asphalt. Estimated cost, $123,000.

Niagara Falls, N. Y.—Walter Jones, City Engr., writes that resolutions have been adopted declaring the intention of the Council to pave Pine Ave. with asphalt, cost not to exceed $49,856.

Shamokin, Pa.—Press reports state that bids are wanted by the Chief Burgess April 20 for paving Shamokin St.

Houston, Tex.—Bids are wanted April 24 for macadam, brick or asphalt pavement on Houston Ave., also for gravel, brick or asphalt pavement on several streets. I. Austin Miller, City Engr.

Harriman, Tenn.—The proposition to issue $200,000 bonds for building county roads, will be submitted to a vote of the people.

Camden, N. J.—Street repaving bonds to the amount of $50,000 have been sold recently.

Champaign, Ill.—The Board of Improvements has passed a resolution to improve several streets and alleys. Estimated cost, $45,000.

Battle Creek, Mich.—Press reports state that the city has been authorized to issue $50,000 paving bonds.

Elizabeth, N. J.—The City Council has given notice of its intention to order paved a number of streets, brick and asphalt to be used. The ordinance has been passed providing for the use of $50,000 for street improvements.

Fort Wayne, Ind.—An ordinance has been passed appropriating $15,000 to be used to pay the city's portion of new street intersections.

Salem, O.—Bonds to the amount of $144,500 were sold April 10 for paving and sewer work.

Denver, Colo.—The late Legislature has passed a bill appropriating $35,000 for the construction of a state road extending from Denver to Buena Vista and thence to Grand Junction.

Ithaca, N. Y.—An appropriation of $15,000 has been voted for brick paving this year.

Kansas City, Mo.—Bids are wanted April 18 for asphalt pavement on Elm St. Henry A. Wise, City Engr.

Boston, Mass.—Bids are wanted April 24 for surfacing and other work on Revere beach parkway and Eliot circle, Revere. William B. De Las Casas, Chmn. Metropolitan Park Com.

Jersey City, N. J.—Bids are wanted April 18 for 22,723 sq. yds. of Belgian paving and 387 sq. yds. repaving on 16th St. and West Side Ave. Geo. T. Bouton, Clk. Bd. Street & Water Commrs.

Solvay, N. Y.—A petition proposing the pavement of Milton Ave. for a distance of two miles is being circulated among the taxpayers.

Bloomfield, N. J.—Township Clerk Johnson writes that it was voted April 11 to issue $75,000 bonds for macadamizing.

Cincinnati, O.—Bids are wanted May 3 for keeping in repair for 5 years streets which have been improved with asphalt. A. B. Rattermann, Pres. Bd. City Affairs.

Brockton, Mass.—Governor Wolcott has signed the bill authorizing the issue of $100,000 bonds to be expended in permanent road improvements. The sum of $60,000 will probably be borrowed this year.

Nazareth, Pa.—Bids are wanted April 22 for the construction of ½ mile regulation race track, as advertised in "The Engineering Record."

Somerville, Mass.—An appropriation of $15,000 has been made for the paving of a portion of Tufts St. and Davis Sq.

Elkhart, Ind.—Press reports state that over a mile of asphalt pavement is to be laid.

Geneva, N. Y.—According to press reports the contract for paving Seneca, Exchange and Linden Sts. has been awarded the Barber Asphalt Paving Co. of New York City, at $1.75 per sq. yd.

Benton Harbor, Mich.—Bids are wanted April 17 for paving Pipestone St. R. P. Chaddock, City Clk.

Boston, Mass.—Bids are wanted April 18 for macadamizing Amory and Chester Sts. and Orkney road. Benj. W. Wells, Supt. of Sts.

Birmingham, Ala.—See "Sewerage and Sewage Disposal."

Denver, Colo.—The Board of Public Works has been petitioned to grade, curb and pave 8th Ave. with asphaltum. Estimated cost, $56,050.

Elwood, Ind.—It is stated that bids are wanted April 17 for 12,000 sq. yds. of paving. John Finan, Jr., City Engr.

Paterson, N. J.—Bids are wanted April 21 for grading and macadamizing Great Notch road. Edw. N. Kevitt, Dir. Bd. Chosen Freeholders.

Rockport, Ind.—It is stated that bids are wanted April 21 for macadamizing about 12 miles of road. John G. Rimstidt, Co. Aud.

Des Moines, Ia.—The following bids were opened April 10 by G. A. Eberhart, Chmn. Bd. of Pub. Wks., for brick paving on 6 in. of concrete foundation, with Portland cement filler: a, 27th St., 2,660 sq. yds.; b, alleys, 2,750 sq. yds. The prices given are per sq. yd. for paving, with the use of gravel, stone and tile concrete, respectively:

O. P. Herrick, a, $1.15⅞, $1.24⅞, $1.19⅞; b, $1.14⅞, $1.23⅞, 1.18⅞.

Iowa Brick Co., a, $1.24, $1.30, $1.28; b, $1.30, $1.35, $1.33.

Ilkes Improvement Co., b, $1.09, $1.22, $1.22.

Bidders all of Des Moines.

Boston, Mass.—The following bids were opened April 4 by the Metropolitan Water Board for surfacing a highway in Clinton and Boylston with broken stone, as advertised in "The Engineering Record." Section 1, indicated by a, is 8,275 ft. long and will require 5,800 tons of broken stone; section 2, indicated by b, is 7,450 ft. long and will require 5,600 tons of broken stone. The figures given are, respectively, price per lin. ft. for surfacing, price per ton for broken stone in place, and total amount of bid:

Newell & Snowling Cons. Co., Uxbridge, Mass., a, 7 cts, $1.90, *$11,599; b, 11 cts, $1.90, $11,459.

Asa Goddard, Worcester, Mass., a, 12½ cts, $1.90, $12,054; b, 13 cts, $1.80, $11,048.

A. J. Wellington, Newton, Mass., a, 15 cts, $1.90, $12,261; b, 15 cts, $1.80, *$11,197.

M. Murphy & Co., Clinton, Mass., a, 20 cts, $1.90, $12,675; b, 20 cts, $1.95, $12,410.

T. H. Gill, Somerville, Mass., a, 17 cts, $1.95, $12,716; b, 17 cts, $1.95, $12,186.

Coleman Bros., Charlestown, Mass., a, 29 cts, $1.85, $13,129; b, 28 cts, $1.85, $12,446.

*Contract awarded.

POWER PLANTS GAS AND ELECTRICITY.

Nanticoke, Pa.—Bids are wanted April 25 for electric street lighting, as advertised in "The Engineering Record."

La Crosse, Wis.—The Council is stated to have granted a franchise to the Edison Light & Power Co., to put in a hot-water heating plant to be run in connection with its lighting plant. About 3 miles of mains will be laid this season.

Owatonna, Minn.—John I. Willson is stated to have purchased the electric light plant, and will make some improvements.

Cleveland, O.—Bids are wanted May 10 for 2,200 70 c. p. incandescent vapor lamps for one year. Geo. R. Warden, Dir. Pub. Wks.

Nashville, Tenn.—The House is stated to have passed a bill authorizing the Governor to establish an electric light plant to light the capitol and grounds.

Tazewell, Va.—J. M. Spotts writes that the matter of constructing an electric light plant is under consideration.

Columbus, Wis.—The citizens are stated to have voted to issue $10,000 bonds for an electric light plant.

St. Cloud, Minn.—The Benton Power & Traction Co. is stated to have petitioned the Council for a franchise to furnish electric light and power. C. M. Hertig, Pres.

Grand Junction, Ia.—The Grand Junction Light, Heat & Power Co. is stated to have purchased the electric light system. A new set of arc lights will be put in and other changes made.

Bedford, Ind.—W. C. Tompson of Chicago is stated to have received a franchise to construct a gas plant.

Frankfort, Ky.—Prof. Sturtevant of the State A. and M. College is stated to have received the contract for an electric plant for the State Penitentiary, to cost about $3,000.

Philmont, N. Y.—The Philmont & Claverack Electric Light & Power Co. has been incorporated; capital, $10,000. Directors: Harry Bates Rensselaer, F. G. Simmons, Hudson; D. H. Denison, Berlin, and others.

Le Roy, Minn.—D. Bosworth and A. Dehley are stated to have purchased the electric light system being installed by H. E. Johnson. They will shortly erect a power station.

Havre de Grace, Md.—John H. Record, Pres. Record Mfg. Co., of Belair, Md., is said to be considering the matter of lighting this place by electricity.

Columbus, O.—A charter has been granted to the Washington Incandescent Light Co., with a capital of $75,000. Incorporators: L. B. Archer, Wm. Z. McDonald and others.

Elroy, Wis.—The electric light question is stated to have carried at the election April 3.

Laconia, N. H.—S. C. Frye, City Clk., writes that a five-year contract has been made with the Laconia Electric Light Co. for lighting the streets with 83 open arc lights of 2,000 c. p., with the privilege of substituting 1,200 c. p. enclosed arc lamps. Price $75 per light per year.

Bloomfield, Ind.—See "Water."

Guttenberg, N. J.—The North River Heat, Light & Power Co. is stated to have received a franchise to erect poles and string wires.

Wausau, Wis.—The citizens are stated to have voted, April 3, in favor of municipal ownership of the electric light plant.

Waterloo, Ia.—The Citizens' Light, Heat & Power Co. is stated to have received a franchise to construct a plant. C. W. Mullan, Pres.

West Springfield, Mass.—It is stated that at the annual town meeting, April 3, it was voted to establish a municipal electric lighting plant.

Milford, Ind.—See "Water."

Santa Monica, Cal.—The Santa Monica Electric Power Co. is reported to be making arrangements to put in a new electric and gas plant to cost about $50,000.

Linneus, Mo.—It is stated that an electric light plant will be constructed.

Russell, Ky.—There is talk of constructing an electric light plant.

Iowa Falls, Ia.—The Electric Light & Power Co. is stated to have received a franchise for a heating plant.

Monroe, O.—The citizens are stated to have voted in favor of a municipal electric light plant.

Mayville, N. D.—See "Water."

Mechanicsville, Ia.—O. H. Helmer is said to be interested in the matter of installing an electric light plant.

Galesburg, Ill.—The Galesburg Electric Light & Gas Co. is stated to have decided to install an electric light plant. Fred Seacord, Secy.

Charleston, S. C.—See "Government Work."

Elizabethtown, Ky.—R. G. Phillip is stated to have received a franchise for an electric light plant.

Washington, Ga.—See "Water."

Galt, Ont.—Bids are wanted May 10 for installing, maintaining and operating an arc and incandescent lighting system. J. H. Scott, Chmn. Market, Fire & Light Com.

Fayetteville, N. C.—See "Sewerage and Sewage Disposal."

Dyer, Tenn.—The Dyer Machine Co. is said to be making arrangements to put in an electric light plant.

Belgrade, Minn.—See "Water."

New York, N. Y.—Bids are wanted April 24 for an electric light plant in school No. 173, Bronx Borough. Richard H. Adams, Chmn. Com. on Bldgs.

Florence, Ala.—It is stated that bids are wanted May 2 for lighting the city with electricity or gas for a period of 5 or 10 years.

Prineville, Ore.—It is stated that bids are wanted June 1 for a plant of 600 16 c. p. incandescent light capacity, to cost $25,000. Address H. V. Gates, Elgin, Ore.

Winnipeg, Man.—The citizens are stated to have voted, April 6, to construct a $60,000 municipal light plant. C. J. Brown, City Clk.

Haddonfield, N. J.—The citizens of Hudson Township are stated to have voted to appropriate $2,000 for electric lighting.

ELECTRIC RAILWAYS.

Corsicana, Tex.—Wm. G. Baker, of Corsicana, and E. N. Cullom, of Birmingham, Ala., are stated to have applied for a franchise.

Chillicothe, O.—The Chillicothe, Mt. Sterling & Columbus Ry. Lighting & Power Co. is stated to have been formed, to construct a line to Clarksburg, New Holland, Mt. Sterling and Morgan Station, to connect with an electric road to Columbus. Incorporators: John C. Entrekin, Chillicothe; O. M. Howser, Clarksburg; W. C. Bostwick, Mt. Sterling, and others.

Woodbury, Conn.—E. S. Boyd of Woodbury is interested in the construction of 22 miles of electric railway to be built by the Southbury & Woodbury Electric Railway Co., at an estimated cost of $250,000. C. S. Lambert, of New Haven, is the Engr. in Charge.

Jackson, Mich.—The Adrian & Jackson Electric Ry. Co. has received a franchise. H. C. Smith, of Adrian, and Chas. E. Townsend, of Jackson, are among the incorporators.

Lexington, Ky.—Dr. David Bennett, Pres. Exchange Nat. Bank, is said to be interested in the construction of an electric railway between Lexington and Richmond, Ky.

Rockville Center, N. Y.—The Nassau Belt Line Traction Co. is reported to have been incorporated to build and operate a street railroad from Mineola to Long Beach; capital, $300,000. P. K. Ames, Pres., Rockville Center; H. L. Nichols, Secy., Hempstead.

Westfield, Mass.—The Woronoco St. Ry. Co. is stated to have petitioned for a franchise through Main St. and the Springfield highway to the West Springfield town line.

Dayton, O.—The County Commissioners are stated to have granted a franchise to the Dayton & Germantown Traction Co.

Bethlehem, Pa.—The Bethlehem & Nazareth Passenger Ry. Co. has received a franchise. Mr. McKee, Pres.

Delhi, O.—The Cincinnati & Aurora Electric R. R. Co. is stated to have received a franchise in this place and Cleves.

Iowa City, Ia.—Geo. W. Koontz, S. W. Mercer and others of Iowa City are stated to have applied for a franchise.

Rockville, Md.—The Council is stated to have granted a franchise to Maurice Talbott, representing a railway company which proposes to build an electric railway from Bethesda Park to Rockville.

Galion, O.—The Ohio Central Traction Co. has been incorporated with a capital of $225,000 to build and operate an electric railroad between Galion, Bucyrus and Crestline. Incorporators: Israel A. Kelsly, Dennis A. Blakeslee, W. E. Haycox and others.

Indianapolis, Ind.—The Indianapolis St. Ry. Co. has received a 34-year franchise. Hiram P. Wasson, Pres.; Dr. Jameson, Secy.

Sandusky, O.—It is stated that the Sandusky & Interurban Electric Ry. Co. will construct a power house 60x120 ft. and car barn 50x250 ft. and a boiler house 50x120 ft.

Erie, Pa.—The Detroit Construction Co., of Detroit, Mich., is stated to have received the contract for constructing an electric line for the Erie Transit Co. from Erie to Cambridge, a distance of about 27 miles.

Marietta, Ga.—The Collins Park & Belt R. R. Co. is stated to have received a franchise.

Steubenville, O.—J. C. McSpadden, a railroad contractor of Pittsburg, Pa., is stated to have petitioned the County Commissioners for a franchise.

Stillwater, Minn.—Bids are wanted April 20 for grading, masonry and bridge work on about 8 miles of lectric railroad, main line and sidings, betwen Stillwater and Wildwood. Address The Twin City Rapid Transit Co., Minneapolis, Minn.

Dedham, Mass.—It is stated that the Needham & Boston St. Ry. Co. will construct a line through this place.

Goshen, Ind.—The Indiana Ry. Co. is said to have in contemplation the extension of its line from Goshen to Lake Wawasee, a distance of about 15 miles.

RAILROADS.

Kansas City, Mo.—The Kansas City, Omaha & Northern Ry. Co. has been incorporated to construct an air line from Kansas City to Omaha via St. Joseph, Savanna and Tarkio, Mo.; capital, $2,500,000. Incorporators: J. H. Pickering, Kansas City, Mo.; David Rankin, Tarkio, Mo.; C. D. Zook, Oregon, Mo., and others.

Pueblo, Col.—A contract for grading and lumber bridge work for 55 miles of railroad on the Kansas, Oklahoma City & Southwestern branch of the Santa Fe system has been awarded to the Shutt Improvement Co., of Pueblo.

Waynesboro, Miss.—It is stated that the Waynesboro, Gulf Coast & Pascagoula R. R. Co. proposes to build its line to the Gulf of Mexico at Scranton, Miss., Waynesboro being the northern terminus. The road will be 107 miles long. J. H. Pitts, Pres., Waynesboro.

Santiago, Chile.—Press reports state that bids are invited until May 15 for the building of important railroads in the south, to unite Valdivia with the main line.

Charleston, W. Va.—The West Virginia & Southern Railroad, which operates a short line from Brownstone through this county to the Boone County line, is reported to be preparing to extend its road to Racine, W. Va.

Chicago, Ill.—C. E. Loss & Co., general contractors, Pullman Bldg., Chicago, will sublet contracts for portions of 50 miles of railroad, about 1,500,000 cu. yds. earth, and 1,000,000 ft. bridging and culvert, between Houghton and Greenland, Mich., on the Copper Range R. R.

Galveston, Tex.—A charter has been granted to the Galveston, Houston & Northern R. R. Co. for a railroad from Houston to Galveston, a distance of 60 miles; capital, $500,000. Incorporators: Chas. S. Broadhead, Delacy Chandler and others.

PUBLIC BUILDINGS.

(See also Schools and Government Work.)

Augusta, Me.—Bids are wanted April 20 for enlarging and making repairs to boiler house and steam plant at the State Capitol. E. C. Stevens, Supt.

Carthage, O.—Bids are wanted April 29 for iron, steel, brick, stone masonry, fireproofing and other work on a building for Longview Hospital. Chas. H. Smith, Secy. Bd. Directors of Longview Hospital.

Louisville, Ky.—The Free Masons propose to erect a $100,000 building as a home for aged and indigent members. Plans expected to be ready May 12. J. E. Wilhelm, Grand Master.

Southbridge, Mass.—It is stated that $16,000 has been voted for an engine house.

Fairmont, Minn.—Bids are wanted May 3 for a jail. A. H. True, Co. Aud.

Wilkesbarre, Pa.—The plans of Fredk. J. Osterling of Pittsburg have been accepted for the court house; probable cost, $450,000.

Kansas City, Mo.—Van Brunt & Howe of Kansas City have prepared plans for a free public bath, to be built by the city.

San Francisco, Cal.—The Supervisors are stated to have passed a resolution to appropriate about $300,000 for a new hospital.

Sacramento, Cal.—The Legislature is stated to have appropriated $40,000 for building a wing at the Southern California State Hospital.

Mineola, (L. I.), N. Y.—The plans of Preston B. Seaman of Long Island City are stated to have been accepted for the $100,000 court house.

Boston, Mass.—Keeley & Houghton of New York City have prepared plans for an $80,000 brick R. C. church, to be erected on Columbus road, Dorchester. N. J. Fitzgerald of Boston is the builder.

Allegheny, Pa.—There is talk of erecting a $300,000 city hall.

Fall River, Mass.—Bristol County is about to erect a $10,000 jail. Louis G. Destremps, Archt., Fall River.

Topeka, Kan.—The citizens have voted to issue bonds to build a city hall and auditorium; probable cost, $100,000.

Iowa City, Ia.—The Supervisors are stated to have accepted the plans of Rush, Bowman & Rush of Grand Rapids, Mich., for the court house, to cost $80,000, and the plans of the Cincinnati Steel & Iron Co. of Cincinnati for the jail, to cost $10,000.

Spartansburg, S. C.—Bids are wanted May 2 for a church. A. H. Twichell, Chmn. Com. First Presbyterian Church.

Atlantic City, N. J.—The City Council on April 10 passed an ordinance providing for the erection of a new city hall.

Lake City, Minn.—Bids are wanted May 1 for a city hall. G. D. Post, Mayor.

Houston, Tex.—Plans are stated to have been completed and contracts will soon be let for the erection of a $25,000 edifice for the First German Evangelical Lutheran Church. Rev. W. Blasberg, Pastor.

Fort Dodge, Ia.—The Webster County Supervisors are stated to have decided to submit to the vote of the people the question of erecting a $100,000 court house.

Arthur, N. D.—Bids are wanted April 25 for a town hall. Walter Phillipe, Town Clk.

Blackwood, N. J.—The Asylum Committee of the Camden County Board of Freeholders is said to be considering plans for improving the insane asylum here at a probable cost of $40,000.

Sycamore, Ill.—It is stated that bids are wanted April 20 for a church. L. L. Cloyd, Chmn. Bldg Com.

Somerville, Mass.—$15,000 has been appropriated for an addition to the public library.

Atlantic City, N. J.—It is stated that the congregation of the St. Nicholas R. C. church will erect a new edifice, at a probable cost of $125,000.

Oberlin, O.—Howard V. Shaw, of Chicago, is stated to have prepared plans for a chemical laboratory for Oberlin College; probable cost, $50,000.

Taunton, Mass.—Bids are wanted April 21 for a fire and police station. N. J. W. Fish, Chmn. Com.

North Branch, Minn.—Bids are wanted April 18 for a town hall. Charles A. Holt, Village Recorder.

Newport, R. I.—The contract for erecting the city hall has been awarded as follows: For the building, R. W. Curry, of Newport, $72,052; ventilating and heating, Lynch & Sullivan, $4,300; wiring and gas piping, Scannevan & Potter, $1,085; and plumbing, Joseph Haire, of Newport, at $3,497.

Jersey City, N. J.—The following bids are stated to have been opened by the Free Library Trustees, April 10, for the new library:

For entire work—Norcross Bros., 160 5th ave., N. Y., $208,191; H. Probst, 1180 B'way, N. Y., $214,500; John T. Rowland & Son, Jersey City, $217,118; P. J. Carlin & Co., Brooklyn, $218,000; M. T. Connolly, Jersey City, $222,649; Robertson & Son, Jersey City, $224,498; Jewkes & Son, Jersey City, $224,990; Alexander Whan, $228,995; Joseph B. Smith, $233,000.

Mason work—Joseph H. Cutley, Jersey City, $33,972; M. T. Connolly, $36,649; Alexander Whan, $42,830; Richard English, excavating, masonry, etc., $48,292; masonry and plastering, $46,717.

Carpentering—Joseph A. Churchyard, $25,400; Barr & Danielson, $29,856; Joseph Jewkes & Son, $31,912; John Keenan, $37,750; A. J. Dittmar & Son, Jersey City, $37,988.

Mosaic work—Adolph Grant, $1,440.

Granite, marble and slate—Thos. Couch, $40,850; setting, $500; J. Dickson & Bro., Jersey City, $44,500 to $46,150.

Vault linings—Steffel & Truman, $575.

Ventilating and heating—Albert Krummert, three bids, $14,240.80, $14,028.80 and $14,265.80; E. Rutzler, New York City, $21,681; Walker & Chambers, $22,000; Armstrong, Potter & Co., $22,000; Wallace & Carey, 131 4th ave., N. Y., $22,136; Gillis & Geoghegan, 539 W. B'way, N. Y., $22,400; Joseph Cam Mfg. Co., $22,591; Henry T. Murphy & Co., $22,800; G. A. Suter, N. Y. City, $22,820; Black & Williams, $22,989; Tranes Bros. & Jellett, $23,300; Edward Joy, Syracuse, N. Y., $23,985; Frank Dobson, $25,339; F. R. Schroeder, $27,883.83; Joseph C. Duff, $28,768.

Plumbing—Fergus Kelleher, Jersey City, $10,100; Joseph C. Duff, Jersey City, $10,187; Edward Joy, $10,250.

Roofing, etc.—A. J. Ellis & Co., 149 W. 28th st., N. Y., $7,499; National Sheet Metal Roofing Co., Jersey City, $7,873.

Plastering—John Egan, $10,700; Joseph Flitch, $10,971.

Ornamented Iron Work—Ornamentation Iron Works Co., $7,649; Brown & Ketcham, Indianapolis, $10,900; Fagan Iron Works, $18,215; Cooper & Wegand, $27,627.

BUSINESS BUILDINGS.

San Antonio, Tex.—A correspondent writes that bids will soon be asked for an iron and brick market house, 300x129 ft. Alfred Giles, Archt.

Boston, Mass.—Plans have been prepared by Arthur H. Bowditch, 112 Water St., for an 11-story building for the Terminal Hotel Co., to be erected on Atlantic Ave. Estimated cost, $400,000.

Philadelphia, Pa.—Lewis Havens, Girard Bldg., has received the contract for a 2-story addition to the mill at 24th and Hamilton Sts., for E. H. Godshalk. Cost, $28,000.

Lewis Havens, Girard Bldg., will erect a corrugated iron extension, 125x200 ft., to the coal shed of the United Gas Improvement Co. at Point Breeze Gas Works. Cost, $40,000.

Saginaw, Mich.—A correspondent writes that it was recently voted to bond to the amount of $35,000 for two markets.

Fall River, Mass.—John Westwood has prepared plans for a $35,000 business block to be erected by Q. Leary, on Hartwell St.

Rochester, N. Y.—Geo. W. Sweeney of the Lexington Hotel is said to be interested in the erection of a 6-story hotel.

East St. Louis, Ill.—It is stated that F. H. Judson will build a 3-story business building on Broadway and 11th St., to cost about $50,000.

Camden, N. J.—Geo. Bachman, 19 Arlington St., Dudley, P. O., Camden, is stated to have received the contract for a bank building for the Central Trust & Safe Deposit Co., at $40,000.

Vinton, Ia.—It is stated that the Burlington, Cedar Rapids & Northern Ry. Co. will erect a $20,000 depot. C. J. Ives, Pres., Cedar Rapids.

Minneapolis, Minn.—It is stated that plans are being drawn and figures are being considered for a building on Nicollet Ave., for W. K. Morrison & Co., hardware stock, to cost about $200,000.

Richmond, Va.—The Chesapeake & Ohio and the Seaboard Air Line are stated to have reached an agreement to build a union passenger station in Richmond. Work will begin as soon as privileges are granted. G. W. Stevens, Mgr. Chesapeake & Ohio R. R., Richmond.

Atlanta, Ga.—Plans for the proposed union station prepared jointly by H. T. McDaniel of Cincinnati, E. L. Corthell and D. Adler of Chicago, are stated to have been completed. The Louisville and Nashville and Southern railways are reported to be interested.

Charleston, S. C.—Plans have been prepared by A. Todd for a $75,000 hotel to be built at the "Isle of Palms," 7 miles from Charleston.

A correspondent writes that there is talk of building a $250,000 union depot.

Scranton, Pa.—The Rutledge Brewing Co. proposes to build a $30,000 brick brewery plant at Green Ridge. I. L. Williams, Archt., Scranton.

West Superior, Wis.—Schmidt Bros., of West Superior, Wis., are stated to have received the contract for the foundation of the grain elevator for the Great Northern Ry. Co. The elevator is to be located here. It will be built of steel and cost about $2,000,000.

Denver, Colo.—The citizens have voted to erect an auditorium to cost about $400,000.

Des Moines, Ia.—Chas. Weitz of Des Moines is stated to have received the contract for the erecting the Younker building on West 7th and Walnut sts.; probable cost $100,000.

Monticello, Ia.—It is stated that bids are wanted April 25 for a business and office building. Nercott & Donnan, Archts., Independence, Ia.

Grand Rapids, Mich.—The Directors of the Grand Rapids & Indiana R. R. Co. are stated to have decided to erect a $75,000 union depot.

NEW YORK CITY.

Permits for the following buildings have been issued; o, signifies owner; a, architect; b, builder, and c, contractor.

152 Madison st, br store & tenem't, cost $25,000; o, L. Kaufmann; a, Schneider & Herter.

379 & 379½ Grand st, br stores & tenem't, cost $25,000; o, Weil & Mayer; a, Schneider & Herter.

20 & 22 Mangin st, br store & tenem't, cost $25,000; o, L. Kaufmann; a, Schneider & Herter.

Grand & Essex sts, br stores and tenem't, cost $30,000; o, L. Kaufmann; a, Schneider & Herter.

544 & 546 East 13th st, br stores & tenem't, cost, $30,000; o, Weil & Mayer; a, Schneider & Herter

59 University pl, 34 East 12th st, br stores & loft, cost $150,000; o, James Stanley; a, Wm C Hazlett.

152 to 156 Monroe st, 3 br stores & flats, cost $65,000 all; o, Wm Sugarman; a, M Bernstein.

19 Rutgers pl, br stores & flat, cost $25,000; o, Max Hyman; a, Horenburger & Straub.

Grand & Suffolk sts, 3 br stores & flats, cost $85,000 all; o, Harry Fischel; a, Samuel Sass.

248 East 3d st, br stores & flat, cost $26,000; o, Lippmann & Friedman; a, M Bernstein.

Washington & Laight sts, br warehouse, cost $60,000; o, James Pyle; a, T R Jackson.

46 Oak st, br stores & tenem't, cost $50,000; o, Rebecca Meryash; a, Horenburger & Straub.

Broadway & 10th st, br store & loft, cost $65,000; o, Henry Metcalfe; a, Richard Berger.

Lenox ave & 119th st, br store and flat, cost $110,000; o, Zimmermann & Valente; a, G F Pelham.

5th ave & 119th st, 4 br stores & flats, cost $90,000 all; o, Julius & Gus J Fleischman; a, Geo F Pelham.

Amsterdam ave & 147th st, br store & tenem't, cost $22,500; o, Hoel & Mayer; a, Neville & Bagge.

3d & Tremont aves, br offices & stores, cost $25,000; o, James O'Toole; a, John E Kerby.

DWELLINGS.

Galveston, Tex.—W. S. Davis, Jr., is about to erect a $10,000 brick residence on 19th St. and Broadway. N. J. Clayton & Co., Archts.

Houston, Tex.—Olle J. Lorehm has prepared plans for an $18,000 flat to be built by M. Biller.

Williamsport, Pa.—C. S. Horton has received a permit to build a $50,000 apartment house at 4th and S. Campbell Sts. Bennett & Rothrock, Archts.

Boston, Mass.—Benjamin Piscopo is to build a 5-story apartment house at 26, 28 and 30 Fleet St. Fred M. Churchill, Archt., 85 Devonshire St. Estimated cost, $50,000.

Kansas City, Mo.—Root & Siemens, Am. Bank Building, have prepared plans for a $15,000 stone dwelling to be erected by Langston Bacon at Independent and Gladstone Aves.

F. B. Hamilton, Beals Bldg., has prepared plans for a $25,000 brick apartment house to be erected by P. V. Rocco on Independence Ave. Plaza.

Philadelphia, Pa.—Chas. McCaul, 10 N. 11th St., has received the contract for the 4-story stone and brick parochial residence and 2½ story school for the Church of St. John the Evangelist at 13th & Chestnut Sts. Cost, $30,000.

Pittsburg, Pa.—W. D. Henry, Secy. of the Pittsburg Terra Cotta Lumber Co., writes that about $25,000 is to be expended in the construction of residences for the men and that bids will soon be received for same.

Sacramento, Cal.—The State Board of Capitol Commissioners are stated to have selected a site for the governor's new residence, which is to cost $40,000.

Baltimore, Md.—The Mt. Royal Construction Co. is stated to have been formed to erect an apartment house on St. Paul St. and Mt. Royal Ave. John Gill, Pres. Mercantile Trust & Deposit Co., is one of the incorporators.

NEW YORK CITY.

Permits for the following buildings have been issued; o, signifies owner; a, architect; b, builder, and c, contractor.

249 E. 7th St., br flat, cost $20,000; o, L. Frankenthaler, a, Kurtzer & Rohl.

11th st & 6th ave, br flat, cost $90,000; o, Paul B. Pugh & Co.; a, G. A. Schellenger.

10 to 22 Rutgers pl, 7 br tenem'ts, cost $175,000 all; o, Leopold Kaufmann; a, Schneider & Herter.

218 & 220 East 20th st, 2 br flats, cost $45,000 all; o, Mrs. C. A. Pratt; a, Schneider & Herter.

105th st & Madison ave, br flat, cost $23,000; o & b, M. J. Naughton; a, Martin Johnson.

4 East 120th st, br flat, cost $25,000; o, Sahra Weiss; a, O. L. Spannhope.

Madison ave & 94th st, br bachelor apartment, cost $180,000; o, McCracken & Dagnall; a, Neville & Bagge.

108th st & Madison ave, br flat, cost $30,000; o, Weitzer & Evens; a, Schneider & Herter.

Manhattan ave & 117th st, br bachelor apartment, cost $90,000; o, Salvadore Lagrassa; a, Neville & Bagge.

Central Park West & 90th st, br flat, cost $100,000; o, Nathan E. Clarke; a, G. F. Pelham.

8th ave & 117th st, 2 br flats, cost $44,000 all; o, Martin Derkin; a, W C Dickerson.

St. Nicholas ave & 147th st, br flat, cost $90,000; o, Jacob M Wimpie; a, G F Pelham.

137th st & 7th ave, 7 stone dwell'gs, cost $154,000 all; o, William Picken; a, John Hauser.

129th st & Lenox ave, br flat, cost $70,000; o, Robert J Blake; a, G Robinson.

3d & Tremont aves, 2 br flats, cost $40,000; o, James O'Toole; a, John E Kerby.

Jerome ave & 167th st, br flat, cost $30,000; o, Geo W MacAdam, Jr; a, Julius Frank.

Teasdale pl & 3d ave, 2 br flats, $50,000 all; o, E L Mueller; a, Rudolph Werner.

Brook ave & St. Paul's pl, br flat, cost $22,000; o, Geo W Martin; a, J J Vreeland.

Lafontain ave & 180th st, 8 frame dwell'gs, cost $200,000 all; o, Chas A Foss; a, J F Kentana.

NEW INDUSTRIAL PLANTS.

J. W. Scott and associates of Sanford, N. C., will erect an 80x200-ft. cotton mill, with between 4,000 and 5,000 spindles.

The Universal Lock Co. of Woodbine, N. J., is to erect a 34x122-ft. brick addition to its factory 2 stories high.

A. K. Smith and associates, of Smithfield, N. C., are to build a cotton seed oil mill with a capacity of 20 tons.

The Lanett Cotton Mills of West Point, Ga., are to erect a factory building 104x364 feet and 4 stories high, with engine room and boiler house separate; also a 100x200-ft. warehouse. They require a 1,200-H.-P. cross-compound engine and water tube boilers.

Mr. James Taylor of Auburn, Neb., is to erect a 3-story, 30x56-ft. flour mill.

The New York Match Co. of York, Pa., is to build a 60x80-ft. five-story addition to its mill, and will want machinery, a motor, generator, etc.

The Beumont Rice Mills are to enlarge their mills and will require a power plant of 150 H.-P.

The Robinson-Hughes Co. of Louisville, Ky., is erecting a 3-story brick addition, about 60 ft. square, to its plant, and will put in a 150-H.-P. engine.

Rennous, Kleinle & Co. of Baltimore, Md., whose plant was recently destroyed by fire, will rebuild it and will want shafting, pipe, electric wiring, etc.

W. K. Wilson & Co. of Fruithurst, Ala., are erecting a 24x80-ft. canning factory, with a capacity of 3,000 to 6,000 cans per day.

DePue Bros., Holloway, Minn., will put up a grain elevator of about 20,000 bushels capacity and use an 8 H.P. gasoline engine for power.

BUSINESS NOTES.

The Adams Patent Sewage Lift Co., formerly at No. 623 Drexel Building, Philadelphia, reports that its business has increased to such an extent that it has been compelled to move to larger and more convenient offices in the Stephen Girard Building in the same city.

The Turner Engineering Co., Bucyrus, Ohio, is furnishing a 250 H.P. Turner water tube boiler for the Findley Street Railway, two of 200 H. P. for the Central Traction Co., and three of 225 H.P. for the Indianapolis Ice & Cold Storage Co.

A. L. Ide & Sons, Springfield, Ill., report the following recent sales of Ideal engines: City of Fountain City, Wis., one 70 H.P.; Monterey, Mex., Electric Light Co., one 250 H.P. and one 110 H.P. compound engines; Kingan & Co., Indianapolis, one 70 H.P.; Emery, Bird, Thayer Dry Goods Co., Kansas City, one 260 H. P.; the Kuntz-Remmler Co., Chicago, one 45 H. P.; Kingman Plow Co., Peoria, Ill., one 100 H.P.; Janey, Semple, Hill & Co., Minneapolis, one 60 H.P.;Caro, Mich., Light & Power Co., one 300 H.P.; Bonham, Tex., Electric Light Co., one 60 H.P.; F. W. Horne, Yokohama, Japan, one 75 H.P.; Boston Store, Davenport, Ia., one 100 H.P.; Pilgrim Hotel, Marshalltown, Ia., one 60 H.P.; Illinois Central R. R. Co., Chicago, one 80 H.P.; Deadwood & Delaware Smelting Co., Deadwood, S. Dak., one 100 H.P.; Hillman Building, Chicago, one 125 H.P. and one 150 H.P. compound; Illinois State Reformatory, Pontiac, Ill., one 200 H.P.; Lancaster, Wis., Electric Light Co., one 100 H.P.; Kieckhefer Bros., Milwaukee, one 190 H.P.; C. J. Smith & Sons, Milwaukee, one 125 H.P.; Anheuser-Busch Brewing Association, two 125 H.P.; Chicago & Great Western R. R., Oelwein, one 180 H.P. and one 300 H.P.; City of Barnesville, Minn., one 60 H.P.; Empire Zinc Co., Joplin, Mo.,one 150 H.P. and one 100 H.P.; Mississippi River Commission, two 500 H.P. compound; W. J. Lemp Brewing Co., St. Louis, two 100 H.P. and one 60 H.P.

As showing the general trend of business at the present time the Chicago Pneumatic Tool Co. states that in one day it received orders for 158 pneumatic tools, including compressors, drills, hammers and riveters. The company's business for March of this year was the largest in its history, being considerably more than double that of March, 1898.

The Stanwix Engineering Co., Rome, N. Y., designers of the Schenectady water tower described in "The Engineering Record" of April 1, write that the stand-pipe was painted inside and out with Edward Smith & Co.'s Durable Metal Coating. In the article it was stated that the tank was painted inside and out with two coats of black varnish equal to this company's Black Bridge Paint.

PROPOSALS OPEN.

Bids Close — See Eng. Record

WATER-WORKS.

Apr. 17. Lakeport, Cal.... Mar. 25
Adv. Eng. Record, Apr. 1.
Apr. 17. Goshen, Ind.... Apr. 1
Apr. 18. San Carlos, Ariz.... Mar. 25
Apr. 18. Meters, Camden, N. J.... Apr. 1
Apr. 18. Grand Forks, N. D.... Apr. 15
Apr. 19. Chicago, Ill.... Apr. 15
Apr. 19. Butte, Mont.... Mar. 18
Adv., Eng. Record, Mar. 18, 25.
Apr. 19. Baltimore, Md.... Apr. 8
Apr. 20. Greenville, Cal.... Apr. 1
Apr. 20. Air cyl'ders, etc., Montgomery, Ala. Apr. 1
Apr. 20. New York, N. Y.... Apr. 8
Apr. 26. Washington, D. C.... Apr. 1
Apr. 27. Removing reservoir,etc.,New York, N. Y.... Apr. 15
Apr. 28. Cincinnati, O.... Mar. 25
Adv., Eng. Record, Mar. 25 to Apr. 15.
May 1. Cullman, Ala.... Apr. 1
May 8. Pima, A. T.... Apr. 15
May 8. Orange, Cal.... Apr. 15
—— Peekskill, N. Y.... Apr. 15
Adv., Eng. Record, Apr. 15.
—— Napoleonville, La.... Mar. 25
—— Corinth, Miss.... Mar. 25

SEWERAGE AND SEWAGE DISPOSAL.

Apr. 15. Honolulu, H. I.... Feb. 25
Adv., Eng. Record, Feb. 25, Mar. 4.
Apr. 17. Goshen, Ind.... Apr. 1
Apr. 17. Sewickley, Pa.... Apr. 8
Apr. 17. Detroit, Mich.... Apr. 15
Apr. 17. Birmingham, Ala.... Apr. 15
Apr. 17. Taunton, Mass.... Apr. 15
Apr. 17. Toledo, O.... Apr. 15
Apr. 17. St. Paul, Minn.... Apr. 15
Apr. 18. Bayonne, N. J.... Apr. 1
Apr. 18. San Carlos, Ariz.... Mar. 25
Apr. 18. Jersey City, N. J.... Apr. 15
Apr. 20. Greenville, Cal.... Apr. 1
Apr. 20. Dayton, O.... Apr. 15
Apr. 20. Cambridge, O.... Apr. 15
Apr. 21. West Hammond, Ill.... Apr. 15
Apr. 24. South Bend, Ind.... Apr. 8
Apr. 26. Cohoes, N. Y.... Apr. 8
Adv., Eng. Record, Apr. 8.
Apr. 26. Washington, D. C.... Apr. 1
Apr. 27. Atlanta, Ga.... Apr. 8
May 1. Logansport, Ind.... Apr. 15
May 3. Sauk Centre, Minn.... Apr. 1
May 5. Bridgeport, Conn.... Apr. 15
May 8. Elyria, O.... Apr. 8
May 15. Medford, Ore.... Apr. 1
May 20. Auburn, Ind.... Apr. 8

BRIDGES.

Apr. 15. Hartford, Conn.... Mar. 25
Adv., Eng. Record, Mar. 25.
Apr. 21. Albany, N. Y.... Apr. 15
Adv., Eng. Record, Apr. 15.
Apr. 21. Pittsburg, Pa.... Apr. 15
Apr. 22. Bay City, Mich.... Apr. 15
Apr. 23. Raleigh, N. C.... Mar. 18
Apr. 24. Huntington, W. Va.... Apr. 1
Apr. 24. Toronto, Ont.... Apr. 15
Apr. 26. Chicago, Ill.... Apr. 15
Adv., Eng. Record, Apr. 15.
Apr. 27. Washington, D. C.... Apr. 1
Adv., Eng. Record, Apr. 1, 8.
May 10. Chicago, Ill.... Mar. 18
Adv., Eng. Record, Mar. 25.
May 31. Chicago, Ill.... Apr. 8
Adv., Eng. Record, Apr. 15.
—— Quincy, Ill.... Feb. 25
Adv., Eng. Record, Feb. 25.
—— Bradford, Pa.... Apr. 15
—— Randolph, Utah.... Apr. 15

PAVING AND ROADMAKING.

Apr. 15. Petersburg, Va.... Apr. 1
Adv., Eng. Record, Apr. 1.
Apr. 15. Jamestown, N. Y.... Apr. 8
Adv., Eng. Record, Apr. 8.
Apr. 17. Portland, Ind.... Mar. 25
Apr. 17. Risingsun, Ind.... Mar. 25
Apr. 17. Bridgeport, O.... Mar. 25
Apr. 17. Toledo, O.... Mar. 25
Apr. 17. Goshen, Ind.... Apr. 1
Apr. 17. Benton Harbor, Mich.... Apr. 15
Apr. 17. Elwood, Ind.... Apr. 15
Apr. 18. Mt. Vernon, N. Y.... Apr. 1
Apr. 18. Jersey City, N. J.... Apr. 8
Apr. 18. Buffalo, N. Y.... Apr. 8
Apr. 18. St. Louis, Mo.... Apr. 8
Apr. 18. Hammond, Ind.... Apr. 8
Apr. 18. Boston, Mass.... Apr. 15
Apr. 18. Kansas City, Mo.... Apr. 15
Apr. 19. Chicago, Ill.... Apr. 15
Apr. 19. Birmingham, Ala.... Apr. 15
Apr. 20. Shamokin, Pa.... Apr. 15
Apr. 21. St. Louis, Mo.... Apr. 8
Apr. 21. Paterson, N. J.... Apr. 15
Apr. 21. Rockport, Ind.... Apr. 15
Apr. 22. Nazareth, Pa.... Apr. 15
Adv., Eng. Record, Apr. 15.
Apr. 24. Boston, Mass.... Apr. 15
Apr. 24. Houston, Tex.... Apr. 15
Apr. 24. Vanwert, O.... Apr. 8
Apr. 24. Muncie, Ind.... Apr. 8
Apr. 25. Bond Hill, O.... Apr. 1
Apr. 25. Greenville, Pa.... Apr. 15
Adv., Eng. Record, Apr. 15.
Apr. 27. Meriden, Conn.... Apr. 8
Adv., Eng. Record, Apr. 8.
Apr. 28. Bellefontaine, O.... Mar. 25
May 1. Benwood, W. Va.... Apr. 8
May 1. Bradford, Pa.... Apr. 15
Adv., Eng. Record, Apr. 15.
May 3. Cincinnati, O.... Apr. 15
May 4. Fort Wayne, Ind.... Apr. 8

POWER, GAS AND ELECTRICITY

Apr. 17. Winnipeg, Man.... Apr. 8
Apr. 18. San Carlos, Ariz.... Mar. 25
Apr. 18. Carthage, Mo.... Apr. 1
Adv., Eng. Record, Apr. 1, 8.
Apr. 20. Genoa, Neb.... Apr. 1
Apr. 22. Jeffersonville, Ind.... Apr. 8
Apr. 23. Port Louis, Mauritius.... Apr. 1
Apr. 24. New York, N. Y.... Apr. 15
Apr. 25. Nanticoke, Pa.... Apr. 15
Adv., Eng. Record, Apr. 15.
Apr. 27. Mechanicsburg, Pa.... Apr. 8
May 1. Franchise, Santa Ana, Cal.... Apr. 1
May 1. Cullman, Ala.... Apr. 1
May 1. Franchise, Fairfield, Cal.... Mar. 25
May 2. Florence, Ala.... Apr. 15
May 10. Galt, Ont.... Apr. 15
May 10. Cleveland, O.... Apr. 15
May 13. Charleston, S. C.... Apr. 15
May 22. Vincennes, Ind.... Apr. 8
Adv., Eng. Record, Apr. 8.
June 1. Prineville, Ore.... Apr. 15
—— Pleasantville, O.... Dec. 24

GOVERNMENT WORK.

Apr. 17. San Francisco, Cal.... Mar. 11
Adv., Eng. Record, Mar. 11.
Apr. 17. Cement, etc., Duluth, Mich.... Mar. 25
Adv., Eng. Record, Mar. 25 to Apr. 8.
Apr. 17. Plumbing, etc., Richmond, Va.... Apr. 8
Apr. 17. Water heater, Cleveland, O.... Apr. 15
Apr. 18. Chicago, Ill.... Mar. 18
Adv., Eng. Record, Mar. 18 to Apr. 8.
Apr. 21. Dredging, Grand Rapids, Mich.... Apr. 15
Apr. 24. New York City.... Apr. 1
Adv., Eng. Record, Apr. 1 to 15.
Apr. 26. Dredging, New York City.... Apr. 1
Adv., Eng. Record, Apr. 1 to 15.
Apr. 26. Dredging, Cleveland, O.... Apr. 1
Adv., Eng. Record, Apr. 15.
Apr. 27. Washington, D. C.... Apr. 1
Adv., Eng. Record, Apr. 1 to 15.
Apr. 27. Detroit, Mich.... Apr. 8
Adv., Eng. Record, Apr. 8, 15.
Apr. 28. New York City.... Apr. 1
Adv., Eng. Record, Apr. 1 to 15.
May 1. Duluth, Minn.... Apr. 1
Adv. Eng. Record, Apr. 1 to 15.
May 1. Fort Hancock, N. J.... Apr. 8
May 1. St. Paul, Minn.... Apr. 8
Adv., Eng. Record, Apr. 8, 15.
May 2. Dredging, New York City.... Apr. 8
Adv., Eng. Record, Apr 8, 15.
May 3. Dredging, New York City.... Apr. 8
Adv., Eng. Record, Apr. 8, 15.
May 4. Bldg., Atlanta, Ga.... Apr. 15
May 6. St. Louis, Mo.... Apr. 8
Adv., Eng. Record, Apr. 8, 15.
May 8. New York City.... Apr. 15
Adv., Eng. Record, Apr. 15.
May 8. Brockton, Mass.... Apr. 15
Adv., Eng. Record, Apr. 15.
May 9. Chicago, Ill.... Apr. 8
Adv., Eng. Record, Apr. 8, 15.
May 10. New London, Conn.... Apr. 15
May 10. Buffalo, N. Y.... Apr. 15
Adv., Eng. Record, Apr. 15.
May 11. West Point, N. Y.... Apr. 15
Adv., Eng. Record, Apr. 15.
May 12. Mobile, Ala.... Apr. 15
Adv., Eng. Record, Apr. 15.
May 13. Charleston, S. C.... Apr. 15
May 13. Chattanooga, Tenn.... Apr. 15
Adv., Eng. Record, Apr. 15.
May 15. New York City.... Apr. 15
Adv., Eng. Record, Apr. 15.
May 18. Baltimore, Md.... Apr. 15
Adv., Eng. Record, Apr. 15.
May 31. Armor plate, Washington, D. C.... Apr. 8
June 10. Dry dock, San Francisco, Cal.... Apr. 15

BUILDINGS.

Apr. 17. Factory, Lancaster, O.... Apr. 8
Apr. 17. School, Tarentum, Pa.... Apr. 8
Apr. 17. School, Lattasburg, O.... Apr. 8
Apr. 17. School, Bryan, O.... Apr. 8
Apr. 17. North Braddock, Pa.... Apr. 8
Apr. 17. School, Sidney, O.... Apr. 1
Apr. 17. Vent. and htg. school, New Castle, Pa.... Apr. 15
Apr. 17. School, Wapakoneta, O.... Apr. 15
Apr. 17. School, New York, N. Y.... Apr. 15
Apr. 18. Town hall, North Branch, Minn.... Apr. 15
Apr. 18. Court house, Madison, Minn.... Apr. 8
Apr. 18. Laurin, Ont.... Apr. 8
Apr. 18. Kentville, N. S.... Apr. 8
Apr. 18. Plans, etc., South Bend, Ind.... Apr. 8
Apr. 18. Schools, San Carlos, Ariz.... Mar. 25
Apr. 18. Bank, Lamberton, Minn.... Apr. 8
Apr. 19. Plans, Nashua, N. H.... Mar. 25
Apr. 20. School, Epworth, O.... Apr. 1
Apr. 20. Camden, Ark.... Apr. 1
Apr. 20. School, Edgwood, Pa.... Apr. 8
Apr. 20. School, Leando, Ia.... Apr. 8
Apr. 20. School, Fairfield, Ia.... Apr. 8
Apr. 20. Church, Sycamore, Ill.... Apr. 15
Apr. 20. School, Searcy, Ark.... Apr. 15
Apr. 20. Augusta, Me.... Apr. 15
Apr. 20. School, New York, N. Y.... Apr. 15
Apr. 21. Taunton, Mass.... Apr. 15
Apr. 21. Dormitory plans, Seattle, Wash.... Apr. 15
Apr. 21. School, Milton, Mass.... Apr. 15
Apr. 22. School, Atlanta, Ga.... Apr. 15
Apr. 22. Asylum, Vasa, Minn.... Apr. 8
Apr. 22. Peru, Ind.... Apr. 1
Apr. 22. School, Springfield, Minn.... Apr. 8
Apr. 24. School, Dayton, O.... Apr. 1
Apr. 24. School, New York, N. Y.... Apr. 15
Apr. 25. Bus. Bldg., Monticello, Ia.... Apr. 15
Apr. 25. Town hall, Arthur, N. D.... Apr. 15
Apr. 25. Church, Woonsocket, R. I.... Apr. 8
Apr. 26. Schools, Washington, D. C.... Apr. 1
Apr. 27. School, Passaic, N. J.... Apr. 15
Apr. 29. Hospital, Carthage, O.... Apr. 15
Apr. 29. School, Edgerton, S. D.... Apr. 15
Apr. 29. School, Prairie City, Ia.... Apr. 15
May 1. City hall, Lake City, Minn.... Apr. 15
May 1. School, McConnellsville, O.... Apr. 15
May 1. School, Glencoe, Minn.... Apr. 8
May 2. Plans, etc., Bus. Bldg., Fargo, N. D. Apr. 8
May 2. School, Devils Lake, N. D.... Apr. 15
May 2. Church, Spartansburg, S. C.... Apr. 15
May 3. Jail, Fairmont, Minn.... Apr. 15
May 4. School, Monroe, La.... Apr. 15
May 9. Htg. court-house, Hallock, Minn.... Apr. 8

MISCELLANEOUS

Apr. 17. Garbage disposal, Louisville, Ky.... Mar. 18
Apr. 20. New Orleans, La.... Mar. 25
Apr. 20. Stone, etc., New York, N. Y.... Apr. 15
Apr. 20. El. Ry., Stillwater, Minn.... Apr. 15
Apr. 21. Street cleaning, Utica, N. Y.... Apr. 15
May 1. Garbage collection, Chicopee, Mass. Apr. 15
May 6. Levee work, West Memphis, Ark.. Apr. 15
May 10. Oil tanks, Montreal, Que.... Apr. 15
May 15. Railroads, Santiago, Chile.... Apr. 15
June 30. El. Ry., Shanghai, China.... Mar. 4
Oct. 1. Railroad, Moscow, Russia.... Feb. 25

SCHOOLS.

Iola, Kan.—The citizens are stated to have voted to erect a $16,000 school.

Passaic, N. J.—Bids are wanted April 27 for a school. Sylvester J. Post, Chmn. Com. on New Bldg.

New Castle, Pa.—Bids are wanted April 17 for ventilating and steam or hot water heating in Jefferson and Central St. schools. J. S. Westlake, Secy. New Castle School Dist.

Duquesne, Pa.—The School Board is stated to have decided to issue $20,000 bonds for a school.

Detroit, Mich.—The estimates for school buildings and sites allowed by the Council is said to be $327,000.

Kirkville, Mo.—The citizens are stated to have voted to issue $35,000 school bonds.

Leadville, Colo.—The School Board is said to be considering the matter of erecting a $40,000 school.

Monroe, La.—Bids are wanted May 4 for a high school. A. A. Forsyth, Mayor.

Niles, O.—J. L. McDonald, City Clk., writes that it has been voted to issue $40,000 bonds for the erection of a high school.

Toronto, O.—The School Board is said to be arranging to build a $25,000 school.

Sioux Falls, S. D.—It is stated that a $50,000 high school will be erected.

Bayonne, N. J.—The Board of Education is stated to have passed a resolution to request the Council to appropriate $100,000 for public school No. 8.

Marietta, Pa.—It is stated that a $15,000 school will be erected.

Memominee, Mich.—Plans are stated to have been prepared for a $12,000 academy for the St. Anne's Society.

Wells, Minn.—McLeod, Campbell & Smith of Duluth are stated to have received the contract for a school at $24,850.

Pontiac, Ill.—The House is stated to have passed a bill appropriating $193,000 for the construction of a normal training school at the Pontiac Penitentiary; also a gymnasium, drill hall, several cottages and a wall around the same.

Depere, Wis.—The plans of H. J. Van Ryn of Milwaukee are stated to have been accepted for a high school; probable cost, $15,000.

Fall River, Mass.—Louis G. Destremps of Fall River has prepared plans for an $85,000 school for the R. C. Notre Dame Parish.

Edgerton, S. D.—Bids are wanted April 29 for a school in section 2. Chas. Hetts, Clk. School Bd.

Devils Lake, N. D.—Bids are wanted May 2 for an addition to a school. L. A. Larson, Secy. Bd. Trustees, School for the Deaf.

Milton, Mass.—Bids are wanted April 21 for an addition to Tucker School. J. Frank Pope, Secy. Bldg. Com., Mattapan, Mass.

Prairie City, Ia.—Bids are wanted April 29 for a school in Des Moines Township. Richard Charles, Chmn. Com.

Glenwood, Minn.—C. S. Sedgwick of Minneapolis has prepared plans for a $20,000 school.

Oneida, N. Y.—The plans of Chas. E. Colton of Syracuse are stated to have been accepted for the Cherry St. school.

Wapakoneta, O.—Bids are wanted April 17 for a school in Noble Township, C. F. Tinnerman, Clk.

McConnellsville, O.—Bids are wanted May 1 for a school in sub-district No. 1, Union Township. B. H. Martin, Clk.

Somerville, Mass.—It is stated that an addition will be erected to the Foster school, at a probable cost of $35,000.

Searcy, Ark.—Bids are wanted April 20 for a college. Jno. T. Hicks, Chmn. Com. of Galloway Female College.

St. Joseph, Mo.—An election will be held April 29 to vote on issuing $50,000 school bonds.

Barre, Mass.—Cutting, Bardwell & Co., of Worcester, are stated to have recived the contract for the high school, at $40,000.

Council Bluffs, Ia.—It is stated that bids are wanted May 1 for $67,000 school bonds. Geo. S. Davis, Treas. school district.

Atlanta, Ga.—Bids are wanted April 22 for a building. Rev. James M. Henderson, Pres., Morris Brown College.

Seattle, Wash.—It is stated that the Board of Regents of the University of Washington will receive plans April 21 for the erection of two dormitories; the cost of the two buildings not to exceed $44,000.

New York, N. Y.—Bids are wanted April 24 for school No. 183, Borough of Manhattan; also April 20 for a school on Butler St., Borough of Brooklyn; also April 17 (change of date), for an addition to school No. 84, Borough of Brooklyn. Richard H. Adams, Chmn. Com. on Bldgs.

Bids are wanted April 24 for alterations, repairs, etc., to several schools in Manhattan Borough, also for a ventilating and heating apparatus in schools Nos. 98 and 173, Bronx Borough. Richard H. Adams, Chmn. Com. on Bldgs.

STREET CLEANING AND GARBAGE DISPOSAL.

Manchester, N. H.—The City Council is considering the matter of constructing a garbage crematory.

Spokane, Wash.—Articles of incorporation of the Spokane Crematory Co. have been filed. The incorporators are: N. Fred Essig, M. M. Cowley, S. R. Stern and F. E. Elmendorf. Capital stock, $15,000.

Chicopee, Mass.—Bids are wanted May 1 for the collection of garbage for one year. R. D. DeWitt, Secy. Bd Health.

Utica, N. Y.—Press reports state that bids are wanted by the City Clerk until April 21 for street cleaning.

Buffalo, N. Y.—Specifications are being prepared and bids will probably soon be asked for a 3 or 5 year contract for the collection and disposal of garbage, ashes, etc.

Washington, D. C.—Warner Stutler, Supt. Street Cleaning Department, writes that the following bids were opened April 10 by the District Commissioners, for cleaning the paved streets and unimproved roads in the District of Columbia, as advertised in "The Engineering Record:"

The bidders were, a, Lilly & Robinson, Indianapolis, Ind.; b, B. J. Coyle, Washington; c, R. V. Rusk, Washington; d, Daggett & Dugan, Washington; e, Wm. Ryan, Washington.

For sprinkling, sweeping and cleaning, by machinery, the paved carriageways of streets and avenues, designated by the District Commissioners. Prices are per 1,000 sq. yds. for 1, 2 and 3 years, respectively, a, 19 cts., 18¾ cts., 18½ cts.; b, 20 4/10 cts. for 3-year contract; c, 21¾ cts., 21⅛ cts., 21¼ cts.; d, 21 95/100 cts. for each year.

For sprinkling, sweeping and cleaning by hand on block system, or in gangs, the paved carriageways of streets and avenues designated by the District Commissioners. Prices are per 1,000 sq. yds., b, 21 7/10 cts. for 3-year contract; d, 21¼ cts. for each year.

For cleaning paved alleys. The contractor is required to furnish 18 laborers, 6 horses and carts and 2 one-horse sprinklers with drivers. The prices are per 1,000 sq. yds. for 1, 2 and 3 years, respectively, d, 33 cts. for each year; c, 35 7/10 cts., 35½ cts., and 35 cts.

For cleaning unpaved streets and alleys. The contractor is required to furnish 36 laborers, 12 horses and carts with drivers. The prices are per day, for 1, 2 and 3 years, respectively, c, $66.50, $66.25, $65.50; d, $67 for each year; e, $70 for each year.

GOVERNMENT WORK.

San Francisco, Cal.—Bids are wanted June 10 for a timber dry dock at the navy yard, Mare Island. Mordecai T. Endicott, Ch. Bureau Yards & Docks, Washington, D. C.

Cleveland, O.—Bids are wanted April 17 for a water heater for laundry, etc., for use of the marine hospital service. H. W. Wickes, Asst. Surgeon, M. H. S.

Vicksburg, Miss.—Local press reports state that the following bids were received April 5 for excavating 7,500,000 cu. yds. of earth along the route for diverting mouth of Yazoo river: Washburn & Washburn, New York, 12¼ cts. a cu. yd.; John Shields, Hennington, N. J., 9.87 cts.; Garvey & Co., Memphis, 22½ cts.; Stone, Sand & Gravel Co., New Orleans, 8.49; Hingston & Woods, Buffalo, N. Y., 11½; Atlantic, Gulf & Pacific Co., New York, 8.89; Rittenhouse-Moore Dredging Co., Mobile, 16; Charles Clarke & Co., Galveston, 9.04; Christie, Lowe & Howarth, Chicago, 9½.

Newport, R. I.—Press reports state that plans are being prepared for the naval training station barracks, for which Congress has appropriated $125,000.

Cleveland, O.—Bids are wanted April 26 at the U. S. Engineer Office for dredging in Cleveland Harbor, as advertised in "The Engineering Record."

Buffalo, N. Y.—Bids are wanted May 10 at the U. S. Engineer Office for constructing concrete superstructure on breakwater at Buffalo harbor, as advertised in "The Engineering Record."

West Point, N. Y.—Bids are wanted May 11 at the office of the Quartermaster for ice-making apparatus and a system of cold storage, as advertised in "The Engineering Record."

Baltimore, Md.—Bids are wanted May 18 at the U. S. Engineer Office for dredging ship channel leading to harbor at Baltimore, as advertised in "The Engineering Record."

New York, N. Y.—Bids are wanted May 8 at the U. S. Engineer Office for dredging in Peekskill Harbor, as advertised in "The Engineering Record."

Kansas City, Mo.—The following bids were opened April 10 by the Superv. Archt., Treas. Dept., Washington, D. C., for the interior finish, vault doors and linings, plumbing, gas piping, approaches, etc., for the post office and court house buildings at Kansas City, as advertised in "The Engineering Record:" L. L. Leach & Son, Chicago, Ill., $169,000; E. F. Gobel, Chicago, Ill., $204,668; W. H. Ellis, Cincinnati, O., $202,550; J. A. McGonigle, Leavenworth, Kan., $189,436; Herman & Cox, St. Paul, Minn., $199,900; Butler-Ryan Co., St. Paul, Minn., $205,300; Dugan & Hayne, Kansas City, Mo., $221,974; Henry Shenk, Erie, Pa., $234,773; Angus McLeod Co., Minneapolis, Minn., $209,435; Richardson & Burgess, Washington, D. C., $214,382; Chas. W. McCaul, Philadelphia, Pa., $232,000.

Grand Rapids, Mich.—Bids are wanted April 21 for dredging harbors on east shore of Lake Michigan. Capt. Chester Harding, Corps Engrs., U. S. A.

Chattanooga, Tenn.—Bids are wanted May 13 at the U. S. Engineer office, for the construction of 2 dipper dredges, as advertised in "The Engineering Record."

Mobile, Ala.—Bids are wanted May 12 at the U. S. Engineer Office for dredging in Mobile Bay, as advertised in "The Engineering Record."

Brockton, Mass.—Bids are wanted May 8 by the Superv. Archt., Treas. Dept., Washington, D. C., for heating and ventilating apparatus for the U. S. Post Office, as advertised in "The Engineering Record."

New London, Conn.—Bids are wanted May 10 for dredging in Five Mile river, Norwalk harbors and Connecticut river, Conn.; also in Pawcatuck river, R. I., and Conn. Maj. Smith S. Leach, Corps. Engrs., U. S. A.

Charleston, S. C.—Bids are wanted May 13 at the U. S. Engineer's office for electric light plants at Fort Sumter and St. Helena Island.

Atlanta, Ga.—Bids are wanted May 4 for several buildings at Egmont Key, Fla. John Simpson, Dept. Q. M. Gen., U. S. A., Ch. Q. M.

New York, N. Y.—Bids are wan[ted] May 15 at the U. S. Engineer Office [for] dredging in Huntington Harbor, as [ad]vertised in "The Engineering Record[."]

St. Paul, Minn.—The following [bids] were opened April 13 by the Sup[erv.] Archt., Treas. Dept., Washington, D. [C.,] for the low pressure and exhaust st[eam] heating mechanical ventilating app[ar]atus, etc., for the U. S. Post Office, C[ourt] House and Custom House, as advert[ised] in "The Engineering Record": W. Mathieson, St. Paul, $50,000; Gaylor[d] Eitageenc, Binghamton, N. Y., $51,[...]; Edward Joy, Syracuse, N. Y., $60,250; F. Porter & Co., Minneapolis, $48,[...]; Augustus J. Archambo, Minneap[olis,] $49,999; Pond & Hasey Co., Minneap[olis,] $48,046; C. B. Kruse Heating Co., [Mil]waukee, $50,970; L. J. Mueller Furn[ace] Co., Milwaukee, $49,386; Chafer & Be[...]er, Cleveland, O., $56,971; G. R. Mor[...] St. Paul, Minn., $53,999.38; Borges B[...] & Co., Columbus, O., $60,447; A[...] Black, St. Paul, Minn., $44,458.

MISCELLANEOUS.

New York, N. Y.—Bids are wa[nted] April 20 for broken stone and trap [...] screenings in Van Cortlandt and B[...] parks. George C. Clausen, Ch[...] Commrs. Parks.

Montreal, Que.—It is stated that [...] are wanted May 10 by the Gall, Sch[...]der Oil Co., Ltd., for 4 steel oil t[anks] of 1,000,000 gal. capacity.

West Memphis, Ark.—Bids are w[ant]ed May 6 (change of date) for 11 m[...] of levee work, containing approxima[tely] 1,248,000 cu. yds. John B. Driver, P[...] St. Francis Levee, Bd.

Syracuse, N. Y.—Henry B. Seama[n ...] New York City has submitted to [the] Common Council his report and p[...] for the abolition of grade crossings. [Es]timated cost of improvement, acc[ord]ing to recommended plan, $2,684,97[...]

Evansville, Ind.—Articles of incor[por]ation have been granted the Evans[ville] Contracting Co. for dredging and d[eep]ening the Ohio river and streams [run]ning into it, building docks and wha[rves]. The capital is $100,000. The dire[ctors] are Jacob Eichel, Jacob Arnold, A. [...]lendach and others.

Winfield, Kan.—A bill has passed [the] State Legislature authorizing the [con]struction of a dam across Timber C[reek] in Island Park.

PROPOSALS.

Race Track.

NAZARETH, [...]

Sealed proposals will be received u[ntil ...] p. m., Saturday, April 22, 1899, by th[e un]dersigned, for the construction of a [...] mile regulation race track at Nazareth [...] for the Northampton County Agricu[ltural] Society.

No bid will be considered unless a[ccom]panied by a certified check, drawn t[o the] order of John R. Reinheimer, treasu[rer of] the society, or New York draft t[o the] amount of $1,000.

All such deposits, except that of th[e suc]cessful bidder, will be returned to th[e per]son making the same within ten days [after] the contract is awarded. If the succ[essful] bidder shall refuse or neglect, withi[n ...] days after notice that the contrac[t has] been awarded, to execute the sam[e and] furnish a bond acceptable to the g[...] committee of said society, in the s[um of] one-half of the amount of contra[ct, the] amount of deposit made by him sh[all be] forfeited to and retained by the soci[ety as] liquidated damages for such neglect [or re]fusal, but if he shall execute the co[ntract] within the time aforesaid the amount [of] deposit shall be returned to him.

All proposals to be in sealed en[velopes] addressed to undersigned and [...] "Proposals for race track."

Specifications and drafts can be [...] the store of the undersigned.

The committee in charge will mee[t ...] 22, 1899, at 10 a. m., at the office of [...] Maus, Esq., Nazareth.

The committee reserves the right [to re]ject any or all bids.

O. H. KNECHT, S[...]
Nazareth[...]

U. S. ENGINEER OFFICE, Army [Build]ing, New York, April 15, 1899.—Seal[ed pro]posals for dredging in Huntington [Harbor,] N. Y., will be received here until 12 [o'clock] noon, May 15, 1899, and then [publicly] opened. Information furnished on [applica]tion. H. M. ADAMS, Major Engrs[.]

Proposals continued on pages xi a[...]

THE ENGINEERING RECORD.

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TABLE OF LEADING ARTICLES.

The Engineering Record, conducted by Henry C. Meyer, is published every Saturday at 100 William Street, New York. Its opinions on technical subjects are either prepared or revised by specialists.

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THE PROBLEM OF ELECTROLYSIS.

It seems probable that within a few years the electric railway companies will be forced to meet a litigation similar in certain respects to the suits brought against them by telephone companies some ten years ago. It will doubtless be recalled by those familiar with the operation of street railways, that, soon after the change from horses to electric traction was made, the patrons of telephone companies became more and more discommoded by imperfect service. The only message received over the wire was not infrequently a buzzing like that from a distant saw mill. It did not take the telephone companies very long to trace the trouble to the return circuits of the electric street railways. The currents wandered away from the tracks and caused the trouble on the telephone circuits, which were of the old-fashion grounded type. Complaints became so numerous that the telephone companies were forced to adopt some remedy. They were compelled to put up all-wire circuits or the railway companies had to use insulated returns, keeping their electric currents on the legitimate path for them. Very naturally the telephone companies preferred to have the railway companies do the work. The railway companies just as naturally declined, and the result was the important litigation which finally determined that the telephone companies did not have a monopoly of all the earth and the fullness thereof. Since that time they have put up all-wire circuits and also their prices, for they are not engaged in business from philanthropic motives.

It is not more than seven or eight years since the straggling currents from the electric railway were found destructive to a far more important branch of public service than telephones. People conducted business for many years without them, but a water supply has been essential to the well-being of communities for many decades. The situation of a city suddenly deprived of water for a protracted period is inconceivably serious. Power plants would be shut down from lack of water for the boilers, industries would largely come to a standstill, and the inconvenience of the people themselves during the first few days would soon become full of menace to the public health. Hence it is that any danger to a water system is far more important than a similar danger to a telephone system. There seems to be no doubt at the present time in the minds of some of the most conservative managers of water-works that the responsibility of electric railway companies for the wandering currents from their tracks should be definitely settled in the highest courts. They point out that it is the height of folly to wait for a serious accident before applying the remedy which would have prevented it. It has been shown in these columns time and again that small pipes have been completely wrecked by electrolysis due to the return circuits of electric railways. That in itself is a sufficiently important situation to merit attention, but when it is considered that the same action which destroyed these little services is also slowly ruining the large mains, it is evident that a careful study of the subject should be made.

There is really nothing mysterious about this corrosion of conduits by electric currents. The action is precisely the same as has been employed for many years by electro-platers. If two plates of metal are placed in a material which will conduct a current of electricity, and such a current is sent from one plate to the other, the plate from which the current flows will be gradually eaten away. It makes no difference whether the material is damp earth or the solution used in the vat of the electro-plating apparatus. The only difference between the two cases is that in the former the corrosion is taking place several feet below the surface, out of sight and frequently out of mind, while in the latter case it is under the watchful supervision of a workman. Just so long as electric currents return to the power stations of street railways through the track, there will be danger to the water main. Thorough bonding of the rails, the use of large supplementary return wires and like precautions simply diminish the danger. It is one of the laws of electricity that where a current has two paths by which to reach a certain point, it will divide, part going by one path and part by the other, in direct ratio to their conducting capacity. In the case of a street railway separated by six feet or so of earth from a water main, the return current has two paths back to the power house. One of them is through the rails, the other is through the earth and the water main with the service pipe running from it into the power station. If the earth is dry and the track is well-bonded, most of the current will return through the latter, but unless the accepted laws of electricity are false, some current will pass through the earth. In case the track is of the poorly-bonded type, still to be seen in many places, then the proportion of current returning through the earth will be greater. The water pipes, being wholly of metal, are the best of conductors, and if they are in the earth in the vicinity of the track, the current makes for them. If these facts had been understood by city officials, there would not have been so many ridiculous ordinances passed concerning electrolysis. There seemed to be a mania some years ago for a type of ordinance specifying certain classes of bonding in the track, and then requiring all currents to be kept off the water mains, a requirement as absurd as a demand for the companies to make the sun stand still at noon. It was eminently proper to require the companies to send their return currents back to the power house through well-bonded track circuits, for that practice diminishes the danger to the pipes, as before stated. To add to that requirement, however, a demand that no electricity should be allowed to escape from such a track system to the pipes was utterly absurd.

It has been shown by a number of engineers that the double-trolley system is the only positive remedy for electrolysis. In that system, whether the wires are overhead, as in Cincinnati, or in conduits, as in several cities, the chances for any leakage of current to the ground are infinitesimal. The overhead double-trolley is unsightly, and the network of wires is not regarded with favor by fire departments or insurance underwriters. The conduit system is expensive, too expensive for use in many localities. It is evident, therefore, that the problem becomes one of minimizing to the utmost the danger to which water mains are exposed by the present single-trolley system of operation. Progressive railway managers have long recognized the fact that if a street car system is built for operation and not sale, it pays to make the return circuit of large conductivity. Some companies have found that a remodeling of their plants in this respect has been equivalent to a large increase in traffic, so great was the previous loss of power from the straying currents. It is hardly likely that enterprising companies will put any obstacles of moment in the way of city officials endeavoring to keep these wandering currents where they belong. Unfortunately, many street railways in this country were built for sale and not for operation. They are poor affairs at the best, and are run on such a small margin of profit that much aid cannot be expected from their managers. These are the companies which render electrolysis so serious, for they will fight every attempt on the part of the city officials to compel them to better their return circuits.

There has probably been no litigation which furnishes a precedent as to the final decision of the highest courts in a case similar to that of the destruction of water mains by railway return currents. In the telephone cases it was possible by the use of all wire circuits to avoid the inconvenience caused by the railway currents in the earth. In case of the water-works mains there is no such remedy. The pipes are there, they form, under certain conditions, a path along which some current is bound to go. It seems, in the light of present knowledge, that these currents may be so reduced by proper precautions as to be without danger in most cases. It is equally evident, however, that the distribution system of the city should be watched with great care to detect any signs of incipient electrolysis. Whether the cost of this inspection must be borne by the city or the railway companies is a question for the courts to decide. It is to be hoped, however, that the authorities of Dayton or some other city where the water mains are being seriously damaged, will take the matter into the courts and determine once for all whether the wholesale destruction of a pipe system, which must eventually result in great expense and inconvenience to a large portion of the citizens, is to be permitted unchecked. Electric railways are certainly a great boon and nothing should be done to restrict their construction and operation except for a greater public good. As a rule, however, they pay little or nothing for the right of using the streets, on which their existence practically depends, and it seems but just that they should be made wholly responsible, not only for the injury they have done to water-works systems, but also for preventing further injury in the future.

The Proposal to Build the Tunnel Railroad in New York City, of which the terms were given in these columns on April 1, has been withdrawn. That proposition was the result of many months of conference and study by representatives of the Rapid Transit Commission and the Metropolitan Street Railway Company. In a letter accompanying the proposition of the Tunnel Company, which was merely another name for the railway corporation, it was stated by its counsel that the work would not be undertaken on the proposed terms unless they met with popular approval and support. The proposition and the explanation of its terms by the company's counsel were made public before

any definite steps were taken by the commissioners, either to accept or reject the offer. Since that time marked opposition has been shown by a portion of the press to two terms in the proposal, those giving a practically perpetual franchise to the Tunnel Company, and permitting it to use the subway for other purposes than a railway route. The reason for the withdrawal of the offer is stated as follows by the counsel: "While the proposition seemed to be received at first with general approval and was treated in the same spirit in which it was made, we are forced to recognize and you agree, that criticisms, often originating in adverse interests and attacking the only details of the plan which gave prospect of profit, have made a lodgment in the public mind and created an impression that we are trying to drive a hard bargain and to get possession of privileges of great value without rendering an adequate return. Our clients are not willing to occupy this position, and they are satisfied that under such circumstances success in the enterprise would be impossible. They are not willing on these terms to undertake to provide a sum which they estimate at fully $60,000,000 with the certainty of changes in financial conditions long before the work is done and to invest in a novel enterprise of doubtful profit." It is a matter of serious question whether there has been much real popular objection to the granting of the terms of the original proposition, except in relation to the right to carry conduits and pipes in the tunnel for the distribution of power and other purposes. Such a right would give the company exceptional facilities for distributing power throughout the city, and before it is conferred the subject should receive very careful attention. The objection raised against a practically perpetual franchise has largely been one fostered by a few newspapers of little weight. The construction of this underground tunnel is much more of a financial than an engineering undertaking at the present time. The experience in London with the underground railway now in course of construction may be taken as definitely settling the leading engineering features of the problem. Financiers whose statements on this subject are worth heeding, have commended the terms of the proposition. Certain parties have come forward with offers to construct a tunnel if given franchises for limited periods. Vague statements have been made about their financial backing, but assuming they carry through their undertaking, the question naturally arises as to the value to the citizens of New York of a hole in the ground without connections with the present surface railway system.

The Water-Works of Athens, Ohio, has a stand-pipe holding about 100,000 gallons. Every night for some time it has been pumped full of water before the engineer leaves the pumping station at ten o'clock, and every morning it has been found practically empty. It shows no signs of leakage, and there is no evidence of broken or fractured mains at any point on the distribution system. This condition of things has long been a source of worry to the officials. Recently it has been discovered that in certain portions of the town a consumer will supply the neighbors with water; they come to his house for it as they would resort to a public well in the good old times. The consumption and waste in the city increased about 25 per cent. last year, and the authorities have decided to call a halt. They have purchased 500 meters and will put them in service just as soon as they can be attached to the pipes. The conclusion has been reached that if anyone wishes to supply his neighbors with water he is welcome to do so, but only on the condition that he pays 20 cents per 1,000 cubic feet, actual measurement. There will be a minimum charge of $5 and a reduction to large consumers. It is confidently expected that the stand-pipe will not become empty so rapidly after the first set of meter bills have been presented. The population of Athens is only about 3,000, and the metering of all the services of a plant for such a population should be followed by results of unusual interest.

The Philadelphia Exposition to be held during the fall months of this year has been so far determined that the general features of the buildings have been made public. They have been planned by Messrs. Wilson Brothers & Company, and will be located on 56 acres of land on the Schuylkill River, deeded for the purpose to the Philadelphia Commercial Museum by the city. The main group of buildings is designed to form a single structure 900 feet long and 400 feet wide, in which there will be about 200,000 square feet of space available for exhibits. These are expected to be representative of American manufactured goods and products, arranged to attract the attention of the delegates to the Second International Commercial Congress, which will meet during the exhibition. This will be attended by specially appointed delegates from a number of foreign governments and by representatives of business houses and chambers of commerce in Latin America, South Africa, India, Australia, China, Japan and other countries. The federal government has already made a large appropriation for the purchase of samples of foreign-made goods with which American products will compete, and these will be shown in a special department. Still another feature of the display will be an exhibition of the methods of packing goods of different classes for shipment to foreign countries, a subject of special importance because custom-house regulations and methods of transportation frequently make the packing systems of the country a source of inconvenience elsewhere. The Franklin Institute is associated with the Philadelphia Commercial Museum in the conduct of the exposition and will celebrate its seventy-fifth birthday during the fair.

The Jersey City Water-Works Contract which was awarded to Mr. Patrick H. Flynn, of Brooklyn, on February 26, seems to be passing through the usual ordeal of previous contracts, and considerable doubt is expressed by people acquainted with New Jersey legal affairs whether the courts will declare it binding. An application for an injunction against the contractor, brought by Congressman Thomas McEwen, has been denied, but the judge stated in his opinion dismissing the writ that the application might be renewed if accompanied by affidavits that the contract was extravagant, exorbitant or the result of illegal combinations. This hint from the judge will probably be followed by the parties who asked for the first writ. Moreover, the Passaic Valley Mutual Protective Association, which was largely instrumental in obtaining the recent injunction restraining the city of Patterson from farther pollution of the Passaic River, has given notice to Mr. Flynn that any attempt on his part to build the works called for in the contract will be followed by an application by the association for an injunction. The basis of this injunction is a previous ruling of the courts that no contractor has any legal right to condemn water for sale to a municipality. The association contends that the riparian owner has rights in a stream which can only be taken from him by due process of law, that the appropriation of water by a contractor for sale to a community does not constitute a public use, and that it is no defence to claim that the rights of downstream owners are not infringed because only the excess of flow due to storm and flood waters will perhaps be taken. Most of these points have already been covered by New Jersey and federal descisions.

ERECTION OF BRIDGE 69, PENNSYLVANIA RAILROAD.

The double track of the main line of the Pennsylvania Railroad crosses the Schuylkill River about 68 feet above the water, at a point a few hundred feet north of the Girard Avenue highway bridge, on a structure originally composed of several massive stone-arch approach spans and a double-intersection Whipple truss span 236 feet 3 inches long. This old span had two deck trusses with Keystone columns and cast-iron connection blocks, and was built in 1865, when the maximum engine load was about 60 tons. Since that time the weight of engines has increased to 100 tons, freight and passenger trains are much heavier per lineal foot and the service of the road demands frequent trains and high speeds, thus greatly increasing the duty of the bridge. It was therefore determined to replace the iron span with a heavier steel one of standard design, whose principal details were illustrated in "The Engineering Record" of March 25. The new deck span has two Pratt single-intersection 11-panel trusses 235 feet 7 inches long, 25 feet 9 inches deep and 19 feet apart, all center to center distances. It rests on the old masonry piers, with its bottom chord about 42 feet above low-water level.

It was required that the old span should be replaced by the new one in exactly the same position without causing any interruption or delay of the regular traffic, and for various reasons it was undesirable to divert the traffic from the direct alignment in the axis of the bridge to a temporary track on either side. The trains were frequent both day and night and crossed the bridge at a comparatively high speed, the old bridge could not sustain the weight of the new one during its erection, and the positions of corresponding members interfered with the use of the old bridge for false work. It was difficult and tedious to trestle up underneath and carry the tracks while removing the old and inserting the new work. It was decided to assemble the new span complete, at the required height, alongside the old span, and when it was finished to move the old span quickly aside and simultaneously move the new span across transversely into the place of the first. This plan involved disconnecting the track, moving both structures about 27 feet, seating the new one in exact position, and reestablishing the track, all in about 45 minutes, the longest available interval between trains. The work was carefully planned and very successfully and satisfactorily executed in a simple and direct manner with ordinary plant, at a moderate expense.

The most interesting features were the details of the false work for sustaining the great concentrated loads and the lateral thrust of masses moving at a considerable height, the convenient and economical false work platform for assembling the new and dismembering the old trusses, the provisions for the transfer of spans, and the methods of moving the combined masses quickly, accurately and safely. The other operations and appliances conformed to ordinary good practice in heavy erection work, and are not here particularized.

At each end of the old span, piles were driven and surmounted by framed bents, forming a well-braced temporary structure, which practically widened each old pier and extended it both up and down stream to receive the two spans alongside of the bridge, first the new one on the south or downstream side, while it was being assembled, and afterwards the old span on the north side during its removal. Four temporary trusses, 191 feet 9 inches long, were assembled in halves and successively floated on barges under the old span. Four sets of four-part tackle were hung from timbers projected over the top chord of the south truss and with them and a hoisting engine placed on each pier falsework, the pairs of semi-trusses were raised

and supported until connected together, then the complete trusses were lowered to bearing with their end shoes on rail skids, and after being guyed were moved south and braced together in two pairs, about 10 feet apart, so as to make a deck bridge, on whose platform the new permanent span was erected and riveted up complete. The old and new spans were braced together and moved as a unit to the north until the new one completely displaced the old one and received the traffic. The temporary span was also slid up stream into a position exactly underneath the old span, and provided a platform from which it was removed. Finally the temporary trusses were taken down on barges and removed, and the piles and framed falsework withdrawn. The whole work, from the time the pile driving was commenced until the falsework was removed, occupied 40 working days and a maximum force of 100 men.

A conventional sketch, not to scale, of one end of the bridge is given in Figure 1. Here the outlines of the temporary timber extensions of the bridge seat and falsework platform are indicated without regard to the lines of the trestle bents and bracing which really compose them, and the successive positions of the old, new and temporary trusses are indicated by the center lines of their bottom chords, except where partial isometric diagrams can be shown without confusion. The pier extension consisted of two principal elements, a high main bent prolonging the bridge seat and receiving the full weight of the old and new spans, stationary and in transit, and a lower main bent supporting the ends of the falsework trusses, both when in use for the erection of the new and the removal of the old span, and while they were moved across under the new span. There were also some auxiliary bents beyond and on top of those shown in Figure 1, which were used for working platforms or to support portions of the main spans, and are here omitted. The main bent and the front bent are each composed of triple transverse rows of vertical posts on piles, all thoroughly braced as indicated in Figures 3 and 4, which show the details of unusually massive and carefully designed falsework. A general side elevation of all the falsework is shown in Figure 2, where the outlines of the new and old spans are indicated by heavy and light dotted lines respectively. A sectional plan and end elevation of the west pier falsework is given in Figure 3, which also gives a front elevation of the main bent. The east pier falsework is substantially the same.

The vertical posts of the lower stories are virtually piles, although they are of 12x12-inch square timber and are braced and framed like the upper story. They were made of 40-foot lengths, cut to corresp nd approximately with the soun lings profile, and driven without sharp ening to a refusal of ½ inch under a 2,000-pound

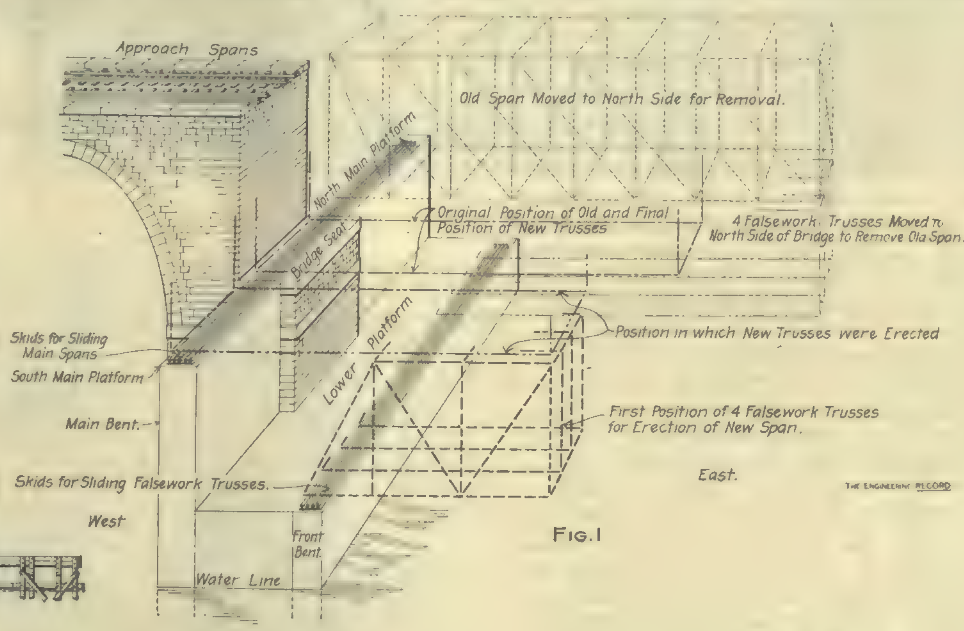
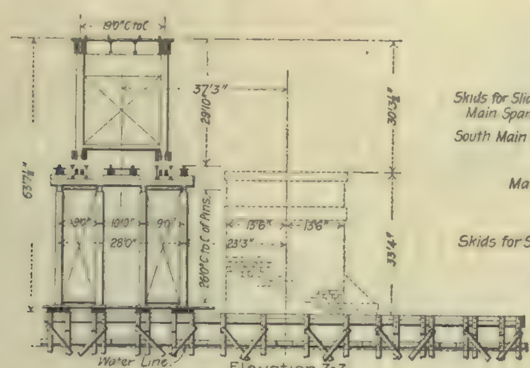


FIG. 1



Elevation Z-Z

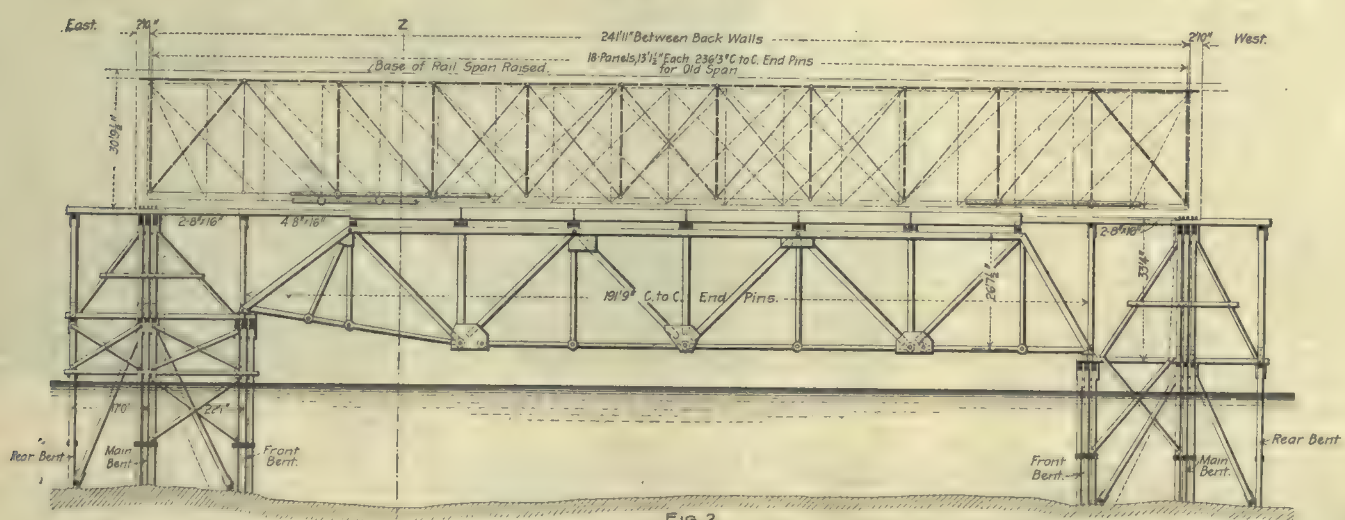
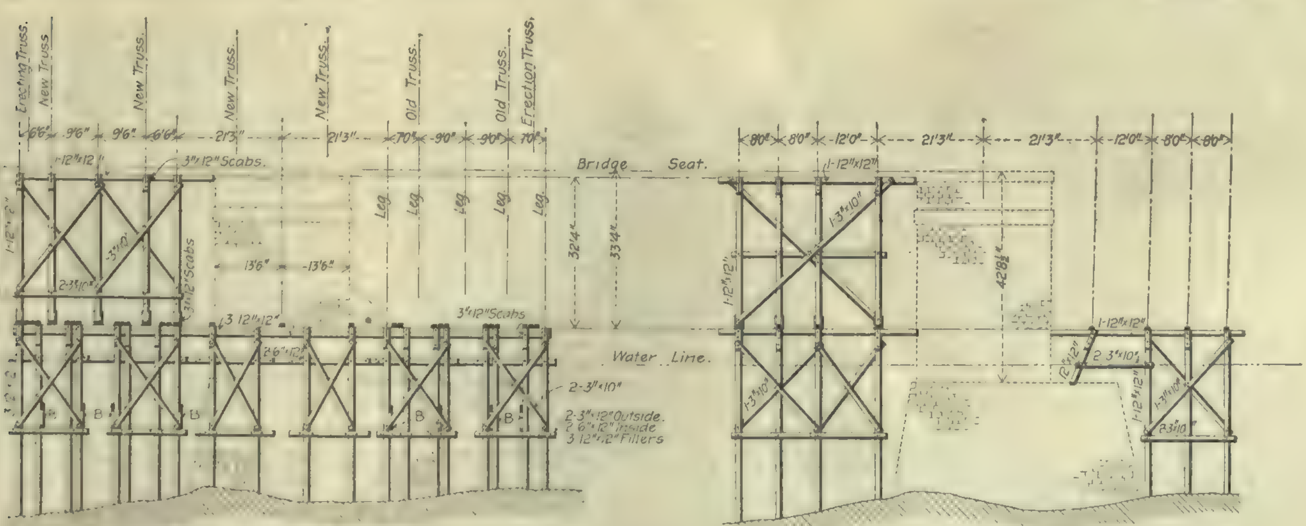


FIG. 2



Section R-R Fig 3

FIG. 4

Section W-W Fig 3

THE ERECTION OF BRIDGE 69, NEW YORK DIVISION, PENNSYLVANIA RAILROAD.

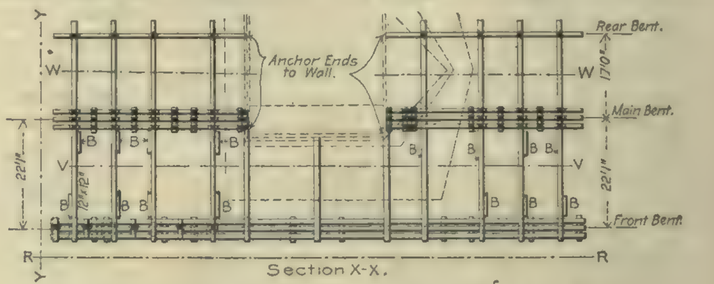
MR. WILLIAM H. BROWN, CHIEF ENGINEER; MR. W. A. PRATT, ENGINEER OF BRIDGES; EDGE MOOR BRIDGE WORKS, CONTRACTORS.

hammer falling 10 feet. The rocky bottom was very hard and few of them penetrated more than 2 feet. The tops were cut off with a horizontal buzz saw, operated by the pile driver, at a height of about 4 feet above the surface of the water, and the bents were capped or double capped and the upper stories built in the usual manner. The main bent was reinforced by two sets of 12x12-inch spur braces, AA, at the tops of alternate posts. These spurs were bolted on shore to longitudinal 12x12-inch sill pieces, EE, 12 feet long, at right angles to them, so as to make T-shaped frames. Then each frame was floated out and sunk in the inclined position, with the sill bearing on the bottom, parallel to and against the other row of piles, and with the tops of the spurs engaging shoulder pieces spiked on the sides of the piles. Pairs of wedges, not shown in the drawing, were driven between the tops of the spurs and the shoulders to give good bearing and adjustment. Transverse X braces, BB and FF, were also secured to the piles under water, so as to avoid the weakness of long, unbraced piles often found in deep water. The second story of the main bent had transverse batter pieces at alternate posts, DD, corresponding to the spur braces below, and all the caps and sills were bolted to the pier masonry, where they abut against it. The front bent is similar to the lower story of the main bent, except that it is continuous from the north to the south end and is clear of masonry; it is shown in Figure 4.

The cap timbers were doubled vertically here as in the main bent, and for the same reason, to secure extra stiffness as stringers on which the tracks were laid for the trusses to slide over to the north side of the pier. Only one panel of the upper story of this bent was framed; this was first built, as shown, in position to support, during erection, the end of the new span beyond the hip joint of the falsework span. After the new span was assembled and moved into position, the second story was moved over to the other end of the bent and used there in the same manner to support the end of the old span during its removal. The rear bent was similar to the front one in most respects, including the movable panel of the second story trestle, but differed from it in being much lighter, with only a single row of piles, and in being separated by the masonry piers into two parts like the main bent. The submerged attachment of the diagonal braces was substantially the same for all three bents, and is shown in Figure 5 for one-half of the south panel of the main bent. Before the piles were driven the braces B and F were bolted on and the cleats H spiked in position, as approximately determined by soundings. The sash pieces II and fillers JJ were cut to length and bored, and bolted on above the surface of the water, and then forced down to position. Finally the upper ends of the diagonal braces were bored and bolted above water in the usual manner. Throughout the falsework all vertical posts and all main caps were 12x12-inch yellow pine timber, in lengths as required, up to 40 feet. The transverse X bracing was of pairs of 3x10-inch plank, one each side of the multiple bent, except for the rear bent and the upper story of the front bent, where single pieces were used. Caps were connected to the posts by pairs of 3x12-inch scabs, and all other pieces were as marked. All connections were made with ⅞-inch bolts driven in ¾-inch bored holes and having 4-inch cast washers at each end.

The falsework span consisted of two pairs of steel trusses, spaced as shown in the cross-section, Figure 2. These trusses had previously been used by the contractors in the erection of the Newport and Cincinnati bridge across the Ohio, and are described in the account of that work published in "The Engineering Record" of July 23, 1898. These trusses were of somewhat irregular and special construction, as shown in the detail drawings Figures 10, 11, 12 and 14 of that article. The transverse struts and lighter vertical posts were of wood and the vertical post connections were bolted. The original length of the trusses was about 200 feet, but they were shortened to fit this span by reducing the end post angle and substituting shorter bars in the end lower chord panels. The three parellel lines of double caps in the front bent of pier falsework were cross-capped by short 12x12-inch timbers parallel to the axis of the bridge, and set close together to form seats under each falsework truss and distribute its weight. Four pieces were thus set under each of the outside and three under each of the inside trusses, and on top of them, in the plane of the bent, was a nest of six 60-pound rails 40 feet long, bolted firmly together side by side. On this rail-bed the falsework trusses were set and connected together by transverse vertical sway brace frames in two pairs, each forming separate deck bridges. These two bridges were connected by horizontal timber struts and the rods (not shown here) at the feet of the end posts, and by 8x16-inch wooden floor beams 32 feet long, bolted transversely to the top chords in sets of four at each panel point. No diagonal horizontal rods or braces were used between the two pairs of trusses. On top of the floor beams were temporarily laid two double lines of 37-inch plate girder stringers. The ends of these stringers were flange bolted together with two horizontal 2-inch cross planks intervening at each joint and connecting them to serve as spacers and for sway bracing. On top of these lines of girders the new permanent truss was wedged up and assembled in the usual manner, the members being handled by an ordinary two-bent strident traveler running on single rails, about 28 feet apart, laid on pairs of 8x16-inch stringers, in the planes of the center lines of the outside falsework trusses. The traveler commenced erecting the new trusses at one end and worked continuously to the other end, finishing the assembling as it advanced. The truss timbers were delivered to the traveler from the opposite end of the bridge on a material track in the center of the erecting platform, which was carried by two pairs of 8x16-inch stringers. The rails of the traveler track and the material track were laid on short pieces of 2-inch transverse plank that distributed their rail pressure to both stringers and served as crossties for spacing the rails of the material track.

The new span was riveted up complete and finished and the tracks laid on it while it remained in the position where it was erected. Its end shoes were seated on transverse beds, one at each end, parallel to the face of the abutment, each composed of six inverted 100-pound rails about 24 feet long. They were bolted close together, side by side, and extended from out to out of the base plates. The heads of these rails were downwards and were supported on turned steel rollers 2½ inches in diameter and 30 inches long, which were set about 8 inches apart in frames corresponding to the live ring of a turntable. The rollers were supported on a rail-bed similar to the upper bearing, but spiked to the almost continuous cross-pieces, which distributed its load to the three lines of caps at the main bent. The lower rail-bed was made continuous from end to end of the main bent, and was thus about 110 feet long, with the rails breaking joints. The grade of the railroad tracks was raised about 4 inches on the approaches and rail bearings and sets of rollers were inserted under the end post pedestals to engage the same roller-bed, as described for the new span. One member of the cast-iron



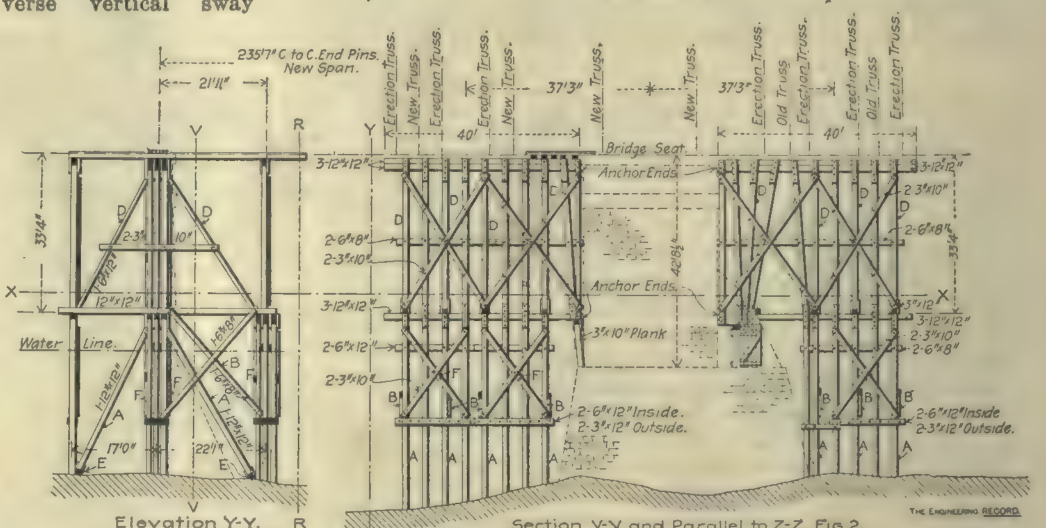


FIG. 3

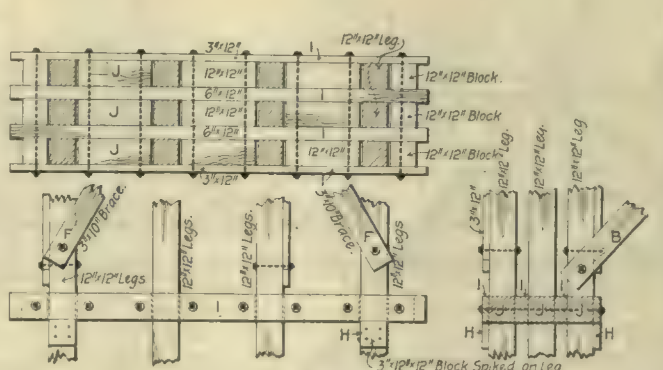


FIG. 5

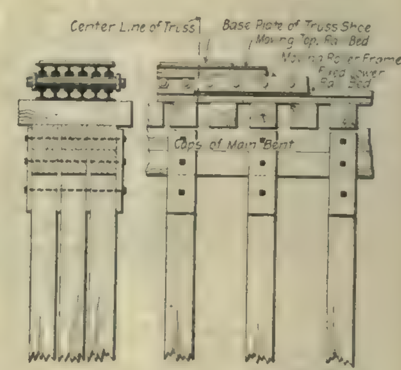


FIG. 6

FALSEWORK DETAILS EMPLOYED IN ERECTING BRIDGE 69.

pedestal under each old end post was removed to accommodate the rail bearings and roller nests. The rollers were continuous over the whole length of the lower rail beds, there being at each end of the bridge 150 rollers, in six sections, whose side plates were spliced together by side pieces bolted on. The rollers were shouldered at the ends and arranged as shown in Figure 6.

An eight-part tackle of 2½-inch manilla rope was attached to the foot of each end post of the north truss of both old and new spans, four tackles in all. The other end of each tackle was anchored to the falsework on the northern extremity of its respective pier, and the lead lines were carried to the spools of four independent hoisting engines, two on the falsework that had been used for erecting the new truss, and two auxiliary ones set on the barges below. The last train passed over the old bridge at 2.56 P. M., October 17, 1897. Immediately afterward a gang of trackmen pulled the remaining spikes in the bridge rails and a locomotive attached to the rails pulled them off. The hoisting engines were started at 2.58½ and a few seconds before 3.01 the moving was finished, the old span having been pulled out and the new one simultaneously moved into its required position, just vacated by the old structure. A four-part tackle was attached to each end of the south truss of the new span and to an anchorage at the south end of the pier and two or three turns around a snubbing post were taken in its fall line. As the bridge was pulled forward these tackles were slacked off by hand, but they were not needed for checks, for which purpose they were provided. Lines from each end of the new span were carried over adjacent fixed pulleys in the same vertical plane and had weights suspended from their free ends at the same initial level. As the bridge moved these weights, ascending uniformly and exactly together, indicated that the two ends of the span were moving at the same speed and that the axis of the bridge remained parallel to its original and final direction.

The tracks already laid on the new span were immediately connected with those on the approaches, and at 3.09 a special train passed over the new span, just 14 minutes after the last train over the old span. During this time the track was severed and reconnected, and a total weight of about 950 tons, including the 660 tons of new span and floor, was moved 27 feet. The upper stories of falsework in the front and rear bents, Figures 2 and 4, were taken down, the four falsework trusses were disconnected and moved across the piers to the north side, under the new position of the old span, a working platform was built on top of them to sustain the old trusses after disconnection, the second stories of the front and rear bent falsework were set up on the north end, in positions corresponding to their former ones, and the old span was taken down and removed, after which the falsework trusses were lowered to barges and floated off and the falsework removed. The falsework spans slid across the pier with their pedestals bearing on the greased rail beds without the interposition of rollers and top rails, and they were pulled by two hoisting engines, one at each end operating a four-part tackle. After the new span was in approximate position, temporary shoes were set under the stiffened end vertical posts and jacked up to lift the whole bridge, so as to release the rail beds and rollers under the end shoes. Then the permanent pedestals and rockers were set on the seats and the bridge shoes lowered into position on them and the jacks further slacked off to release the vertical post shoes, which were removed.

Figure 7 is a view looking south, and shows two old trusses in position on the south side, ready to receive the new span. Some of the tackles by which the trusses were raised to position are seen still attached to their top chords and to the top of the old bridge, and one-half of the next falsework truss is seen, connected together, on the deck of the barge, ready to hoist up. A later view, looking north, is shown in Figure 8, where the falsework span is complete and the new permanent span is half erected on top of it. The old displaced span is shown in Figure 9, and underneath it, in the background, is seen the falsework span ready to be pulled forward on the lower sets of rails and serve as a working platform. At the right of the picture is shown one hoisting engine on top of the falsework and another one below it, in the barge, by which the west ends of the spans were pulled across.

FIGURE 7.—VIEW OF ERECTING TRUSSES WHEN READY FOR NEW SPAN.

FIGURE 8.—THE ERECTION OF THE NEW BRIDGE ON THE FALSEWORK TRUSSES.

FIGURE 9.—VIEW OF THE OLD SPAN AFTER ITS REMOVAL.

The ends of the vertical posts seen projecting above the upper platform at the end of the pier are braced back to the other posts and served as anchorages for the hauling tackle, which may be seen still attached to them.

The design and specifications for the new span and the plan of moving it were prepared by the Pennsylvania Railroad Company, Mr. W. H. Brown, M. Am. Soc. C. E., chief engineer, and Mr. W. A. Pratt, M. Am. Soc. C. E., engineer of bridges. The falseworks were framed and put in place, traffic was maintained and the moving of the two spans was executed by the Pennsylvania Railroad Company's New York Division forces, Mr. Jos. T. Richards, M. Am. Soc. C. E., engineer maintenance of way, and Mr. Geo. W. Mershon, master carpenter. The contract for the building and erection was let to the Edge Moor Bridge Works, Mr. W. H. Connell, president; Mr. C. W. Bryan, chief engineer, and Mr. S. P. Mitchell, manager. The structural and falsework details were developed by the bridge company, and the erection was done under the direct supervision of Mr. C. S. Hall, engineer of erection. Acknowledgement is made to Mr. Pratt for drawings, photographs and other data.

While this is not the first bridge to be erected by this method, it is probably the longest and heaviest span to be moved so far transversely, and the completeness and stability of the falsework, the perfection of preparation, and the remarkable success and rapidity of the final operations, make it notable. Foreign engineers, especially in France, frequently project heavy spans of riveted stiff girders longitudinally from pier to pier, and their very slow and laborious hand work emphasizes the success of this lateral movement of a pin-connected structure by steam power without interruption of a heavy express traffic.

STREET CLEANING IN WASHINGTON.

In the Contracting News Department of the issue of "The Engineering Record" of last week there was a brief summary of the bids received for street cleaning in the District of Columbia. This deserves comment as marking an interesting instance of the importance to a municipality of a careful examination of the actual cost to contractors of work let to them. Street cleaning in that city falls under four heads, machine work on improved streets and avenues, hand cleaning, paved alleys, and unpaved streets and alleys. The first annual report of Mr. Warner Stutler, superintendent of the street cleaning department, gives some important figures concerning the cost of this work during the year ending June 30, 1898.

During that time 240,521,788 square yards of machine sweeping was done at 25¾ cents per thousand square yards. The work of this nature is carried on between the hours of 9 in the evening and 6 in the morning. The streets cleaned are divided into six routes, which average about 1,000,000 square yards each, and are swept in regular order. Four inspectors are employed to follow the machines, see that the streets scheduled are swept, note any inferior work done by the contractor, and report it to the office. The superintendent drives over the route early in the morning after it has been swept to see if the work has been done properly, and on the results of his observations and the reports of the inspectors depends the amount of payment to the contractor, for deductions are made for inferior work. These amounted during the last year to $268. The manner in which the work is to be done by the contractors whose bids were printed last week is indicated by the following extracts from specifications:

"The streets will be cleaned in the following manner: Each paved street will be first sprinkled by a watering cart from curb to curb in order to lay the dust; the sprinklers will be immediately followed by the sweeping machine, which will sweep from the center of the streets to the gutters on each side. The sweepings will be at once collected into heaps at the curb line and then removed by the carts. The contractor will furnish each cart driver with a broom or brush for sweeping up after each pile of dirt is removed. Sufficient water must be used in sprinkling to prevent the raising of dust in sweeping, but care must be taken not to wet the carriageways so that the sweepers cannot remove the dirt. The contractor must see that no sweepings are thrown into the sewer traps or drops, and will remove from the mouths or throats thereof any material lying therein. Should any sweepings be thrown upon the sidewalks, they must be promptly removed by the contractor.

"The sweepings must include everything in the nature of dirt, refuse, ashes, old building material, dirt, etc., from wagons, leaves, and sand or other material used in repair of pavements which may be found upon the carriageway. Ashes (without permit), refuse, old building material, dirt from wagons, leaves, grass from lawns, etc., are only placed on the carriageways in violation of the city ordinances, and parties placing them there are liable to punishment for so doing, and the District authorities will use every reasonable endeavor to prevent such deposits, but the contractor must accept the risk of removing all such ashes, refuse, etc., as may be found on the street. The work of cleaning shall be thorough, and shall include the removal of mud, dirt, etc., from depressions or holes in the carriageway surface caused by defective pavement or otherwise, and the character and thoroughness of the work shall be at all times subject to the approval of the Superintendent of Street Cleaning and the Commissioners of the District of Columbia. The wagons or carts used by the contractor for the removal of the street sweepings shall be strong and tight in all parts, so as to prevent their contents from dropping on the streets, and shall be subject to the approval of the Superintendent of Street Cleaning at all times. All wagons or carts used for this purpose shall have, on each side, the name of the contractor or contractors conspicuously painted or shown; also, the number of the cart or wagon. The filling of all machine brooms used in sweeping must measure not less than 8 inches in length outward from the surface of the spindle before being put on the work. All machine brooms while in use must be set in the proper notch to sweep the street surface, and there left until it is necessary to make a change on account of wear."

The requirements for this portion of the street cleaning work also specify that eight hours shall constitute a day's work, except in cases of emergency. No workman is to receive less than $1.25 per day, and the District Commissioners are authorized to demand from the contractor evidence that all his bills for labor and material have been paid promptly. When any scheduled street or part of a street has not been swept on the route being cleaned, or the work has been done poorly, a deduction is made corresponding to the area which has been neglected. The provision in the contract governing the removal of snow and ice reads as follows: "The contractor will be required to keep snow ploughs, levelers and scraping machines ready for use during the winter. During or after each snowstorm the gutters and carriageways of such streets, avenues, alleys and places as may be directed by the Commissioners of the District of Columbia, will be opened and cleared of snow by him. For this work the contractor will be allowed 10 per cent. over and above the actual cost at current market rates of labor, etc.; certified pay rolls to be filed with the Superintendent of Street Cleaning and payment to be made on the certificate of said Superintendent."

During the fiscal year ending June 30 1898, 118,309,372 square yards of paved streets and avenues were cleaned by hand by contract at the rate of 32 cents per thousand square yards. This work has given general satisfaction, and its discontinuance would be followed by serious complaint from the citizens. In this system the streets are kept cleaned during the day. Each man is assigned to a certain section or block, and is provided with a bag carrier and a half-dozen bags, push broom with scraper attachment, sprinkler, short-handled shovel and broom. After sweeping the entire surface in the morning, the area is constantly patrolled during the day and kept cleaned, the sweepings being placed in the bags for removal to the dump. Four inspectors are employed to see that the work is done properly, and note any defective cleaning which should be the cause of deduction from the contract price. Should work be suspended on account of rain or other cause, a deduction is made according to the time lost; if two hours is lost in this way, one-fourth of the area is deducted from the schedule. During the year a portion of the work was done by day labor under the direct oversight of the Superintendent, who reports that it can be accomplished at 20 cents per thousand square yards in this manner with better results than were given by the contractors.

The cleaning of the improved alleys is important because the sanitary condition of the city depends largely on the thoroughness of this work. During the past year eighteen men, six horses and carts with drivers, and three one-horse sprinklers were employed on this work. The area cleaned was 28,023,227 square yards, and the cost was $10,929. The work is done by sprinkling the alley, sweeping the rubbish into the center, sweeping and hoeing it into heaps and then removing the piles immediately.

The cost of cleaning the unimproved streets and alleys during the year was about $16,500. The work was done by gangs of eight laborers and two horses and carts, which are required to keep the roadway clean, the gutters clear and free from weeds and grass and attend to the complaints of citizens along these roads. The force was inadequate to do the work properly, as it was able to go over the roads but once a fortnight. Many of the unimproved alleys are the dumping places for all sorts of filth, and the task of keeping them clean is a serious one.

MUNICIPAL NOTES.

The report of the Board of Public Works for Milwaukee for 1898 contains, as usual, a number of sections of general interest. Owing to injunctions against issuing permanent street improvement bonds, contracts for asphalt and brick pavement could not be made until late in August, and, on account of unfavorable weather, some of the asphalt was not laid until November. Mr. George H. Benzenberg, M. Am. Soc. C. E., city engineer, states that no good results can be obtained with such pavement when it is laid so late in the year in the climate of Milwaukee. When circumstances prevent the letting of contracts which cannot be completed before the first of October, he advises postponing such work until the following season. Had similar advice been given and followed in a number of northern cities, some pavements would not now be in use to the disgust of both the property owners and the men who laid them.

The most interesting feature of the report by Mr. Benzenberg relates to the management of the water-works. When the year began no payment or credit was received by the water department for supplies for street sprinkling, drinking troughs, schools, parks or other city purposes. No provision had been made in the general city appropriation when the budget was fixed early in the year. In order to distribute the payment for the water furnished to the various city departments, the general ordinances were amended, making it the duty of the City

Comptroller to credit the water department annually with the several amounts due for water furnished, and to charge such amounts to the respective funds for the maintenance of the departments. In conformity with this ordinance, suitable provisions were made during the present year in the appropriations for the bureaus. This action on the part of the City Council is expected to ensure the water department a proper compensation from the departments for the water furnished for general city purposes, and to that extent relieve the water consumers, who have heretofore been compelled to pay for the water so furnished, while the large number of non-consumers escaped paying, though enjoying the benefits of fire protection, street sprinkling, city baths and all other general water privileges at the exclusive expense of the consumer. The sum thus obtained by general taxation during the current year is expected to amount to about $65,000.

The adjustment of the water rates in the city, which has already been referred to in these columns, comes in for an interesting discussion, which, on account of its importance, is reprinted in full: "Early in the year the Common Council requested the Board of Public Works to promptly readjust the water rates, whereupon the Board immediately applied to the Council for more definite information, first, whether the water supplied for all general or specific city purposes should be paid for by the city or its several departments, and second, whether the meter rates should be fixed at a flat rate or be classified according to the amount of consumption.

"No definite reply, however, was received from the Common Council to these two inquiries, so necessary to the Board to readjust the rates in a manner that would meet with their approval, until at its session of November 28, the Common Council directed the Board to revise the water rates so as to equalize the same on the basis of a flat rate per hundred cubic feet and maintain the revenue equal to the expenditures of the department, including the amounts necessary to pay for the interest and sinking fund of the bonded indebtedness of the department. This revision of the rates was to apply to both metered and unmetered consumers so far as it might be just and fair to each class according to the amount of water consumed by it, the different city departments to pay for the water consumed by them, the quantity to be determined by meter or by computation, and a special charge of $1 per annum to be made against each meter to cover the extra expense of reading it.

"In compliance therewith, and on the basis of the information collected on the subject of water consumption in this city, a revised schedule of rates was submitted on December 15 for approval by the Common Council. This schedule fixes the rate for all metered water at the flat rate of 4½ cents per 100 cubic feet, or 6 cents per 1,000 gallons, and $1 per annum for reading the meter, which constitutes the minimum rate for metered water. The regular or unmetered rate was fixed as equitably and uniformly as was possible for the unmetered consumers as a class, based upon a given quantity of water consumed by them, and each individual ratepayer of this class is entitled for such rate to a given quantity of water per day, as defined in the table based on the flat meter rate. This revised rate will materially reduce the revenue from the metered consumers, all of whom had to pay at the rate of 15 cents per 100 cubic feet for the first 25,000 cubic feet consumed each year. Of the 22,000 metered consumers fully 96 per cent. did not use more than that amount during any year. Based on the metered consumption of the past year, each of over 12,000 metered consumers will not, aside from the charge for reading meters, pay over $2, and each of over 5,900 metered consumers will not pay over $1 per year, a rate unparalleled by any other city in the country."

The result of introducing meters in Milwaukee is shown in the following table:

Water-Works Statistics, Milwaukee.]

Year.	Pumpage. Gallons.	Revenue per Million Gallons.	Number Taps.	Number Meters.	Daily Consumption per tap. Gallons.
1880	4,490,454,297	25.06	6,888	26	1,781
1881	4,855,501,612	27.36	7,584	28	1,767
1882	5,362,000,765	32.77	8,147	91	1,803
1883	5,397,876,086	34.27	9,133	221	1,619
1884	5,351,549,821	38.35	10,034	403	1,457
1885	5,692,803,528	38.98	10,990	572	1,461
1886	6,525,629,311	38.29	12,212	871	1,464
1887	7,332,490,248	34.72	13,243	1,728	1,517
1888	6,993,193,455	39.00	14,394	3,523	1,334
1889	7,201,074,028	39.63	15,732	4,749	1,255
1890	8,168,985,925	38.30	17,368	5,876	1,288
1891	8,756,954,720	37.89	18,838	7,526	1,274
1892	8,306,164,264	47.91	21,680	9,008	1,076
1893	9,116,454,429	47,27	23,863	11,347	1,047
1894	9,438,184,796	46.12	26,492	13,581	976
1895	9,232,334,480	47.87	29,797	15,951	849
1896	9,083,032,733	54.24	32,118	17,930	773
1897	8,628,500,514	45.52	34,304	19,966	689
1898	8,463,820,835	49.10	35,994	22,098	644

The department's records show that 70 per cent. of all private water pipe connections are metered at present. These services include those to all railways, manufacturing establishments and business houses in the city, yet the amount of water metered does not exceed that supplied to the remaining 30 per cent. of consumers whose supplies are not metered and are generally used for domestic purposes. Notwithstanding the enormous waste permitted among many of the unmetered consumers, the consumption per capita per day has been brought down to 80 gallons, and the consumption per tap per day has been reduced to 644 gallons.

The Water Commissioners of Newburgh, N. Y., have recently been troubled by the electrolysis of some of the pipes under their charge, and in their annual report for 1898 there are some statements concerning this subject from Messrs. Everett Garrison, John D. Van Buren and C. E. Hewitt. Voltmeter tests were made at forty different points along the whole line of the local railway, and the water pipes found to be from 4 to 43 volts negative to the rails at most places, although at several points they were 1½ to 4 volts positive. In the vicinity of the power house, where the pipes would naturally be expected to show a strong positive reading, the voltmeter needle stood at zero. On looking into the matter it was found that a heavy bond had been made between a neighboring water pipe and the conductor which returns the current from the rail to the negative pole of the dynamo. Hence whatever current might be following the water pipe would be returned by means of this bond without causing any serious effect to the main. The effect of this connection has been to make some strange alterations in what would be the normal electrical conditions of the pipes, for example at the place where the water pipe was found to be 43 volts negative to the rails, the return current of the railway was passing through the pipes, although the rail circuit back to the power house was much shorter. Had the rails been properly bonded the amount of current passing to the pipe would have been but a small fraction of what was actually indicated by the readings. Pipe laid bare at one of the spots where voltmeter showed electrolysis was probably taking place was found to be pitted by soft spots from 1/16 to 3/32 inch deep, having all the marks of electrolytic action.

The work of the City Engineer's department in Minneapolis during 1898 involved a number of new methods of carrying on street paving. For example, many of the alleys in the downtown portion of the city had been temporarily paved with cedar blocks 10 or 11 years ago and were in an unsafe and unsanitary condition. Some of the gratings over and around basement windows and areas were broken or totally wanting, and the walls supporting them in a dilapidated condition. Many manhole covers to the coal areas were ready to give way under the first heavy load to which they might be subjected. These alleys have been paved with brick on concrete foundations and with sandstone and granite blocks on sand. The areas and windows were put in good condition by the City Engineer's department by day labor. In setting the grating for window areas the plan was to build up the wall to the elevation of the bottom of the pavement, and there place a frame made of angle steel having its vertical length equal to the depth of the pavement. The grating was fitted neatly into this frame. The bars were supported at one end by an angle riveted to the frame on the alley side and at the other end on an I beam having its end riveted to the frame next the building.

The brick pavement was laid during the year by day labor. The brick was bought from the Purington Paving Brick Company of Galesburg, Ill., at $15.50 per thousand. The company guaranteed 57 brick per square yard and guaranteed the quality for ten years, provided sand filler was used in the pavement. The sand employed for filling was heated to about 150 to 200 degrees Fahrenheit and swept into the joints until they were flush. The pavement was then rolled until it became firm, sand was again spread over it and left half an inch deep on the surface. Asphalt filler was used in the alleys because water might leak through the areas around the openings and along the rough walls of the building.

Sandstone blocks were used for paving during the year for the first time in the history of Minneapolis. They were laid on streets having heavy traffic, and the City Engineer who signed the report, Mr. F. W. Cappelen, M. Am. Soc. C. E., states that every one seems well pleased with them, as the surface affords a good footing for horses and there does not appear to be as much noise as with brick or granite. The blocks were cut from 4½ to 5 inches wide, 10 to 15 inches long, and 6 to 7 inches deep. They were laid on a sand foundation and an asphalt filler was used; the cost of the work was $1.72½ per square yard.

The asphalt paving laid during the year is guaranteed for ten years by the contractor, the Ayres Asphalt Company. Two sections of the specifications for this work are quoted:

"All settlements, defects or damages in any portion of the pavement due to the use of defective material or workmanship, or to the proper use of the street as a roadway, or to the action of the elements occurring at any time before the expiration of ten years from the acceptance of the work by the City Engineer, shall, on demand, be promptly repaired and made good at the contractor's expense. Depressions or ridges causing variations in the surface of ⅜ inch or over, measured within the length of a 4-foot straight edge, as well as cracks ⅜ inch in width or over, or disintegrated cracks, must be properly repaired. And there will be retained out of the moneys payable to the contractor 10 per cent. of the amount of the contract, the same to be expended in making such repairs on the line of the street as the City Engineer may deem necessary. Upon the expiration of such period of ten years, provided the said pavement shall at the time be in good order, the contractor, upon the production of a certificate from the City Engineer, stating that the street is in good condition, shall receive the whole or such part of the sum last aforesaid as may remain after the expense of making such repairs in the manner aforesaid shall have been paid therefrom.

"In addition to the retention of the above 10 per cent. the contractor shall, at the time of the execution of the contract, give to the city of Minneapolis surety bond in the sum of 15 per cent. of the full amount of the contract, said bond to be approved by the Mayor, conditioned upon the full performance of the above guarantee on the part of the contractor to keep said pavement in good repair for a period of ten years from and after the acceptance of the work by the City Engineer."

The asphalt used for this contract is what is known as the Standard California brand. Mr.

Cappelen states that the work has been completed in a satisfactory manner and the surface is equal to any put down in the city. This is also the first pavement laid in Minneapolis where a chemist has been kept at the plant constantly, testing all the material that went into the paving. Particular care was also paid to the sand used, as the quality of this material was considered very important. Every kettle of asphalt cement was also tested to secure absolute uniformity in the pavement. It might be added, also, that the contractors voluntarily constructed 2-foot brick gutters at places where water formerly stood on the asphalt and that material was found to disintegrate rapidly.

Previous reports of the City Engineer have referred to the trouble caused by erratic and unnecessary sprinkling on asphalt pavements. In the report for 1898, Mr. Cappelen states that through the efforts of Mr. John Crosby, an alderman, no sprinkling has been done on any of the new work, but the streets have been cleaned during the day time by hand on the block system. The carriageways thus cleaned are stated by Mr. Cappelen to have "looked simply beautiful," and no complaints on account of lack of sprinkling was brought to his notice. In his opinion where an asphalt street is kept constantly wet it is impossible for the hand cleaners to gather up the slime which soon accumulates, and as soon as such a street becomes dry the slime is changed into an abominable dust, which can only be laid by sprinkling. "The wet streets are a nuisance to ladies and bicyclists, and without question very detrimental to the life of a pavement."

The construction of the new reservoir in Minneapolis has been followed by results described by Mr. Cappelen as follows: "A very peculiar fact is this, that the number of bacteria in the river water at the north side station is reduced from 25 to 50 per cent. by passing through the reservoir. The free ammonia is also reduced. One thing is certain, that the typhoid fever rate has, during the year, been wonderfully reduced, to wit: to 40 per 100,000 as against 70 in 1897. As most scientists familiar with the subject agree that typhoid is a water-carried disease, the above result is most gratifying, particularly when it is a fact that not since 1878 has the typhoid rate been so low in Minneapolis, and the only other time it occurred was in 1877. As 30 deaths from typhoid per 100,000 is conceded to be the permissible rate for good water supplies, it is most encouraging to see the decrease above referred to."

In the annual report of the City Engineer and Water-Works Superintendent of Oberlin, Ohio, Mr. W. B. Gerrish, are some figures concerning the operation of the sewer farm of that town, which was described in "The Engineering Record" several years ago. It has 3½ acres underdrained for filtration and 1¾ acres not underdrained which are used for broad irrigation. The land cost $1,500, and the expense of preparing the farm up to the present date has been $990. About 80,000 gallons of sewage are received daily. There are 443 connections with the sewerage system, and it is estimated that about 2,700 people live in the houses so connected. During the past year its operating expenses, including repairs and supplies, amounted to $567, which is equivalent to just 21 cents per person using the sewerage system.

The lighting of the pumping station of the Madison, Wis., water-works is now done by electric lamps in place of gas burners which were formerly employed. There were three of these burners in the engine room and two in the boiler room, which cost on an average $243.45 annually. Mr. John B. Heim, superintendent of the water department, recently had an electric plant installed for this service. It has a capacity of 50 lamps and cost $587.10. The interest on this sum, at 5 per cent., is $29.36 a year. The total cost of operating the plant during the past year was $37.57. The total expense for interest and operation is therefore $66.93. These figures show that financially the installation of the plant has been a success, while the improvement in the illumination of the station has been very marked.

The same report contains some interesting figures concerning the local use of water. The average cost of operation for each consumer during the year, exclusive of interest on the investment in the plant, was $4.45. There were 2,473 services in use, of which number 2,269 have been metered. The total amount of water pumped during the year was 273,017,000 gallons. Of this amount 97,521,000 gallons was registered by the metered services. Of these consumers, 806 paid the minimum rate of $2.25 per six months in January, and 1,061 in July. If the unmetered services are assumed to be supplied with water in the same relative proportion as those which are metered, they would have taken during the year 7,415,000 gallons; there was also pumped during the year 93,000 gallons for fire purposes. If these three amounts were added together and subtracted from the total pumpage, there remains nearly 168,000,000 gallons of water to be accounted for. Mr. Heim assumes that of this amount 60,000,000 gallons was used for street sprinkling, 34,000,000 gallons for schools, churches and public buildings, 34,164,000 gallons for the flushtanks of the sewerage system, or a total of 112,164,000 gallons. The remainder, nearly 56,000,000 gallons, is assumed to have been used for flushing, or as lost through leakage. Had the city been able to receive pay for each gallon pumped their revenue collected during the year might have been raised on a rate of 6½ cents per hundred cubic feet. As it was, the average meter rate paid was 15 2/3 cents per 100 cubic feet, and the average amount under the schedule rate was only 2.8 cents for the same amount.

WATER FILTRATION, ZURICH, SWITZERLAND.

[By James H. Fuertes, M. Am. Soc. C. E.]

The following article is a continuation of the series of papers on European Sanitary Engineering, of which the last, on sewage disposal at Kingston-on-the-Thames, appeared in the issue of April 8, 1899:

The main water supply of Zurich is taken from the lake of the same name through a pipe reaching about 660 feet out from the shore, the intake end being from 46 to 56 feet below the surface, according to the stage of the water. The water, before passing into the distribution system, is filtered through sand. Each of the filters has about 7,233 square feet of filtering area. Of the first five filters three were set in operation in December, 1885, and two early in 1886. Two more were built in 1892, and in 1895-96 it was necessary to provide three more; thus the present plant consists of ten filters with an aggregate effective area of 72,330 square feet.

As originally constructed the first three were covered with masonry vaulting, and the next two were left uncovered. The filters built at later dates were all covered, as the result of studies made in 1886-88, and in September, 1892, the two open filters were also covered. The earlier filters had concrete bottoms, on which a double layer of brick was laid with open joints, forming underdrain channels. Upon this brick floor was placed from 2 to 6 inches of coarse gravel, then, in successive layers, 4 inches of fine gravel, 6 inches of coarse sand and 31½ inches of fine sand. The rate of filtration in each filter was separately regulated by hand, and the loss of head due to the resistance to the passage of the water through the sand was indicated by floats. When the loss of head reached 24 to 32 inches the filters were cleaned by removing about ½ inch of sand from the surface with square-ended shovels. When about 20 inches in depth had been removed in this way the filter was refilled to the original depth with clean sand. After each scraping the filters were refilled from below with filtered water, and set in operation again. The open filters required cleaning much more often than those which were covered.

In 1887 the average period between cleanings of the covered filters was 77 days, while the uncovered filters required cleaning on the average every 48 days. In 1892 and 1893 both kinds of filters were cleaned more frequently than in 1887, yet the open filters required the treatment at shorter intervals than the others, as is shown by the following tables from the report of the Stadtrat of 1893:

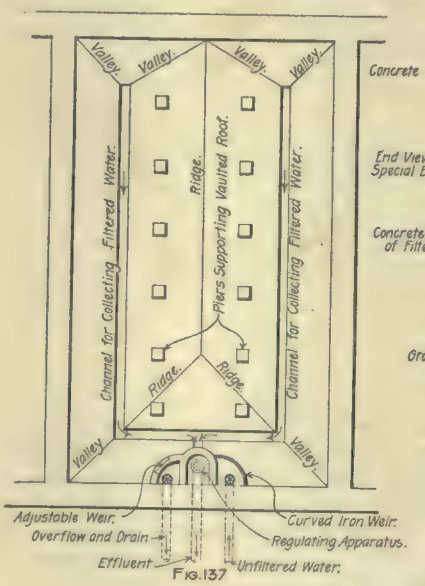


FIG. 137

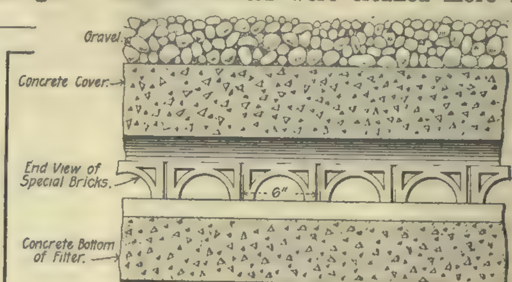


FIG. 138

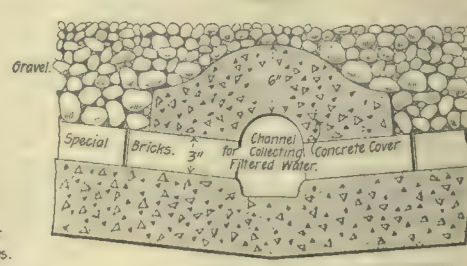


FIG. 139

THE ZURICH WATER FILTERS.

Number of Days Between Cleanings.

	Covered Filters. 1892.	Covered Filters. 1893.	Open Filters. 1892.	Open Filters. 1893.*
Minimum	19	12	11	13
Average	36	27	23	20
Maximum	69	73	50	39

* 1893 to the middle of September.

Gallons of Water Filtered Between Cleanings.

	Covered Filters. 1892.	Covered Filters. 1893.	Open Filters. 1892.	Open Filters. 1893.
Minimum	26,420,000	9,168,000	19,419,000	13,606,000
Average	44,914,000	31,255,000	29,855,000	21,532,000
Maximum	76,618,000	116,658,000	47,952,000	51,572,000

Upon each of the open filters there would frequently form a thick layer of green algae, which not only clogged the surface rapidly, but also gave much trouble through the floating to the surface of gas bubbles carrying with them portions of the algae growth, thus disturbing the surface of the filter and allowing raw water to pass through the sand to the underdrains. The covered filters were free from this objection because the algae did not grow in the dark. Aside from this trouble the open and covered filters were equally efficient from both the bacteriological and chemical standpoints, excepting when occasionally in winter, during the removal of ice from the open filters, the top surface would be disturbed.

In 1886, 1887 and 1888 a series of tests were made to determine what would be the effect on

the effluent of changing the rate of filtration between wide limits. The following table contains a summary of these tests, compiled from the report of the city chemist, Mr. Alfred Bertschinger:

Rate of Filtration.	No. of Observations.	Org'nic Matter Mgr. per Litre.	Ammonia Mgr. per Litre.	Albuminoid Ammonia Mgr. per Litre.	No. of Bacteria per Cu. Cm.
In the Winter of 1887.					
Less than 3.28 ft......	6	18.5	0.010	0.034	19
From 12.5 to 16.4 ft....	15	17.7	0.004	0.032	51
From 22.3 to 28.2 ft....	29	19.7	0.004	0.033	23
From 32.1 to 44.0 ft....	28	18.8	0.006	0.032	18
Over 65.6 ft............	3	20.2	0 006	0.037	18
In the Summer of 1888.					
From 8.9 to 10.8 ft.....	7	14.5	0.003	0.022	21
From 12.5 to 16.4 ft....	19	14.2	0.003	0.022	11
From 22.3 to 26.2 ft....	40	14.3	0.003	0.022	22
From 32.1 to 49.2 ft....	25	15.2	0.003	0.022	12

The rate of filtration given in these tables means the actual depth of water passing through the filters in 24 hours. The figures given above are averages. The limits of speed ranged from 8 inches to nearly 93 feet per day, and, so far as any inferences may be drawn, the removal of bacteria was independent of the speed. Mr. Bertschinger concludes that the top surface of the filters removed all the bacteria in each case, and that those found in the filtered water probably had grown in the lower part of the filter and underdrains, or in the pipes and reservoirs. In order to demonstrate that the number of bacteria increased after the filtered water had passed into the mains, analyses were made, of which an abstract is given in the following table:

Average Number of Bacteria per Cubic Centimeter.

Year.	In Lake Water at Filters.	In Filtered Water at the Pumps.	In Filtered Water Drawn from Faucet in Town.
1886	178	26	30
1887..............	226	18	38
1 88..............	188	19	35

Probably the principal reason that the great rates of filtration used in the foregoing experiments showed no effect on the removal of the bacteria is that the lake water itself contains so few bacteria, probably about 200 per cubic centimeter on the average. With waters containing greater numbers of bacteria the results have not been found to agree with these.

The special features of the new filter beds are the concrete vaulting, the underdrainage system and the automatic regulating apparatus. The regulating apparatus with the indicators of the filtration head and water level in the filters and small balancing reservoir were described fully in the issue of August 1, 1896, of "The Engineering Record."

The water from the lake cannot be delivered upon the filters by gravity, and therefore it is lifted by a centrifugal pump driven by a small hydraulic motor. The lift varies from about 3.2 to 10 feet.

Figure 137 gives a sketch plan of the bottom of one of the new filters. The whole bottom, excepting the channels leading to the outlet is covered with specially made bricks, Figures 138 and 139, which offer little obstruction to the flow of the water to the outlet. Over the collecting channels, which are kept clear of bricks, there are placed special cover plates of concrete, as shown in the drawings.

The filtering materials consist of 8 inches of coarse gravel, covered with 8 inches of fine gravel, and on top of this about 22½ inches of sand. The water is admitted at the level of the top of the sand, and enters the filter over a long, curved iron weir in a corner near the regulating apparatus, to prevent the disturbance of the sand surface. Under normal conditions the water stands about 5 feet deep on the sand, and the filtration head is increased by allowing the water to fall in the outlet well, the regulating apparatus being so designed that the water passes through the filter at a uniform rate at all times, and the filtration head automatically adjusts itself to deliver the given quantity while the filter surface is slowly clogging.

When a filter will not deliver the required quantity per hour, with the allowable loss of head, the surface is scraped and raked over, and the sand removed in the process is taken out and washed. The period between scraping varies greatly with local conditions.

PROPELLER PUMPS.

In "The Engineering Record" of March 25 there was printed a brief description of a deep-well pump designed by Mr. P. K. Wood, of Los Angeles, Cal. The pump illustrated and described is a screw propeller, with spring guides, which serve the double purpose of checking the whirling motion of the water and preserving the alignment of the shaft. The following notes on a similar form of pump have been received from Mr. Dabney H. Maury, Jr., M. Am. Soc. M. E., engineer and superintendent of the Peoria Water-Works Company:

"In 1895 I designed, constructed and put in operation for the Peoria Water Company, screw propeller pumps on exactly the same principle of those designed by Mr. Wood. Instead, however, of the shaft being steadied by curved spring guides, the guide blades in my pump were radial, starting at the shaft bearing and terminating in an outer ring a little smaller than the diameter of the pipe or well casing. The radial guide blades were curved somewhat like those of a downward flow turbine, the object being to take the whirling water above the screw propeller with as little shock as possible, and deprive it of its rotative energy by transforming its rotary motion into a vertical one. In effect, each screw propeller with its guide blades was a turbine running backwards and lifting water, instead of being driven by falling water.

"Various forms of propellers were tried, two, at least, being of the screw type, while a third was like the turbine wheel. The outer rings, which were made in one piece with the guide blades and the shaft bearings, were fitted on their outer edges with projecting rubber gaskets so adjusted as to allow the whole apparatus to be raised or lowered in the well casing, while at the same time fitting the casing closely enough to keep the shaft steady. These pumps were driven by a Pelton wheel on the same vertical shaft, the Pelton wheel being driven by water from the force main of the high-duty pumping engines at the pumping station. The weight of propeller pumps and shaft, as well as that of the Pelton wheels, was carried by ball bearings above the Pelton wheel. The water lifted by the propeller pumps flowed by gravity to the main well, from which the city's supply is taken, while the water used to drive the Pelton wheels was not lost, but flowed to the same well through the same pipe.

"The screw pumps referred to successfully lifted water. The experiment was also tried of prolonging the shaft of a vertical centrifugal pump down into the well and fitting this shaft with propeller pumps of the type already described, the object being to keep the suction pipe of the centrifugal pump always supplied with water, while depending upon the centrifugal pump to do most of the work of lifting. As the propeller pumps, neither alone nor combined with the centrifugal pumps, gave the efficiency of centrifugal pumps working alone, the latter were used instead. The system is covered broadly by United States patent to me. I hold no patents on screw pumps, and I did not know before I designed my screw or turbine pump, that others had done the same thing before me. I have since found a large number of patents—some of them more than fifty years old—on devices more or less similar to my own, and to the pump referred to in your issue of March 25.

"In 'The Engineering Record' of April 2, 1898, is an article entitled Auxiliary Suction Pumps, in which is described the addition to the Bremen water-works plant. In 'Zeitschrift des Vereines Deutscher Ingenieure,' March 12, 1898, is given a fuller description of the Bremen plant, and an abstract of an American article, describing our supplementary plant here. The same patents which cover the plant described in the latter article cover, also, another installation similar to that at Bremen, but designed and begun by me, here, four years ago, or about three years before the Bremen plant was put in. A brief description of both of our plants was given verbally by me to the American Water-Works Association at Indianapolis in 1896, and will be found on pages 67 and 68 of the 'Proceedings' for that year. The later plant, which now embodies many practical improvements over our first installation, consists of Pelton wheels driven by water from the force mains of the main pumping engine, and driving centrifugal pumps which lift water into a tank built around the suction pipe of the main engine, the pressure-water used to drive the Pelton wheel being discharged into this same tank. There are four units consisting each of a Pelton wheel and a 2,500,000-gallon centrifugal pump on the same vertical shaft. Careful tests made here, show a combined efficiency of Pelton wheel, line shaft and centrifugal pump of over 52 per cent., not including pipe-frictions.

"This auxiliary suction plant not only shortens the suction lift of the main engines, enabling them to work without taking air or jumping, and lessening materially our repair bills, but it also increases the water supply very considerably by pumping from a level some 20 feet lower than could be reached by the suction pipes of the main engines. At the same time the main engines, instead of having, at times of low water, to be run two at a time, at one-quarter speed, for the full 24 hours, and with a consequently very great loss of economy, can, with the aid of the auxiliary plant, be run one at a time, at best and most economical speed for just as many hours as may be necessary to furnish the required water. So that it is much cheaper, at low stages, to run the main engines with the auxiliary pumps than without them, in spite of the added lift. This plant will probably be described more fully later in a paper before one of the engineering societies."

THE AMBALLA WATER-WORKS.

The works for supplying water to the cities of India have many features of interest to American engineers, not so much for the precedents they offer as for the novelty of some of the methods employed to overcome the peculiar difficulties against which the Anglo-Indian engineer must contend. In "The Engineering Record" of September 10, 1898, an interesting paper on the water-works of Simla was printed, and in the present issue another by the same author, Mr. Charles E. V. Goument, Assoc. M. Inst. C. E., is reprinted from the "Selected Papers" of the Institution of Civil Engineers. It describes the works of Amballa, an important railway town of about 250,000 population in South Punjab. The works were projected in 1887 by Messrs. J. W. Wright and B. G. Wallis; the plans were modified by Mr. J. M. Campion in 1891, and revised and carried out by Mr. Goument. The plant was designed to furnish 7 imperial gallons per capita daily to a population of 30,000, about 15,000 gallons to the police and civil lines, and 22,500 gallons to the jail, making the total maximum daily supply 247,500 imperial gallons. The supply is derived from twenty wells, situated about 8 miles from the city, on the right bank of the Tangri River. The water table at the site of the wells is 6 feet below the ground level and falls towards Amballa, where it is more than 30 feet below ground-level. The ground also falls towards the town, the difference of level being about 45 feet. The water is conveyed to the town

through an 8-inch iron main by a dual system which combines gravitation and pumping. The former, taking advantage of the natural slope of the ground and water table, delivers about 4,000 gallons per hour into the service reservoir in the city when the pumps are not working. The pumps supplement the gravitation supply and force the remainder through the same main at a velocity of 3 feet per second, which scours out the main and keeps it free from sedimentary deposits. The water is delivered in the town into an elevated circular steel reservoir, which rests on a circular brick tower 26 feet high, and holds one day's supply. It is distributed from this tank through a network of cast-iron piping, varying between 12 inches and 3 inches in diameter, and 75 standposts placed at convenient points in the streets.

The site of the wells is a tract of sandy waste land between the Tangri River and one of its main branches; about three-fourths of a mile from the former and a fourth of a mile from the latter. Both these channels run full and discharge a large quantity of water during the monsoon months—July to September—but they are dry for the rest of the year. There are no villages, tanks or other sources of pollution within a considerable distance of the wells, but, as an additional safeguard, an area of 2,000 feet by 1,000 feet has been taken up round the wells and is strictly preserved. The wells are constructed of bricks in lime mortar and are covered with a concrete dome. Their internal diameter is 7 feet, and they are pitched 60 feet apart, center to center, in a line normal to the direction of slope of the water table. The depth of the wells is about 40 feet. They all terminate in sand of varying degrees of coarseness. Six wells in the middle of the line are entirely in sand. The rest have passed through bands of clay of varying thickness. The water-level is about 6 feet below the surface, and its extreme fluctuation, as observed at different times of the year for several years, has not exceeded 15 inches above or below this level. The estimated yield of the wells had been based on extensive experiments on trial wells sunk on the site. These experiments had been made on single wells, and showed that a well 7 feet in diameter would yield 15 gallons per minute under a head of 7 feet. It had therefore been assumed that twenty such wells, pitched at such a distance apart as to avoid intersection of the deeply-depressed portions of their surrounding cones of exhaustion (as observed at the trials) would yield, approximately, 300 imperial gallons per minute. The actual yield of the wells placed 60 feet apart is, however, found to be only about 195 gallons per minute. The cones of exhaustion round the wells are now somewhat larger than those observed during the trials, but the difference is not considerable, and would not altogether account for the actual yield being so much lower than that estimated. The main reason for the difference would seem to lie in the very variable character of the soil. The yield of each well has been tested independently by noting its rate of recoupment after it had been pumped down 7 feet below normal, and it is found that the yield of the different wells is very variable. The recoupment of some of the wells, which are in very coarse sand, is found to be better than that observed in the trial wells from which the estimate was formed; while others, in finer sand, do not give nearly such good results. At present the supply from twenty wells is sufficient, but the demand must increase considerably in the near future. When a larger supply is required more wells will be added and connected with the present system. The bottoms of the wells have been loaded with 2½-inch stone ballast, 6 feet deep, to prevent sand creeping into them, but it has been found that this loading, though it effectually prevents blows, does not completely check the gradual ingress of sand under the head to which the wells are pumped, viz., 7 feet. The increase of sand at the bottoms of the wells is, however, very slow, and it is believed that it will stop when the accumulation has reached a certain limit.

The wells are connected by a line of 9-inch cast-iron pipes laid parallel to the line of wells with 4-inch pipe connections to each. These pipes are laid 3½ feet below normal spring-level, and act as suction pipes for the pumps when these are working, and collecting pipes for the gravitation main when the pumps are not at work. As these pipes are laid under water in a treacherous sandy soil, they are provided with flexible joints. The main 9-inch pipes have Maclaren rubber joints, and the joints of the 4-inch branches are of the ball type. The depth at which the connecting pipes are laid, viz., 3½ feet below ordinary spring-level, has been fixed by the following considerations: 18 inches has been allowed as the maximum fall of water-level due to continued dry weather and other causes (the maximum observed being only 15 inches); the other 2 feet give the head, under which, as ascertained by previous experiments, the wells are capable of yielding the full supply which the gravitation main can carry away at the gradient at which it is laid.

There are two pumping engines and two boilers. Each engine is capable of forcing 375 imperial gallons per minute with a velocity of 3 feet per second through an 8-inch main 8 miles long, which has a fall in this length of 17 feet from the axis of the pumps to the high-water level of the service reservoir in the city. The pipes being at present new and smooth, the hydraulic pressure registered by the gauge at the pumps when the engines are doing this duty is only 160 feet; but the engines are designed to deliver the water with a velocity of 3 feet per second under a head of 242 feet, to which it is calculated the pressure will rise when the main becomes encrusted and rough after some years' use. The engines are of 30 horse-power and of the compound horizontal condensing fly-wheel type. An air-ejector is fixed above the pump-barrels to draw water into the pumps and charge them fully before the engines are started. This is accomplished in the ordinary way by blowing steam through the ejector and creating a vacuum. The ejector does away with the necessity of having foot-valves on the suction pipes in the wells, which would have offered obstruction to the gravitation flow. As the delivery main falls away from the pumps, a loaded valve is fixed on it to give the engines a load when they start.

The suction pipes, 9 inches in diameter with flange joints, are just laid above ordinary water level, and join the 9-inch pipe-line connecting the wells in the middle of its length by a vertical bend and T-pipe. A stop-valve is fixed on each side of this connection, which enables half the wells to be cut off at any time for examination or repairs while the other half are still available for supplying the town.

The delivery main is 8 inches in diameter, and it is 3,400 feet in length to its junction with the gravitation main. It might have joined the gravitation main immediately beyond the pumping station; but as that main is below spring-level for a distance of 3,400 feet from the wells, and is not easily accessible for repairs, it was deemed advisable to lay a second line of pipes for the pump delivery at a depth of 3 feet below ground up to the point where the gravitation main emerges above spring-level.

This main is 8 inches in diameter, and it is laid below a hydraulic gradient line drawn from the high-water level of the service reservoir in the town to the level of the pipes connecting the wells. For a distance of 3,400 feet from the wells, the pipes are laid below spring-level, and have flexible rubber joints. From this point onwards the pipes are turned and bored with the usual percentage of lead joints to allow for expansion and contraction. The length below water-level is provided with hatch pipes and manholes every 500 feet, to facilitate inspection and location of accidents. A stop valve is fixed at the head of this length where it takes off from the connection pipes of the wells, and another at its lower end where it is joined by the delivery pipes from the pumps. By closing these two valves, this length of pipes is cut off entirely from the pumping system. An open vertical pipe is fixed near the stop valve at the upper end, which acts as an air escape, and also provides a means of scouring this length by pumping back through it from the point where it is joined by the delivery main.

Beyond the junction of the two mains the pipes are laid in the ordinary manner at a mean depth of 3 feet below ground. There are 4-inch scour valves at each depression, and 1¾-inch air valves at each summit, or every 5,000 feet where summits do not occur for long distances.

The service reservoir was designed by Mr. Goument on the principle of the Norton Tower on the Vyrnwy Aqueduct, constructed by Mr. G. F. Deacon, M. Inst. C. E. [See "The Engineering Record" of October 3, 1891.] It compares favorably in cost with other designs, and the economy of the design would obviously have been greater if the tower had been higher. Its other advantages are: (1) the accessibility of all its parts for periodical painting and repairs; (2) its perfect freedom for expansion and contraction from variations of temperature.

The spherical bottom and the hoop girder from which it is suspended are built of mild steel plates of special quality manufactured in Scotland, and the upper cylindrical portion is of wrought iron. The inside of the tank is coated with asphalt varnish, composed of one part of asphalt and two parts of coal tar, laid on in two thin coats. The capacity of the tank is 220,000 imperial gallons.

THE WATER PROBLEM OF LANCASTER, PA.

The water supply of Lancaster, Pa., is now in such a condition that it has become necessary to make some important changes in the plant, mainly to rid the water of sediment which it contains at times. A number of engineers have reported in recent years on the works, the last being Mr. Allen Hazen, Assoc. M. Am. Soc. C. E., who was recently retained to investigate the clarification of the supply. This subject is so intimately connected with other features of the needed improvements that this engineer's report was obliged to take the whole problem of betterments into consideration. The report is of more than local value, as the following review of its leading features will show.

The water is taken from Conestoga Creek, having a drainage area of about 350 square miles. Nearly the whole of this catchment basin is rolling land, having an unusually dense population for farming country, amounting in fact to about 95 per square mile. There are several small towns on the watershed, but there is no particular point of pollution other than the general surface washing. A chemical analysis of the water shows that it carries at all times enough lime to enable sulphate of alumina to be used satisfactorily as a coagulant in connection with mechanical filters. The water becomes muddy at times and the main problem is to clarify it. The filtration of the supply to remove the effects of sewage pollution and surface washing from tilled land is important, but secondary to clarification.

The turbidity of the water in the creek was observed daily from September 6, 1898, to April 1, 1899, by noting a depth at which a platinum wire 0.04 inch in diameter could be seen at noon. The reciprocal of this depth in inches

was taken as the measure of the turbidity. The observations ran from 0.02 to 2.00, averaging 0.06 in September, 0.05 in October, 0.13 in November, 0.16 in December, 0.13 in January, 0.10 in February, and 0.29 in March. Mr. Hazen states that the amount of mud carried by the creek is about the same as that in the Allegheny River at Pittsburg, but only a small part of that carried by the Ohio River at Cincinnati and Louisville. During short periods the water at Lancaster is worse than that at Pittsburg, but the muddy water does not run so long.

Conestoga Creek is not a large stream, and becomes very low in continued dry weather. No gaugings have been made of the low-water discharge, but some observations taken by Mr. E. F. Frailey, superintendent of the water-works, indicate that the total flow of the stream during a period of very dry weather does not exceed 8,000,000 gallons per day or 0.035 cubic foot a second per square mile of watershed. The city is now using over 6,000,000 gallons per day on an average, and the maximum consumption is already equal to the minimum flow of the creek. It is evident that if the consumption is allowed to increase there will be a serious shortage of water when the next severe drought occurs. To obtain water from another source will be very expensive, and Mr. Hazen very naturally advises the city in the strongest terms to use its present supply less wastefully. The quantity of water now pumped is about 140 gallons per capita daily, at least twice as much as is necessary. The city is advised to extend its meter system in order to check this waste, particularly as the results of the use of meters on the service pipes of large consumers has been to keep down the consumption in 1898 to what it was in 1892. Mr. Hazen shows that, under the present system of fixture charges, some of the consumers allow water to flow through leaky plumbing fixtures into the sewers in unlimited quantity, and the only protection which the city has against such waste is house to house inspection, usually an inadequate procedure. "Only a fraction of the population will waste water in this way, but experience shows that this fraction, if unchecked, is capable of wasting enough water to run up the total consumption to an alarming extent. Under the meter system each person who wastes water is obliged to pay for it precisely as if it was used, and under these conditions the wastes quickly disappear."

The city is now supplied practically by direct pumping. During August, 1898, the pump records show that the maximum supply in 24 hours was 8,118,000 gallons, of which about 58 per cent. was supplied during the 12 day hours. These figures were used by Mr. Hazen as the basis for laying out the new works. If sand filters are used he advises constructing a 13,000,000-gallon reservoir, into which water will be pumped directly from the river. Thence it will flow to four filters, each with an effective area of 0.83 acre, and after passing through these sand beds it will go to a pure water reservoir holding about 2,000,000 gallons, which will equalize the fluctuation in the demand for water for domestic purposes, and also afford a sufficient storage for the purpose of fire protection. The raw-water reservoir is large enough, so that no water need be taken from the creek for periods of 36 to 48 hours, when the supply is extremely muddy, and at all times it will afford an opportunity for some sedimentation before filtration. The total cost of such a plant, including land, is estimated at $278,500. The estimated cost of maintenance, based on an average annual consumption of 6,500,000 gallons daily, is as follows: Operating expenses of filters, including the cost of preliminary pumping from the creek to the reservoir, $8,250; interest on the cost of plant, at 3½ per cent., $9,747; depreciation and sinking fund charges, $5,600; total cost of maintenance, $24,167. The depreciation and sinking fund charges are taken large enough to retire the cost of the pumps in twenty years, and of all the structures in thirty years, but no depreciation is reckoned on the cost of land. In the case of the mechanical filtration plant, it is proposed to install the filters over a clear-water reservoir in order to save any additional expense for land. No raw-water reservoir is provided, as the additional amount of sulphate of alumina required for the coagulation of the river water will not cost as much as the fixed charges on such a reservoir. The plant is assumed to contain twenty mechanical filters, 17 feet in diameter, and rated at 500,000 gallons each daily; the total cost of this plant is estimated at $189,000. The estimated cost of maintenance for the same annual average consumption as before is as follows: Sulphate of alumina, one grain per gallon of water filtered, including wash water, $5,000; all other expenses of operating filters, including cost of preliminary pumping, $6,500; interest at 3½ per cent., $6,616; depreciation and sinking fund charges, $7,000; total cost of maintenance, $25,116. The life of the filters has been taken at 15 years in computing the depreciation, and all other structures are assumed to last as long as similar works for sand filters. Under these circumstances Mr. Hazen recommends the construction of sand filters, and in so doing takes occasion to point out the benefits to be derived from filtration in the following words:

"The inconvenience of muddy water is so obvious as hardly to require comment. I believe that from this point of view alone the cost of filtering water would be more than justified by the results accomplished. There is, however, another point which deserves attention, namely, the danger from water-carried diseases by the use of raw water. You have been thus far very fortunate in this respect, and your location is favorable in that there are no large towns or cities upon your creek which discharge sewage into it. The population upon the watershed, however, is very dense, and while large quantities of sewage are not discharged into the creek at any one point, the amount of waste material which enters it and its tributaries on the whole watershed must be very great in the aggregate. Pollutions of small streams by rural populations are very irregular in amount. Sometimes they do not show themselves for years; occasionally they give rise to very grave consequences. If matter containing the germs of typhoid fever enters the stream or its tributaries, as it may do at any time, its effect on a stream as small as the Conestoga would be many times more serious than it would be in a larger river. The experience of Plymouth, Pa., where the dejecta from one man caused a very serious epidemic, and of Lowell, Mass., where a few cases upon a small tributary of the Merrimac River at Chelmsford caused a very serious outbreak in Lowell, are cases in point. The conditions on Conestoga Creek are in every way favorable for the transmission of disease germs, and the fact that you have thus far escaped serious consequences cannot be taken as an indication of the safety of your present condition."

THE SEWERAGE OF LONDON, ONT.

The sewage of the City of London has been discharged into the River Thames and other water courses for a number of years, but, owing to suits arising on account of pollution, a system of intercepting sewers is now under construction, which will conduct the sewage to filtration beds. The following information concerning the undertaking has been taken from a paper by Mr. W. T. Ashbridge, assistant engineer in charge of the work, presented recently to the Canadian Society of Civil Engineers.

The brick sewers vary in size from a 20 x 30-inch egg-shape to a 26 x 39-inch egg-shape and a 36-inch circular sewer. Wherever shaky or quicksand bottoms were encountered timber cradles were used as a foundation, and were generally made of 1-inch planks nailed to 1 x 4-inch ribs, 18 inches apart, cut to the proper shape. The ribs were usually fastened on the under side of the planks and the cradles, which were 4 feet 6 inches long, were forced into the bottom by the workmen standing or jumping on them. With these cradles the difficulty has not been one of keeping them up, but of holding them down, and it was usually necessary to do this by struts until the brickwork was somewhat advanced. In one section the planks were fastened on the under side of the ribs, and the spaces between the latter filled with 4 inches of concrete, which was allowed to set at least 24 hours before they were lowered into the trench. These were used on a section where the sewer is laid along streets adjacent to and occasionally crossing the line of a creek in which the level of the water is 5 to 8 feet above the invert of the sewer. The cutting is mostly sand, and so far as completed there has been enough water to keep a centrifugal pump, with a 3-inch discharge, working steadily.

The construction on this section consists of a single ring of brickwork surrounded by concrete of varying thickness. To place this concrete to the best advantage, the bottom portion, 4 inches, is mixed and molded as before stated into the wooden cradles on the bank, and is allowed to set hard before being lowered into the trench. The weight of these is about 700 pounds, and they are made in 4-foot lengths. To enable them to be easily calked, small strips of canvas filled with grass are nailed to one end of each, and when the cradles are being laid they are pressed tightly together. This forms a very good joint, and is only required temporarily to allow the inside ring of bricks to be laid. The pump is set about 50 feet ahead of the completed brickwork, and when in operation draws water from both directions, that portion which is near the sewer being conveyed through 2½-inch tiles laid on each side of the cradles. This method has proved very successful, and effectually prevents the water and quicksand from boiling up through the bottom. Occasional entrances into the sewer were left to allow the ground water to drain away. These weepholes are afterwards closed, but not for some weeks after the work is laid.

The new sewers were designed on the separate system, and where connections with old sewers carrying storm water were made, special forms of overflows were necessary. The general design of these consisted in carrying the new house sewer beneath the storm sewer, the invert of the latter over the former being made of flat iron plates ¾ inch thick. In the invert of the storm sewer, just above the house sewer, is an opening to a channel leading to the house sewer. The invert of the storm sewer on the lower side of this opening is a few inches higher than on the upper side. In times of ordinary flow all the sewage drops through this opening and runs into the intercepting sewer below, but during rains most of the storm water flows across the opening and remains in the storm sewer. The width of the opening can be varied at will by means of removable blocks. There are in all some sixteen connections arranged in this way. Overflows and relief outlets have also been left at various points, consisting of openings built in the sides of the sewer and closed with wooden doors, whose tops are set at the required height of overflow. If necessary the doors can be lifted and the whole flow diverted temporarily.

Flushing gates, closing against the current, were placed on certain sewers at intervals of 1,000 to 1,500 feet. They are held shut by a bar of iron with a forked end jammed against an inclined rod, and when sufficient water has accumulated behind the gate the bar is pulled or knocked out, the door swings back or is

lifted, and the flush is immediate and substantial. Along one sewer, inlets have been made to utilize the creek water for flushing purposes. Each consists of a large and small chamber, the former being 4 x 6 feet by 14 feet long, having an outlet to the sewer 2 feet from the bottom, and being separated from the small chamber by a 14-inch wall at the other end. This latter is really two chambers covered with gratings set in the bed of the creek. One of these small chambers connects with the large one by a grating, and is intended for an ordinary flow. Should a large flush be required, it can be had by opening a gate valve connecting the other half of the small chamber with the large one.

To carry the sewer across the river at one place, a bridge was built, and was made to serve highway purposes as well. The bridge has a central span of 162 feet, and viaduct approaches of 468 feet, making a total floor length of 630 feet. A steel riveted pipe 36 inches in diameter was carried under the floor throughout the length. This pipe was made of ¼-inch metal, painted with two coats of graphite over one coat of red lead. Inside the pipe no rivet heads show below the horizontal diameter. The pipes were brought on the ground in 32-foot lengths, and as much as 200 feet of them were laid in position in one day. To facilitate jointing the butt-strips on the pipes were made in two parts, on one length this strip being shop-riveted to the lower, and on the next length to the upper half, thus saving some trouble in fitting. The curves were made to a 74-foot radius, the center of each cross seam lying on the arc of the circle. The work went easily together, and in only a few cases was it necessary to alter the positions of the saddles on the beams. About five joints were riveted and calked in a day.

To reach the sewage farm a long stretch of low lands had to be crossed. This land being from 2 to 16 feet below the grade line of the sewer, it was decided to lay an inverted syphon, and in order to make the most of the ordinary dry weather flow, the size was reduced to 20 inches in diameter, the intention being to lay an additional 24-inch pipe when required, and thus bring the total capacity eventually to that of a 30-inch pipe, which it was originally intended to lay at once. The object is to have as great a present velocity as possible. Cast-iron pipes were used, specified to weigh at least 1,620 pounds per 12-foot length. They were laid in the same manner as water pipes. The descending leg of the syphon is a brick well 10 feet in diameter, and 13 feet deep below grade, connecting with the pipe by a 20-inch gate valve. From this well a 16-inch pipe leads to a relief sewer running to the river, a separate connection being made also with this relief from the upper grade. These are for purposes of overflow for storm water, and for diverting flow when necessary to examine the syphon. Over this syphon well a house will be built to cover valve gear, etc., and to allow the sediment and coarse screening to be removed easily. The ascending leg is not now being built, but it is intended to make it a 20-inch pipe. From its foot a 20-inch pipe is laid to the river, and at present the whole flow will be discharged there. Mr. A. O. Graydon, Assoc. M. Am. Soc. C. E., is city engineer, and Mr. Willis Chipman, M. Am. Soc. C. E., was the consulting engineer for the sewers and sewage disposal plant.

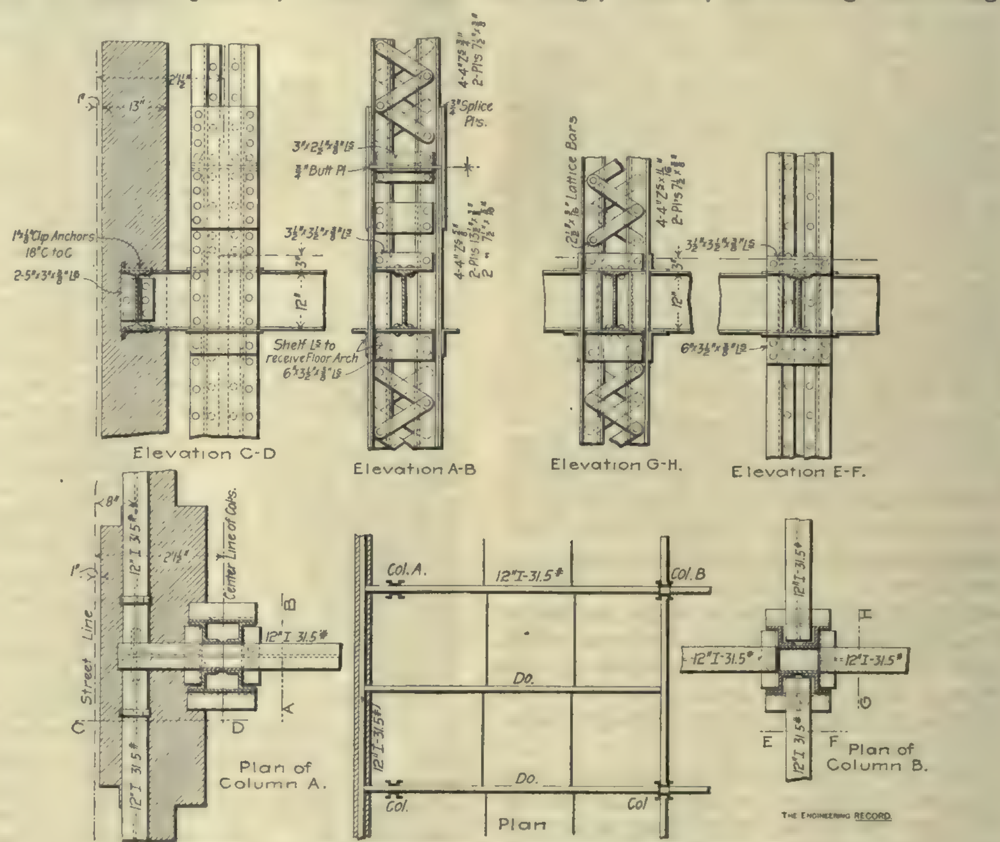
COLUMN AND BEAM CONNECTIONS IN THE WILLIAMSON BUILDING.

The Williamson Building, which is to occupy a prominent position at the corner of Euclid Avenue and Public Square, in the city of Cleveland, Ohio, will be a sixteen-story office building, with a frontage of 92 feet on the Square and 116 feet on the Avenue and a height of about 200 feet above the sidewalk. It is to be of fireproof steel cage construction, and special pains have been taken to secure the utmost economy in design, while preserving the essential features of rigidity and strength.

In studying to reduce the number and weight of pieces for the connections of the wall-bearing girders, a simple and efficient detail of construction was devised, which, although so easy and direct as to appear obvious, yet is apparently just one of those details which have hitherto been overlooked.

Every column is made of two pairs of Z bars, each pair riveted to a web plate and separated a few inches from the web of the other pair, the two pairs being connected by lattice bars and batten plates riveted to their outstanding flanges. Figure I is a diagram of the gėneral arrangement of columns, beams and wall girders, showing that while the floor beams abut against, and are connected to, the sides of the interior columns, they extend continuously through the center of the exterior or wall columns, projecting beyond them in such manner as to form cantilevers which carry the wall girders for the support of the masonry. All beams are connected to the columns by simple brackets of standard patterns, riveted to the flanges of the Z bars above and below, and securing their upper and lower flanges. The lower angles, or seat brackets, are all shop-riveted to the columns, and the exact distance between centers of holes in the beam flanges carefully laid out. After the beams have been placed in position in the field, the upper angle brackets are assembled and field-riveted with iron rivets, thus ensuring perfect bearing, close fitting and great rigidity, with a minimum outlay of shop-work and material.

By the use of the floor-beam as a continuous girder, with the wall-load concentrated at the end of the short arm reacting against the floor-load distributed on the long arm, considerable economy of material is obtained and a noteworthy percentage of saving is effected in the weight of the floor system. The simplicity of the shop-work, which especially avoids all cutting of beam flanges, renders its execution easy, and facilitates erection, thus reducing the cost of construction in a practical and effective manner. To Mr. Geo. B. Post, M. Am. Soc. C. E., architect, and to Mr. Amory Coffin, M. Am. Soc. C. E., structural engineer of this building, acknowledgement is made for the data here presented. The shop-work and erection will be done by the Van Dorn Iron Works, Cleveland.



COLUMN AND BEAM CONNECTIONS, WILLIAMSON BUILDING.

MASSILLON STATE HOSPITAL.

(Continued from Page 455.)

The Massillon State Hospital, which consists of a colony of buildings near Massillon, Ohio, was described in part in the preceding issue of "The Engineering Record." A plan of the general arrangement of the buildings was given and some of the various buildings were described and illustrated. In the present connection, attention will be directed almost entirely to the engineering features of the hospital.

A separate building is set apart for dining purposes and occupies at present a prominent position among the group of buildings. It stands at the front of the axial line, about which the buildings are scattered, and is a large building with a single lofty story, built of brick, with rock-faced foundations and tiled roof. In ground plan it consists of a long, narrow building with a large wing on each side. The central part is divided into two rooms, the front one a dining room, 54x80 feet, for the employees and those of the inmates who can conduct themselves with propriety, and the rear division for a scullery and serving room. There is not a distinct division of the central part from the two wings, however, the dividing walls rising from three archways on each side. One of the wings is for the men and the other for the women, and each is 60x75 feet in plan. Each dining room has its own vestibule and entrance. The three together are capable of seating, besides the employees, including attendants and outside help, about 1,000 patients, a number which is thought to include all in an institution of 1,500 patients who can be served in this way. The building cost about $70,000, ranking next to the hospital in this respect. The floor is of tile and the wainscot is marble. The roof is supported by an iron truss work and the interior ceiling is of metal panels conforming with the arching truss members.

The dining-room building is heated by the hot-blast system. Air enters under the vestibule of the left wing, passes to the heating chamber near the center of the cellar, where particles of dust are intercepted by a cleaning screen, and is drawn through a heating coil. The warmed air is then taken by a blower provided with a double discharge, one horizontal and at the top, and the other up and at an angle, and is forced in opposite directions through brick ducts. There are in all eight fresh air flues, two for each of the four rooms. These are located in the exterior corners, ex-

cept the two in the scullery, which enter at the inner corners of the room. The air issues into the rooms from these hot-air flues through large registers, eight feet above the floor. Vent registers are at various places at the floor and lead to the roof space, where the air escapes through ventilators in the roof. The vent registers' faces may be shut at any time, and an internal circulation set up, economizing steam in a way that is desirable in a building occupied only for a short time at intervals of several hours. The internal circulation is brought about through a large grilled register in the wall dividing the serving room from the central dining room, through which the cooler air gravitates to a brick duct in the basement by which it may reach the heating chamber. Two dampers, mounted on vertical axes, and connected with each other by a small cable, control this action and rotate in such a way that one damper is closed while the other is opened. Any desired proportion of the outside and inside air may therefore be mixed.

The other buildings of the Massillon Hospital which are heated by the indirect system are the infirmary and the two cottages. All three of the buildings are equipped with an independent blower and heating coils, and are designed after the general heating plan as described for the hospital building. An exterior view of "Cottage B" is shown in Figure 9.

The boiler and engine plants are in separate buildings, and the steam supply to the engines is carried underground through the tunnels, which, as has already been mentioned, extend around the grounds The steam is generated at 100 pounds pressure by four 200-horse-power Heine water-tube boilers, equipped with Murphy stokers, and occupying one-half of the available space of the boiler house. A brick smoke stack rises in the center of the building, with the boilers on one side, and there is, therefore, sufficient floor space on the other side for doubling the present capacity whenever it becomes necessary to do so. Coal for the boilers is brought on cars, which are hauled up a trestle to the part of the building used for a coal storage. A separate room is provided in the boiler house for boiler-feed, service and fire pumps, air compressor for damper regulators and incidental apparatus. A view of the power house is shown in Figure 8.

Steam leaves the boilers at the front, supplying a steel header 18 inches in diameter, extending across the boilers at the rear. The header is supported by a frame work of light I beams and angle iron and supplies three steam mains at one end. The connections both to and from the header are made at the top, and the condensation collecting within it is dripped off. Two of the mains carry high-pressure steam, one 6 inches in diameter, to the pumping room, and the other, 8 inches in size, to the engine room for power. The third main is for heating, being provided with a 10-inch reducing valve with bypass. The heating and power mains extend side by side to the wall of the boiler house, where they drop to the tunnel. The joints at the entrance to the tunnel are made with tees, in the bottom of each of which a drip is connected, returning the condensation to the return tank, that from the high-pressure pipe by means of a trap. The high-pressure main continues in the tunnel to the power station, where a portion of the steam is taken to the engines, separators being also provided for intercepting the steam condensed. Beyond the connection to the engines, the steam is reduced to 40 pounds per square inch, and is carried through the tunnels to the dining, hospital and infirmary buildings for hot-water heaters, to the kitchen for cooking purposes, and to the laundry for the ironing machinery. Hot water is also supplied to both kitchen and laundry; to the former by piping from the heater in the dining building, and to the latter from a heater in the building itself, using either low-pressure or exhaust steam. The heating main runs through the tunnel, rising with the gradual incline of the tunnels, so that the condensation occurring in it is returned to the tunnel entrance, where it is drained, as already mentioned. Branches are taken from the main for the heating systems of the various buildings. The condensation from these sources, together with the steam condensed in the hot-water heaters, is carried back to the boiler room in a 6-inch main. A cross section of the tunnel may be seen in Figure 7.

The power house is a rectangular building about 44x86 feet in plan, and is divided by an interior wall into two rooms, one for the engines and generators, and the other, half its size, for the ice-making and cold-storage machinery and the air-compressing plant. There are at present but two engines in operation, occupying about one-half of the engine room space, so that there is room for double the engine capacity whenever the remaining buildings of the hospital shall have been completed. The engines are Russell tandem-compound non-condensing and are direct-connected to the generators, one to a 50-kilowatt General Electric and the other to a 100-kilowatt Card generator.

The tunnel extends under the center of the power house, and opens at the top into a trench, through which both live and exhaust-steam pipes are connected to the engines. The trenches have 4-inch brick sides and cement bottoms 3 inches thick. Cast-iron cover plates are laid on these, flush with the engine room floor. An oil extractor is placed in the exhaust line and the exhaust steam may be utilized in the two heaters in the power house, which are also provided with low-pressure live-steam connections, or it may pass to the laundry or into the atmosphere through a back-pressure valve.

The tunnels in which the steam pipes and electric wires are carried about the grounds are built of brick. The main tunnel occupies the position of the axial line of the hospital buildings, and a branch tunnel, leaving the main at a point about midway between the dining building and the kitchen leads to the hospital. The tunnels are all 6 feet 6 inches inside height, with the cross section shown in Fig. 7. Brick pilasters are built in the sides of the walls, 3 feet 3 inches high, with 13-inch faces, and extend to the spring of the arch. The pilasters are spaced about 16 feet apart, those on one side being staggered midway between the opposite ones. Cast-iron plates are fitted to the top of the pilasters and the heating main is carried on these by expansion rollers, as shown. The steam main for the water-heaters and the return pipe are suspended below the heating main by wrought-iron hangers fastened to the cast-iron plate. Expansion joints are placed in the pipes about every 120 feet. The width of the tunnels is 6 feet 6 inches, except the distant portion of the branch tunnel which is 4 feet 6 inches. Manholes are built where the reduction takes place and at the junction of the main and the branch. The manhole walls rise square from the tunnel, changing gradually to a circle at the grade line. The top is covered with a 6-inch stone flag with a 30-inch cast-iron ring and grating in the center.

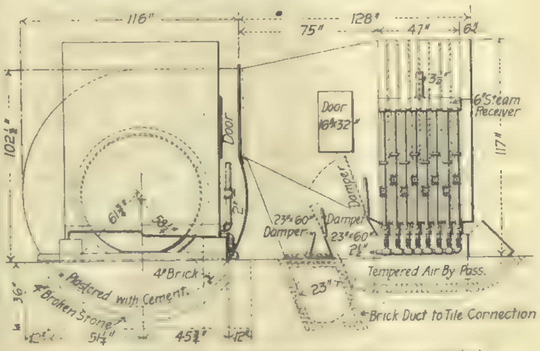


Fig 6 Side Elevation of Heater in Hospital.

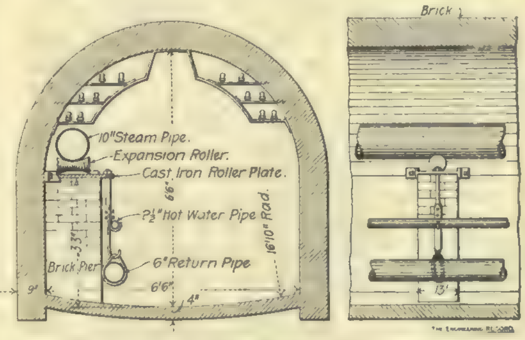


Fig 7 Cross-Section of Tunnel.

DETAILS OF HEATING PLANT, MASSILLON STATE HOSPITAL.

The branches from the tunnels to carry the wires and pipes for the supply of cottages and infirmary are 24 inches square, brick, with concrete bottom and stone flagging for cover. Vent holes are located at points where branches are taken, providing for light and air whenever it is necessary to work at these points. They are circular wells of 4-inch brick, and are covered in a manner similar to the man holes. The tunnels pitch toward the boiler house at various grades. The branch tunnel rises from the main with a slope of .05 feet for every 100 feet, for a distance of 600 feet, and then 6.535 feet per 100 feet for the remaining 135 feet to the end of the tunnel. The pitch of the branch conduits is still greater and is such as to bring the steam pipe and electric conduits into the buildings at the level of the basement floors.

The lighting of the present hospital is divided into five groups, each supplied by a pair of mains, leaving an individual switch at the switchboard. There are also four power mains, with corresponding switches, and the nine pairs of mains are carried in a trench below the power station floor to the tunnel. The wires are all covered with double-braided weatherproof insulation and are carried in the tunnel on petticoat glass insulators, on iron straps, on the arch of the tunnels. This construction may be seen in Figure 7. One of the lighting mains supplies the dining room, with branches to the kitchen, the storehouse and the two cottages; another feeds the infirmary and workshop; and the remaining three are carried to the hospital, laundry and to the boiler house. One of the power mains supplies the blower motors in the dining room and the two cottages, and a small motor to run a bread mixer in the kitchen; two others supply motors driving blowers in the hospital and the infirmary, respectively, and the fourth main leads to the laundry. Where branches are tapped in the tunnel, a switch and fuse block are connected in the circuit, being mounted on slate and enclosed in a wood case.

The wiring of the hospital and infirmary buildings is done in iron-armored conduits, made by the Interior Conduit & Insulation Company. The mains from the tunnel lead to a distributing box, from which feeders are taken, running under the floor to different parts of the building. The feeding branches rise in the various sections, passing through a distribution box on each floor. In the kitchen and laundry iron-armored conduits are used in the wall, but the wires for the ceiling distribution are carried on insulators, facilitating the extensive use of drop lights desired for these buildings. The wiring of the two cottages is quite similar, and the same insulator construction is employed for the distribution of extension lights. The dining room is supplied from two centers of distribution, the feeding mains from the tunnel going to both of two cabinets. The various wires rise from the distribution boxes to the attic in iron-armored conduits and are then carried horizontally to the various outlets on porcelain insulators, mounted about 20 feet apart, on wooden horses.

The water supply is furnished by an air-lift

FIGURE 9.—COTTAGE "B," MASSILLON STATE HOSPITAL.

plant from several wells 375 feet deep. The air is supplied by a two-stage Ingersoll-Sergeant compressor, shown in Figure 10. It has a stroke of 12 inches, steam cylinders 10 and 17 inches in diameter, and air cylinders 9¼ and 14¼ inches in diameter, and is designed to furnish 344 cubic feet of free air per minute, at pressures of 80 to 100 pounds. The air-lift plant has a capacity of about 400 gallons per minute on a lift of 150 feet. The water is discharged into a large cistern, from which it is forced by a Laidlaw-Dunn-Gordon pump into the mains and to the standpipe. The standpipe is enclosed by a tower of red brick, stone and terra cotta. Service pipes run into each building, and there is also a fire protection system, with an underwriters' pump and hydrants.

To dispose of the sewage a combined system of filtration and broad irrigation was adopted. A main sewer of vitrified pipe, 10 inches in diameter, and designed to carry the sewage of 2500 people, was carried through the ridge at the west of the buildings to a reservoir. There are two sections of laterals, the north and the south, of which the north section has been built. The south section will not be built until the hospital is extended in that direction. In the north section there are four branches running to the hospital, the cottage, the laundry and the infirmary. These buildings are so situated as to keep the sewers clean without the use of flush tanks, but connections have been made with 2-inch pipes to the fire service for use when extra flushing is necessary. As the sewage from the most distant building reaches the reservoir in less than 30 minutes, while it is yet fresh, very little ventilation was considered necessary. Perforated covers were used in the manholes and no intercepting traps were placed on the house drains, thus allowing the sewer to be ventilated through the pipes in the buildings. The reservoir was cut off from the buildings by means of a running trap.

Tests of the materials on the site of the beds and farm showed that the sand and gravel contained more or less clay. It was decided that in irrigation one acre of this land would care for the sewage of 100 people; consequently an area of 25 acres would ultimately be needed, and this is easily available. The filter beds are to be used in cold or wet weather, or when the irrigation area cannot take all of the sewage. Four acres of filter beds were designed for the 2,500 people, but only one acre, divided into four beds, has been built. The material used was clean sand and gravel selected from the most favorable spots. The bottoms of the beds are of the natural surface material, built in waves, with summits midway between the underdrains, of which there are two in each bed. The waves slope 6 inches in 25 feet, which is one-half of the distance between the drains. These are 4 inches in diameter and have a slope of 1 in 500. On the bottom is a layer of selected gravel 8 inches thick at the drains and 4 inches at the summit of the slopes. On this is placed the selected sand and gravel, so as to make the average depth of the bed 4.5 feet.

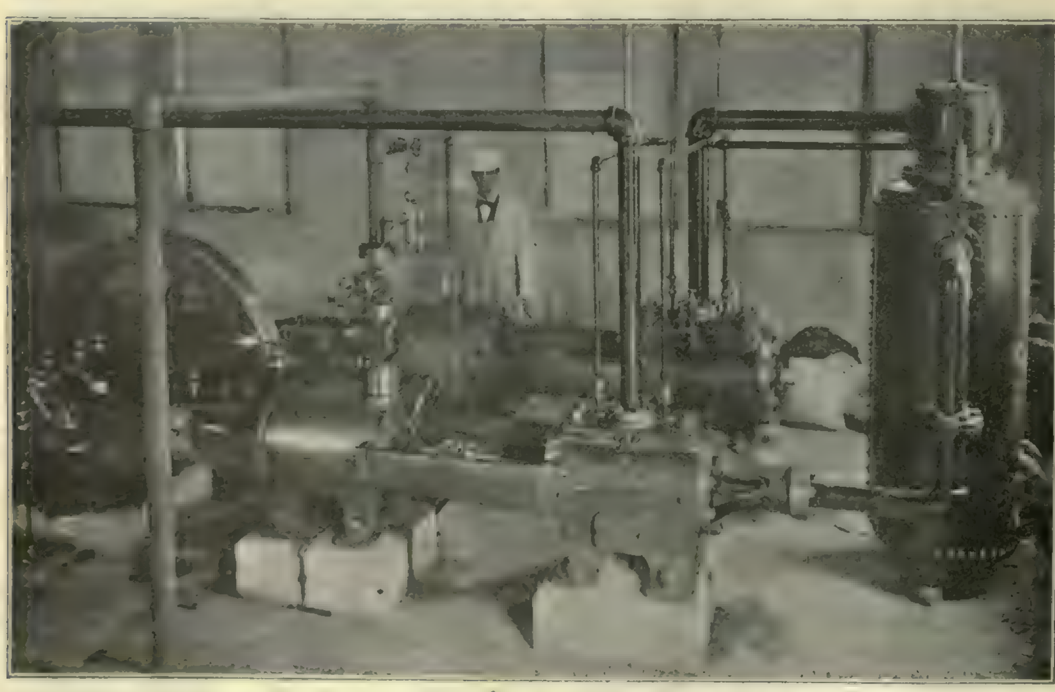


FIGURE 10.—TWO-STAGE COMPOUND AIR COMPRESSOR FOR POHLE LIFT.

The reservoir is 40x15x5.5 feet, with a capacity of about 25,000 gallons, which was considered a safe dose to apply to a bed at one time. It is emptied by an 8-inch Miller automatic syphon, and the discharge is regulated by the size of the pipe running to the beds, so as to continue it over a period of about 30 minutes, with a uniform flow at the beginning and end of discharge.

There is a gate at the reservoir by means of which the sewage may be turned on to the farm instead of the beds The reservoir has brick walls, with a concrete bottom, and a roof of brick arches supported on iron beams. The cost of the sewers, reservoir and filter beds was about $9,250.

The buildings were designed by Messrs. Yost & Packard of Columbus, Ohio, and erected by Messrs. J. W. Myers & Company of Ashland, Ohio, and Messrs. Robert H. Evans & Company of Zanesville, Ohio. The mechanical and electrical work was designed by Messrs. E. P. Roberts & Company of Cleveland, Ohio, with Mr. E. C. Cooke of Cleveland as associate engineer in charge of water supply. The sewerage work was designed by Messrs. Snow & Barbour of Boston, Mass. The heating work was installed by Messrs. Chafer & Becker of Cleveland, Ohio.

FIGURE 8.—BOILER HOUSE.

DATA ON ELECTRIC-POWER GENERATION, GLASGOW.

In February of the present year, the Glasgow, Scotland, Corporation Tramways Committee commissioned Mr. H. F. Parshall, M. Inst. C. E., to investigate the conditions under which the Glasgow tramways could be worked, with a view to determine the most efficient and economical method of generating and distributing electric energy for the overhead trolley system of electric traction. The report which he submitted in reply contains much that is of general interest aside from its local application, and some of the figures he gives will doubtless prove a valuable addition to data on the cost of electric-power generation.

The present street car service of Glasgow consists of 380 cars, drawn by horse, and 27 operated electrically. Having reference to proposed extensions and the usual growth accompanying the conversion of horse-traction into electric-traction systems, the report deems that 600 cars is a reasonable number upon which to base the generating and distributing arrangements. The track construction was suited for electric traction, since the rails were considered to be of the best cross-section and of ample weight. The policy of charging low fares had

increased the number of passengers carried per car-mile as well as the number of stops, the result being that the amount of power consumed in Glasgow was greater than that consumed in many other cities. The average consumption of power at the car from actual measurements taken on present electric-traction works was found to be 7.2 kilowatts, or 9.65 horse-power, and this figure was considered a fair one for the whole system. The total amount of power to be delivered to the cars under average working conditions on the basis of 600 cars would be, therefore, 5,800 horse-power. The maximum load for normal working conditions was found by increasing the average working load by 60 per cent. This relation of maximum to average load was the conclusion reached after an examination of the load curves of a number of cities and a consideration of the experience in Glasgow. The capacity of the machinery must be such, it was calculated, as to deliver 9,250 horse-power to the cars, or, allowing for losses in transmission and distribution, that approximately 11,500 electrical horse-power must be generated as a maximum working load at the power station. Assuming 85 per cent. as the ratio of electrical horse-power at the busbars to the indicated horse-power of the engine, the engine capacity for the maximum working load would amount to approximately 13,000 horse-power. An aggregate of 17,000 indicated horse-power was thought requisite in the generating station, if an allowance were made for a spare plant.

The conditions of electrical distribution were then taken up. The conclusion was reached that in order to meet the conditions obtaining in Glasgow, several centers of distribution would be required for the following reasons: First, the distances to which energy must be conveyed were so great and varied as to preclude an economical supply at 500 volts; and second, the maintenance of the property of the corporation in gas and water mains, and the conditions to be complied with in regard to the difference of potential on the rails specified by the Board of Trade, would entail in the case of a single center of distribution an elaborate and complicated return system, involving great outlay in cables and machinery, which would necessarily require subdivision into several comparatively small units in order to meet the varied conditions and the distances to which the cables would need to be carried. Satisfied that more than one center of distribution was an economical necessity, it was considered upon further investigation that the present requirements could be fulfilled with five centers of distribution.

Under the conditions already named, and with the belief that at least five centers of distribution were necessary, there was no hesitation in advising that the energy be supplied from a single station generating three-phase high-tension currents, to be transformed into direct currents at 500 volts in a number of sub-stations. It was considered that this system was more advantageous from every point of view than a supply of the energy from the same number of generating stations, suitably located and generating direct currents at 500 volts. The advantages of the three-phase system over the other were given as follows: Less capital expenditure in buildings, generating plant and in real estate investments; less working cost and repairs; greater flexibility, better adaptation to the requirements of future extensions, and speedier installation, time being considered of importance in the transition from horse to electric traction. A single station could be built at a site where power could be transmitted at moderate cost, where good coal delivery could be made from more than one railway, and where it would be possible to provide for extensions. The sites now used as car sheds and stables were considered as well situated for sub-stations, and no alterations would be necessary, as the transforming apparatus would only occupy a small portion of the space at present available. It was thought that no skilled labor would be required at the transformer stations. The concentration in load was urged as effecting a saving in supplies and repairs and in fuel and water. Better facilities for coal handling were afforded, it was thought, in a single large station, which could be built and put in working order more quickly than several smaller stations.

In reporting on the generation of power for the tramway department, it was found scarcely possible to avoid reference to the question of joint supply of electricity for lighting as well. The following were points advanced against such a joint supply: The maximum loads in both lighting and traction occurred at the same time. The capital cost for a given watt-hour production was three or four times as great for lighting as for traction, owing to the difference in the nature of the loads. In other words, the traction plant was worked at its greatest capacity three or four times as many hours in the year as the lighting plant. Machinery of a different type was commonly used for lighting, and the switching appliances were absolutely different. The electrical arrangements for electric lighting were necessarily much more complicated and elaborate than was the case for electric traction. The cost of energy for electric traction, owing to its better load factor, would not be more than 25 per cent. of the cost for lighting.

Mr. Parshall appended to his report some figures comparing the two traction systems outlined. The following tables give the cost of power per kilowatt-hour, delivered to the cars, on the basis of 600 cars running 16 hours per day, with 200 of these running between four and five hours additional per day, taking an average of 7.2 kilowatts per car.

A three-phase generating station containing four 2,500-kilowatt units with transmission at 6,500 volts, and five sub-stations containing 500-kilowatt and 800-kilowatt units, and located in present car depots.

Power expenses.	Generating Station. Cents.	Sub-Station. Cents.	Generating and Sub-Stations. Cents.
Coal delivery and handling	0.252	......	0.252
Water, at 4d. per 1,000 gals	0.0166	......	0.0166
Oil, waste and supplies	0.0179	0.0108	0.0287
Labor	0.1015	0.073	0.1745
Total power expenses	0.388	0.0838	0.4718
Maintenance	0.0522	0.0057	0.0579
Fixed Charges:			
Depreciation, interest, insurance, rates and taxes	0.423	0.125	0.548
Totals	0.8632	0.2145	1.0777

To the above figures must be added the cost of maintainenance, depreciation and interest upon the high-tension cables for connecting the generating station to the sub-stations, amounting to 0.0386. This makes the total cost of the three-phase scheme 1.1163.

Five generating stations containing 500-volt railway generating units.

Power expenses.	Cents.
Coal, delivery and handling	0.315
Water, at 4d. per 1,000 gals	0.0208
Oil, waste and supplies	0.0223
Labor	0.4069
Total power expenses	0.765
Maintenance	0.071
Fixed Charges:	
Depreciation, interest, insurance, rates and taxes	0.661
Total	1.497

Neither set of figures includes interest on the cost of sites and railway connections.

THE WANAMAKER STABLES, NEW YORK.

One of the largest stables in New York is that at 160 West Tenth street for the city and suburban delivery service of the Wanamaker store. The building comprises a main part fronting about 120 feet on Tenth street and having a depth of about 90 feet, and a rear part about 30 feet wide and 100 feet deep extending through to Christopher street. The front part has a basement and two stories, and the rear a basement and four stories. All of the first and third stories are used for wagon storage, all of the second story and part of the basement for stalls. The building is of the ordinary warehouse type, with brick walls and wooden floor and roof, and is not specially designed for stable purposes. The principal interest in it is due to the arrangements and equipment for the performance of its special service.

There are two entrances on Tenth street and on Christopher street, each through a wide vertically sliding door and up a gentle incline to the level of the first floor, about 4 or 5 feet above the pavement. Here all horses are unharnessed and the wagons stored up to the capacity of the floor area, the excess being taken to the third story on an elevator which has a capacity of one large or two small wagons each trip. The horses are taken up and down the inclines to their stalls in the basement or second story and their harness is hung up in the first floor harness room. After disposing of his wagon for the night each driver deposits his day's collections with the cashier and changes his uniform for a plain suit kept in a locker. The blankets when wet are hung in the dry room, and all wagons are washed every night.

Throughout the whole building the floor and roof boards, beams and girders are of wood except three lines of transverse plate girders supporting the joists of the first floor and transverse plate girder floor beams in the rear. The columns in the main part are of cast iron, and in the rear part the floors are carried by the walls, without columns.

The floor of the second story in the main part is entirely covered with a layer of concrete finished smooth in the stalls and checked in 6-inch squares in the passages. All the available floor space in this story is covered by stalls which have passageways from 9 to 12 feet wide between them. A narrow space, just wide enough for a man to pass through, is left between the front wall and the north ends of the groups of stalls. A wide space is left between the rear wall and the south ends of the groups of stalls so as to afford an ample passageway to the head of the incline. The space around the incline and over its landing on the first floor is utilized for baled hay storage as shown in the second floor plan, Figure 1. Adjacent to this storage place is a large square brick shaft, formerly serving as a manure chute, but now disused. There are in this room 100 open stalls, each about 5x9 feet, and two large box stalls. Originally, when the stable was owned by the Hilton-Hughes Company, the space occupied by twelve or fifteen of the stalls at the north ends of the three middle rows was reserved for an exercising floor, but it has since been covered with the stalls.

These newer stalls have very high partitions and head-walls of solid boards, but all the others have ordinary partitions and head-walls of horizontal 2-inch boards 5 feet high, surmounted by diagonal fine-mesh wire screens 2 feet high. At each corner of each stall is a 6-inch round post reaching from floor to ceiling. The box stall partitions are the same as the others, but they have single corner iron grain boxes, while each of the open stalls has an iron manger across the head which contains a hay rack, a grain box and a water box. The latter is filled through a valved branch from a pipe underneath and must be opened and closed by the attendant who enters the stall and reaches under the manger. The overflow is through a protected outlet into a waste pipe.

The concrete floor of each stall is slightly pitched to the heels, where a shallow open gutter is moulded in the concrete. There is a gutter across the heels of each row of stalls and each empties through a bell trap into the sewer pipe. About 3 feet of the floor at the head of the stall is floored with fixed boards, the remainder consists of open slats, made in two sections battened together, so as to be easily han-

dled. These are taken up daily and the concrete floor and gutter washed and swept and liquid disinfectant applied. There is a long watering trough arranged with its overflow wasted into a pipe which empties into the gutters so that all waste helps to flush them. Besides this there is a special valve and stand pipe at each end of the trough which enables the entire contents of the trough to be discharged at once into a gutter to cleanse it. There are four fire hose valves in the room and hose from any of them can also be used to flush the gutters and wash the floor. A steam pipe is arranged so that its nozzle can be inserted in the watering trough and the water there heated in cold weather by forcing live steam into it. A similar arrangement is provided at the iron sink on the opposite side of the building, where a couple of stalls are omitted near the box stalls to provide space for washing and handling horses, etc. The room is lighted by the front windows, by gas, and by four turret skylights in the flat roof. It has an overhead automatic electric fire alarm intended to operate if the temperature rises above a fixed maximum. The room is warmed by wall coils of steam pipe near the ceiling, and four ventilating flues are built in the wall and have inlets near the ceiling which are protected by registers.

When the rear part of the stables was built no provision was made in its construction to adapt it to stable use, but as the business demands increased, the stable room in the main building became inadequate and was supplemented by putting twenty open stalls and two large box stalls in the second story, adjacent to those in the main building, and forming a part of the same group, although nominally separated from them by fireproof doors. Access to these stalls is by the incline in the main part and they are used for the overflow when there are more horses than can be accommodated in the main part. No provision whatever exists here for drainage; the level floor is of ordinary tight boards and in the stalls is thickly covered with peat moss, imported at a cost of $8 or $10 a ton, which is used for bedding and absorbs the liquid. The open stalls are about 5x10 feet and have 6-foot partitions of 2-inch horizontal boards about 8 inches wide, capped by 2x4-inch strips without screens, and are secured at the heels by 7x7-inch posts extending to the ceiling. This room and the other stories of the rear part is lighted by end and side windows and by gas.

The box stalls are very large and are used ordinarily for the storage of baled hay. The grain supply is all kept in two large bins adjacent to the elevator shaft in the fourth story. They extend from floor to ceiling and are built of narrow 2-inch plank laid up as in elevator walls. They are filled from the elevator platform through doors in the top of the shaft. They are lined with zinc and have hopper-shaped bottoms terminating in rectangular vertical chutes, one of them running to the second story and the other to the basement. At the bottom of each chute there is a series of inclined screens arranged so that the grain passing over them necessarily is cleaned before being discharged. The grain is delivered from the bottom of the chute into an iron box mounted on wheels, which is rolled down between the rows of stalls and each horse supplied. Before the installation of the large elevator the manure was thrown down a chute and afterwards loaded on wagons in the basement. It is now loaded on several iron dump carts, Figure 2, such as are used for the grain distribution, and these are taken on the large elevator to the first story, where they are stopped at a convenient height for dumping directly into a dump wagon similar to the small car. There are three or four wagon loads of manure daily, which are drawn away by the stable employees.

The basement of the main building is arranged similarly to the second story, but as part of the space is required for other purposes there are only seventy-six open and two box stalls, which are fitted and equipped substantially the same as already described. The rear part is used as a horse shoeing shop, with three fires, and contains machinery for the large elevator and the two small ones. The gas engine which operates it is run continuously during the day. A narrow room is partitioned off from the east side of the south wall in the main part and was formerly used for a wheelwright shop, but is now used for storage. The space along the west wall corresponding to the side row of stalls in the second story is enclosed by partitions surrounding the old manure pit, now used for baled hay storage, and the boiler room. The three double rows of open stalls and the single row along the east wall correspond with those in the second story except that the former are shorter and that there are two very large box stalls at the north end of the latter. There are two doors in the north wall of the basement, which open into a narrow area extending across the front of the building. Beyond this area is a long and narrow sidewalk vault in which are two separate waterclosets for the employees and rooms for general storage. With these exceptions the basement plan corresponds with that of the second story. The basement floor is of concrete with moulded gutters protected by perforated sectional cast-iron covers at the heels of each row of stalls.

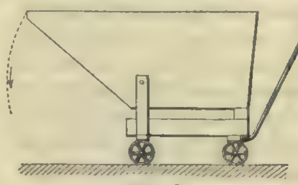


Fig.2

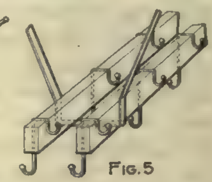


Fig.5

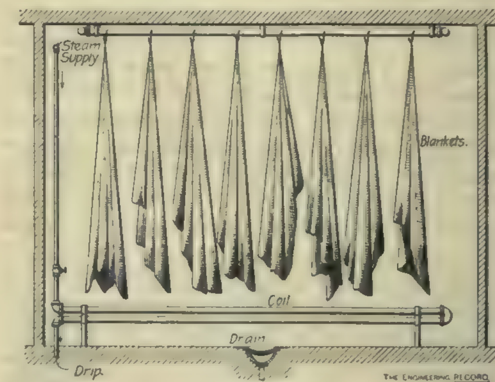


Fig.4

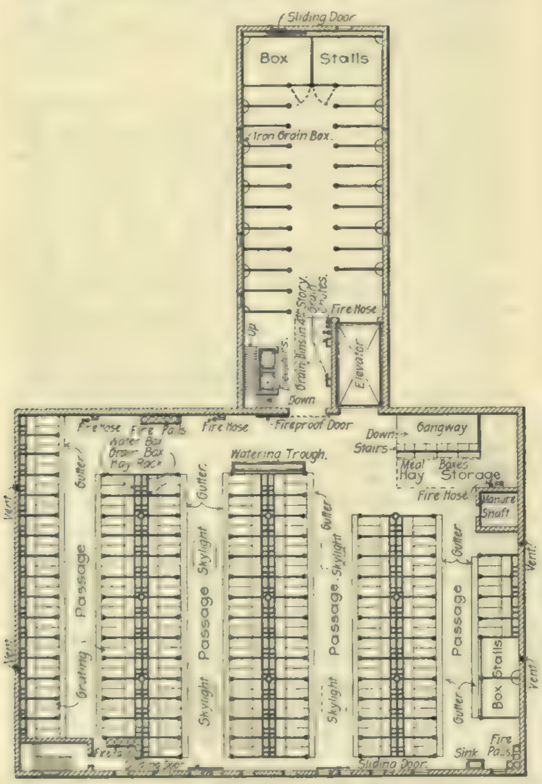


Fig.1 Second Floor

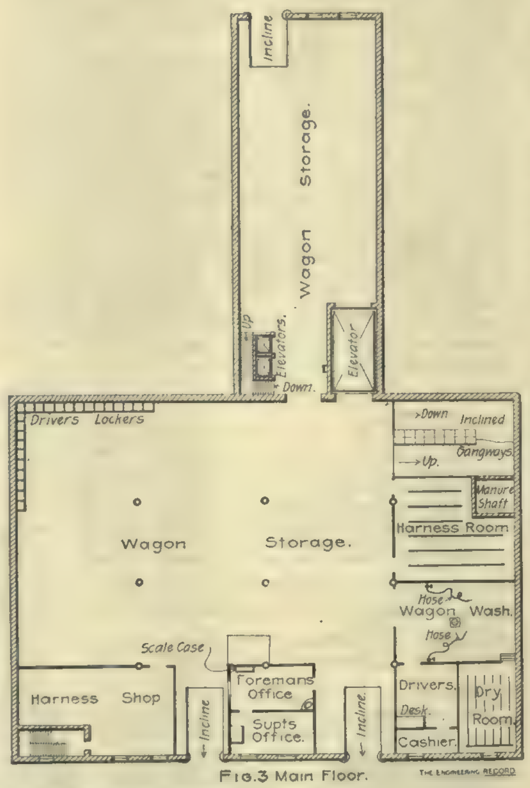


Fig.3 Main Floor.

FLOOR PLANS, WANAMAKER STABLES, NEW YORK.

The first and third stories of the rear part are used for wagon storage and the fourth story as a shop for painting the wagons. Formerly the harnesses were kept here and the two small elevators were used for handling them. Except in the first story of the main part none of the floor beams are ceiled underneath, but all are whitewashed, as are all the interior walls. The first story is finished with varnished pine wainscot ceiling, partitions, etc., relieved by the iron columns and girders painted vermilion. The arrangement is shown in Figure 3, most of the space being left free for the accommodation of wagons at night. The level of the floor is reached by depressed passages from the street and is unobstructed except by four columns. The superintendent's and foreman's offices are enclosed by glazed partitions and occupy the space between the two front entrances. The blanket drying room is about 15x20 feet and has a wooden floor pitched to a center drain. There are six lines of 2-inch steam coil set on standards close to the floor and supplied from above as shown in Figure 4. Numerous stout hooks are screwed into a stiff framework of small pipes fastened to the ceiling, and from them the wet blankets are suspended to dry. Adjacent to this room is the wagon washing room with a wooden floor pitched to a center drain and supplied with two stand pipes and short sections of hose. Here two men wash all the wagons every night, about six minutes being required for a wagon. Next is the harness room, where all the harnesses are hung every night. The double harnesses are hung on six rows of numbered hooks suspended from the ceiling as shown in Figure 5, and the single ones are hung on lettered hooks and brackets fastened to the walls. The horses and wagons are numbered and lettered to correspond. Next the harness room are the horse inclines to the second story and basement. These are easy wooden inclines with cleats across the upper surface and a thick filling of leather clippings spread on top. The leather is redistributed over the incline and wet down every day.

Over 200 horses are now kept in these stables and a force of 30 men, all told, is required to care for them. The appearance of the stables is clean and orderly and the arrangements are considered satisfactory except that it is difficult to pack and unpack the large number of wagons, especially in view of the necessity of starting the suburban deliveries at 3 o'clock in the morning.

NOTES.

A Device for Preventing Water Hammer is shown in the accompanying cut. It consists of a special dome-shaped fitting introduced into the piping and intended to become filled with the air which finds its way into pipes carrying water. The air forms a cushion when water hammer occurs, thus relieving the pipe of the more sudden strain which would be felt if the cushion did not exist. The device is made by the Pneumatic Dome Manufacturing Company, 502 E Street, Washington, D. C., from which further particulars may be obtained.

The Abolition of Grade Crossings in Syracuse has been studied for some time by Mr. Henry B. Seaman, M. Am. Soc. C. E., who has just presented a report on the subject. There are six railways entering the city and these intersect the streets at grade at 129 places. Mr. Seaman presents two plans for their elimination, each involving an expenditure of about two and a half million dollars. The tracks are to be concentrated on four depressed tracks connecting with a union depot and freight yards of 700 cars capacity. The quantities in the estimates are 122,000 cubic yards of rock excavation, 1,096,000 yards of earth excavation and 26,200 yards of masonry of various classes.

The death rate in Cienfuegos, Cuba, which was shown in a diagram in "The Engineering Record" of April 8, may be supplemented by the following figures just received from Col. Gaillard, chief engineer of the Department of Santa Clara: For the week ending March 25, 36 deaths; for the week ending April 1, 37 deaths; for the week ending April 8, 29. It will be noticed that these figures are lower than any on the diagram previously printed. Col. Gaillard also writes: "In your issue of April 8, under the heading 'What American Administration Has Done for Public Health in Cienfuegos, Cuba,' you give me sole credit for an improvement, largely due to the issue of rations by direction of Major-General J. C. Bates, U. S. V., Commanding the Department, and to the untiring and most efficient efforts of Major J. H. Hysell, Chief Surgeon, Department of Santa Clara; Lieut. C. E. Codd, Third Regiment, U. S. V. Engineers, and Dr. Veatie, Health Officer of Cienfuegos."

Transparent Wire-Glass has recently been placed in the market for use in unprotected windows exposed to flames, where shutters are not desired. Wire-glass has been recognized for several years as a valuable fire-resisting material, but solid cast glass having wire embedded in it, which is also sufficiently transparent for use in windows, is believed to be a novelty. The Mississippi Glass Company of St. Louis and New York has recently succeeded in producing this material in sheets 18x40 inches in size and one-fourth and three-eighths of an inch thick. The glass is cast about a wire screen having an inch mesh, and is then polished on both sides to give it the necessary finish for use in windows. It has all the properties which have made wire-glass of the translucent variety so well known, and has been subjected to many fire tests, showing that, after it has been cracked by high heat and subsequent sudden cooling by jets of water, it still retains its general form and will act as a barrier against the spread of fire.

The Thirty-Ninth Meeting of the American Society of Mechanical Engineers will be held at the Arlington Hotel, Washington, D. C., May 9 to 12. Following is a list of the papers announced for the meeting: Mr. F. L. Emory, "Relation Between Initial Tension and Power Transmitted by a Belt"; Mr. C. L. Newcomb, "Experiments on Various Types of Fire Hydrants"; Mr. G. W. Bissell, "Experiences with Deep-Well Pumping Rods"; Mr. A. F. Nagle, "Pipe Flanges and their Bolts"; Mr. George R. Henderson, "Manufacture of Car Wheels"; Mr. R. P. Bolton, "Equipment of Tall Office Buildings in New York City"; Mr. Storm Bull, "The Central Heating Plant of the University of Wisconsin"; Mr. E. A. Darling, "The Power Plant of a University"; Mr. G. I. Alden, "The Plunger Elevator"; Mr. C. R. Pratt, "Elevators"; Mr. C. H. Quereau, "The Allen Valve for Locomotives"; Mr. John Fritz, "Rolling Mill Fly-Wheels," and Mr. F. W. Gordon, "New System of Valves for Steam Engines, Air Engines and Compressors"; Mr. J. B. Stanwood, "Standards for Direct-Connected Generating Sets"; Mr. R. S. Hale, "Boiler and Furnace Efficiencies"; Mr. F. L. Emory, "Test of a Steam Separator"; Mr. Gus C. Henning, "Investigations of Boiler Explosions."

PERSONAL AND OBITUARY NOTES.

Mr. Paul Nash has been appointed city engineer of Stamford, Conn.

Mr. G. P. Pike has been appointed city engineer of Kalamazoo, Mich.

Mr. S. J. Spray has been elected county surveyor of Chaffee County, Col.

Mr. Charles H. Ladomus has been elected city engineer of Chester, Pa.

Mr. John J. McLaughlin, M. Am. Soc. C. E., has been reappointed engineer of Queens County, N. Y.

Mr. K. S. Putnam has been appointed superintendent of the water and sewer departments of Rome, N. Y.

Mr. Edmund Mather has been re-elected water commissioner of Harrisburg, Pa., a position he has long filled.

Mr. Robert Hooke was re-elected city engineer of Chattanooga, Tenn., a post he has served faithfully for a number of years.

Mr. John B. Hawley, M. Am. Soc. C. E., was re-elected city engineer of Fort Worth, Tex., April 7, for the term of two years.

Mr. Frank C. Osborn, M. Am. Soc. C. E., of the Osborn Company, Cleveland, O., has been appointed engineer of the Grand Island Bridge Company of Buffalo.

Colonel Fred Funston of the Twentieth Kansas Volunteers, who has won an enviable military reputation in the Philippines, is a civil engineer and a graduate of the State University of Kansas.

Mr. Franklin Riffle, M. Am. Soc. C. E., has associated himself with the Wolff & Zwicker Iron Works Company of Portland, Ore. For the past two years Mr. Riffle has been in British Columbia looking after the interests of an English mining syndicate.

Mr. William J. Wilgus, M. Am. Soc. C. E., has been appointed chief engineer in charge of construction and maintenance of way of the New York Central Railroad, in place of Mr. Walter Katte, resigned. Mr. Wilgus began his railroad career with the engineering department of what was then the Minnesota & North Western Railroad, advancing from the position of rodman and draftsman at the age of 20 to assistant engineer of maintenance of way five years later. He has served in various capacities on a number of railroads since that time, with the exception of a few months spent in private practice in St. Paul, Minn.

Mr. Walter P. Rice, M. Am. Soc. C. E., formerly city engineer of Cleveland, O., has been appointed director of public works of that city. He has appointed Mr. James Ritchie, M. Am. Soc. C. E., chief engineer of the department. The latter was graduated from the Massachusetts Institute of Technology in 1878, and has been engaged in the engineering work of several railways, the Cleveland Shipbuilding Company and river improvements, under the Corps of Engineers, U. S. A. One of his leading undertakings, the interesting dry-dock at Lorain, was recently described in a paper before the American Society of Civil Engineers.

CONTRACTING NEWS

OF SPECIAL INTEREST TO

CONTRACTORS, BUILDERS, ENGINEERS, AND MANUFACTURERS

OF ENGINEERING AND BUILDING SUPPLIES.

For Proposals see pages xi, xii and 488.

WATER.

Alton, Ill.—An informal vote was taken April 18 in favor of municipal ownership of the water-works. The vote was taken merely to find out what the public sentiment was on this question.

Duquesne, Pa.—Bids are wanted April 24 for drilling wells at the Duquesne pumping station. S. H. Young, Chmn. Water Com.

Windsor, N. Y.—The Governor has signed the bill legalizing an issue of $20,000 bonds for a water-works system.

San Carlos, A. T.—See "Government Work."

Mayville, N. D.—Bids are wanted May 2 for a system of water-works and electric lights. Samuel Torgerson, City Aud.

Grand Forks, N. D.—Bids are wanted for water mains. F. A. Brown, City Aud.

Frederick, Md.—Bids are wanted April 25 for the extending of the system of water-works to Fishing Creek. Probable cost of work, $28,000. William F. Chilton, Mayor.

Fulton, N. Y.—A special election will probably soon be held to vote on the question of issuing bonds for the purchase of the existing system of water-works.

Columbus, Miss.—Plans and specifications are being prepared for a water and light system.

Glassboro, N. J.—The Council has under consideration the establishment of a water and lighting plant.

Deadwood, S. D.—It is stated that the city will vote on the proposition to issue $50,000 bonds for a permanent water supply.

Lonetree, Ia.—It is stated that a vote will be taken April 27 on the proposition to issue bonds for water-works.

Healdsburg, Cal.—Press reports state that the injunction against the issue of $80,000 water and light bonds has been dissolved. The work of construction will now be commenced.

Clarksville, Tenn.—The Council is seeking for authority to issue $20,000 bonds for a filter plant.

Benton, Wis.—It is stated that the proposition to issue water-works bonds was carried.

Waterloo, Ont.—It is stated that the rate-payers have voted to issue $40,000 bonds, $23,000 for the purpose of purchasing the water-works from a private company and $17,000 for the erection of a stand-pipe and a complete water-works plant.

Whitefish Bay, Wis.—A stock company is being organized which intends to construct a system of water-works and electric lights.

Goldhill, Ore.—It is stated that it has been voted to bond for water-works.

Redwood City, Cal.—A special election has been called for May 20 to vote on the issue of bonds for the improvement of the water-works and electric light plant.

Salt Lake City, Utah.—The City Council has ordered improvements to the water-works system, estimated to cost $32,000.

Prescott, Ariz.—It is stated that a number of mains are to be added to the present water system and a sewerage system is to be built at an estimated cost of $75,000.

Austin, Minn.—Press reports state that bids are wanted April 24 by the City Council for laying water pipes.

Tarboro, N. C.—John A. Weddell, City Clk., writes that it was voted April 15 to issue $40,000 water-works and sewerage bonds.

College Hill, O.—Bids are wanted May 1 for a system of water-works. F. R. Strong, Village Clk.

Laurel, Del.—Bids are wanted May 3 for a water plant and sewerage system, as advertised in "The Engineering Record."

Morristown, N. J.—Bids are wanted May 4 for putting an asphalt-coated concrete lining into the new reservoir at the Morris Plains State Hospital, as advertised in "The Engineering Record."

Reading, Pa.—A correspondent writes that a reservoir is to be built and a pipe line laid for the suburban village of Wyomessing. Thos. Merritt, of Reading, Village Pres.

Newark, N. J.—The contract for driven wells at Belleville has been awarded to A. J. Connelly for $30,975, according to local press reports.

Ruthven, Ia.—It has been voted to issue bonds for the construction of water-works.

Winchester, Ind.—Bids are wanted May 3 for the construction of water-works and arc lighting system, as advertised in "The Engineering Record."

Gallatin, Tenn.—Bids are wanted May 15 for a system of water-works. E. O. Buchanan, Secy. Water-Works Com.

Ottawa, Ont.—Bids are wanted May 16 for furnishing the necessary water turbines and pumps for the water-works. J. C. Rogers, Chmn. Water-Works Com.

Brooklyn, N. Y.—The Board of Public Improvement has approved extensions and improvements to the water supply in Queens Borough, estimated cost $65,000.

Martinez, Cal.—It is stated that bids are wanted May 1 by the Road Commissioners for 24,160 ft. of ½ to 4-in. water pipe.

Wellsville, O.—It is stated that bids are wanted May 15 for laying about 205 tons of 12-in. water pipe and 6 tons of 8-in. pipe and castings. D. A. Davidson, Supt. Water-Works and City Clk.

Wilmington, Del.—The Water Department has decided to erect a water tower in Brandywine Park, near Mt. Salem Lane.

Border City, N. Y.—The Seneca Springs Water Co. has been incorporated, with a capital of $10,000. Directors: F. C. Hofmann, C. S. Codington and G. F. Ditmars of Geneva, and others.

Newbern, N. C.—At the election in May a vote will be taken on the proposition to purchase a water-works and sewer system and an electric light plant.

Covington, Tenn.—A bill providing for the issue of $30,000 water and sewer bonds has passed the third reading in the House.

Tacoma, Wash.—N. L. Taylor, City Engr., writes that the Commissioner of Public Works has been authorized to call for bids immediately for the construction of a 30-in. stave pipe, 2,000 ft. in length; the above work being done as a partial means of holding the water claim of the city on the South Fork of Puyallup River, 25 miles distant. Preliminary surveys for a water supply from the above source are practically completed and a pipe line will be located during the coming summer; provided the incoming City Council concurs in the plans approved by the present Water Committee.

Los Angeles, Cal.—Local press reports state that a new cover is to be placed upon the Bellevue reservoir, at a cost of $15,000.

Red Lodge, Mont.—George H. Bailey, City Clk., writes that the proposition to construct water-works will be voted upon May 1.

St. Marys, Ont.—T. D. Stanley writes that in about two months a vote will be taken on the issue of bonds for the construction of water-works. Probable cost, $40,000.

Dubuque, Ia.—The Dubuque Water Co. has named John N. Baldwin, of Council Bluffs, Ia., and Benezette Williams, Engr., of Chicago, Ill., as appraisers of the water-works. The appraisers appointed by the city are ex-Gov. Horace Boies, and Judge J. J. Ney.

Seattle, Wash.—According to local press reports, bids were received as follows for the Cedar river water-works. The bidders were: a, Moran Bros. Co., Seattle; b, Smyth, Wakefield & David of Portland, Ore.; c, Pacific Bridge Co., San Francisco, Cal.; d, F. McLellan; e, Cawsey, Carney & McWilliams; f, Stirratt & Goetz.

For subdivision No. 1, which includes the pipe lines from Cedar River to Swan Lake and from the lake to the city, complete, as well as the headworks at the intake, etc: a, $1,016,721.27; b, $970,095.90; c, not extended; d, $921,681.30.

For subdivision No. 2, including the two reservoirs in the city: A, $236,840.03; b, $200,134.35; c, not extended; d, $252,705.00; e, $247,841.84; f, not extended.

For subdivision No. 3, including the stand pipe on Queen Anne Hill and the mains connecting it with the reservoirs and the distributing system on Renton Hill: a, $55,554.80; b, $49,481.20; c, not extended.

For subdivision No. 4, including the connections of the Nagle addition reservoir with the general distributing system, with a 36-in. pipe to the corner of Sixth Ave. and Pine St.: a, $30,949.50; b, $27,014.50; c, $35,900.00.

North Bend, Neb.—It was recently voted to bond to the amount of $7,200 for water-works.

Winnipeg, Man.—H. W. Ruttan, City Engr., writes that the following bids for two pumping engines of 5,000,000 gallons capacity each, per day, were opened April 3 by the chairman of the Fire, Water & Light Com.: John McDougall, Montreal, *$89,080; Barr Pumping Engine Co., Germantown Junction, Philadelphia, Pa., $72,600 (duty, customs charges not included); Holly Manufacturing Co., Lockport, N. Y., $97,800.

*Contract awarded.

The contract for furnishing 2,310 meters was awarded to the National Meter Co., of New York City, for $36,855.

Mankato, Kan.—H. V. Hinckley. Consulting Engr., of Topeka, Kan., writes that the following bids were opened April 12 for the construction of water-works at Mankato: A, complete system as per plans; B, deduction for 16,884 ft. of spiral-riveted steel pipe in place of cast iron; C, deduction for tower and 40,000 gal. steel tank in place of stand pipe 12 x 8; D, approximate contract price, subject to some slight changes:

	A	B	C	D
W. W. Cook, Junction City, Kan ...	$22,290	$1,950	$680	$19,660
D. Turner, Clyde, Kan ...	22,320	1,025	355	20,940
B. P. Eagan, Nebraska City, Neb ...	23,250	1,000	405	21,845
Sheely & O'Shee, Lincoln, Neb ...	22,078	1,020	300	20 758

SEWERAGE AND SEWAGE DISPOSAL

Braddock, Pa.—Bids are wanted May 1 for 3,165 ft. of 20 to 30-in. terra cotta pipe sewers and 12 manholes. Sam'l A. Taylor, Boro. Engr.

Sioux City, Ia.—Plans and estimates have been ordered prepared for a storm water sewer on Pierce St.

Albany, N. Y.—Bids are wanted May 1 for a vitrified pipe sewer in William and Howard Sts. Thomas J. Lanahan, Clk. Bd. Contract & Apportionment.

Tarboro, N. C.—See "Water."

Springfield, O.—Bids are wanted April 29 for 18 and 20-in. pipe sewers in 2 streets. P. Huonker, City Clk.

East Cleveland, O.—Bids are wanted April 29 for sewers in several streets. H. B. Chapman, Village Clk.

Toledo, O.—Bids are wanted May 1 for 12, 15 and 24-in. cylindrical pipe sewers. Wm. O. Holst, City Clk.

Laurel, Del.—See "Water."

Indianapolis, Ind.—Bids are wanted April 26 for a sewer in Illinois St. M. A. Downing, Chmn. Bd. Pub. Wks.

Prescott, Ariz.—See "Water."

Williamsport, Pa.—Bids are wanted May 1 for constructing a section of storm sewer in West St., also along the bed of Spring Run; bids are also wanted for repaving West St. with vitrified brick. Geo. D. Snyder, City Engr.

San Carlos, A. T.—See "Government Work."

Andover, Mass.—Sewer Extension bonds to the amount of $30,000 have been sold to E. H. Rollins & Sons.

Laurium, Mich.—The Council is stated to have sold $35,000 sewerage bonds.

Fort Dodge, Ia.—Bids are wanted April 24 for a sanitary sewer in 5th Ave. D. A. Weller, City Clk.

Kalamazoo, Mich.—A correspondent writes that estimates are wanted for brick paving and sewer work contemplated. Work done by day labor. G. B. Pike, City Engr.

Wallace, Idaho.—The City Clerk writes that at a recent election it was voted to issue $18,000 sewer bonds.

Olean, N. Y.—Bids are wanted May 2 for a 20-in. sewer in East Sullivan St. E. E. Allen, Supt. of Sts.

Lorain, O.—Press reports state that storm water sewers are to be built this season at South Lorain.

Newbern, N. C.—See "Water."

New Haven, Conn.—It is stated that bids are wanted April 24 for sewers in several streets. C. W. Kelly, City Engr.

Elkhart, Ind.—It is stated that bids are wanted April 26 for 8,400 ft. of 12 to 30-in. pipe sewers in several streets. D. F. Cordrey, City Engr.

McKees Rocks, Pa.—The Borough Council has under consideration a proposition to issue $100,000 for the purpose of making sewer and street improvements.

East St. Louis, Ill.—A bill has passed the Legislature authorizing the construction of a sewer running from one end of the town to the other. Probable cost, $150,000.

Marshall, Mich.—The sum of $25,000 has been voted for the construction of main sewers.

Glenwood Springs, Colo.—W. H. Trunbor, of Colorado Springs, is the engineer in charge of constructing the proposed sewer system, estimated to cost about $10,000. Probably only part of the system will be built this summer.

Valdosta, Ga.—Maxey Ashley, City Clk., writes that an election will be held May 20 to vote on the issue of $35,000 sewer bonds.

Lorain, O.—Plans have been ordered for three sewer districts. L. A. Fauver, City Engr.; Riggs & Sherman, of Toledo, O., Consulting Engrs.

Owosso, Mich.—The town has voted to appropriate $15,000 for the construction of main sewers to be built according to plans prepared by Riggs & Sherman, of Toledo, O.

Turtlecreek, Pa.—It is stated that the Borough Council has decided to issue $45,000 bonds for sewers and paving in certain streets.

Washington, D. C.—Local press reports state that the contract for excavation and concrete work on the proposed middle service sewer for the District of Columbia, to be located near Brightwood, has been recommended for award to R. A. Malone, of Lancaster, Pa., at 40 cts. per cu. yd., for 30,000 cu. yds. of excavating and at $7.20 per yd., for 11,000 yds. of concrete work.

Auburn, Ind.—Bids are wanted May 17 for the construction of a sewer system, as advertised in "The Engineering Record."

Independence, Mo.—Local press reports state that the following bids were received for the construction of a sewer system requiring about 7 miles of mains: M. S. Jackson of Cedar Rapids, Ia., $20,639.80; Colyer Bros. of this county, $24,777.37; Matt & Roberts of Jefferson City, $19,520.51; Laird & Black of Des Moines, Ia., $17,698.51; Nevins & Johnson of Kansas City, $15,282.36; J. G. Glennon of Kansas City, $22,743.67; Katz & Crandall, Omaha, $19,334.21.

Akron, O.—John W. Payne, City Engr., writes that the following bids were opened April 15 for the construction of 18,900 lin. ft. of brick sewers, 425 ft. of which is to tunnel through a hill and be lined with a 3-ft. brick sewer:

Hunt & O'Neil, $41,468.93; Hallinan Bros., $48,777.06; McCourt & Davidson, $43,153.40; Adams Bros., Zanesville, O., $53,755.66; S. C. McGowan, $46,561.07; James Wildes & Son, *$37,964.68; Joseph Hugell, $42,058.69; Greenville Construction Co., Greenville, O., $44,019.55. Address of bidders Akron, unless otherwise stated.

*Contract awarded.

Ottawa, Ont.—Newton J. Ker, Engr. in charge, writes that the following bids were opened April 14 for the construction of sections 1 and 2 of the sewer system. The work includes 13,121 ft. of 5-ft. to 7-ft. sewers, and 42 manholes, the trench is expected to average 20 ft. in depth, and will be excavated in rock, clay and quicksand: O'Leary & Robillard, Ottawa, *$226,119; Bourgne & Paulin, Ottawa, $245,650; Geo. Goodwin, Ottawa, $247,000; Viau & La Chauce, Hull, Ont., $266,907; W. Davis & Sons, Ottawa, $320,000; Engineering Contract Co., New York City, $329,850; Wm. Stewart, Ottawa, $397,777.

*Contract awarded.

Contracts for the remaining section, No. 4, will be let about June; probable cost, $75,000.

North Braddock, Pa.—The following bids were opened April 13 for the construction of sewers in Sixth St., as advertised in "The Engineering Record." S. A. Taylor, Borough Engr., 339 5th Ave., Pittsburg:

Ott Bros., $24,263.40; Rosser & Howell, $33,441.60; Keeling & Ridge, Pittsburg, $25,270.60; Sloan & McIlvain, Allegheny, *$20,527.00; Cronin & O'Herron, Pittsburg, $25,595.30; Thomas McNally, $29,592.90; John McQuade, Pittsburg, $27,679.50.

John Dell & Co. of Braddock, Pa., secured the contract for pipe sewers in Hawkins Ave., at $4,660, and for Corey, Center and Charles St. sewers at $4,374.

BRIDGES.

Norristown, Pa.—Local press reports state that bids are wanted May 17 by the County Commissioners for a bridge over Saw Mill run at Airy St.; also for an infirmary at the Almshouse.

Washington, D. C.—Bids are wanted May 6 for raising the iron highway bridge crossing Klingle Ford Road, as advertised in "The Engineering Record."

Raleigh, N. C.—W. C. McMackin, Supervisor of Roads, writes that the contract for a steel bridge over the river at the Falls of Neuse has been awarded to the Virginia Bridge & Iron Co., Roanoke, Va., for $6,800.

Macon, Ga.—Local press reports state that the City Council accepted the offer of the Brackett Bridge Co., Cincinnati, O., to build a bridge over the Ocmulgee River with brick and cement floor for $37,000.

Council Bluffs, Ia.—The City Engineer reported the bridge over Indian Creek at Bryant St. in a dangerous condition, and recommended that it be replaced with a steel bridge.

Stockton, Cal.—Press reports state that the construction of a combination railroad, wagon and pedestrian drawbridge to cost about $30,000, to be under consideration.

Boston, Mass.—The loan bill for $200,000 for a new bridge 60 ft. wide over Mystic River and known as the Malden bridge, has been signed by the Governor. Bids opened by City Engineer Jackson a few weeks ago for the draw of this bridge were made on a basis of 50 ft., and will not be further considered. New bids will be called for.

Columbus, O.—The County Engineer is preparing plans for a new bridge across Big Walnut Creek at Hibernia. Same will have a 210-ft. single-span with 30-ft. roadway, and brick pavement.

Kansas City, Mo.—A bill has passed the House authorizing the new Union Depot Co. to construct and operate the Winner bridge.

Los Angeles, Cal.—The City Engineer recommends the building of new bridges to replace the present structures at Aliso and Macy Sts.

Cambridge, Mass.—The County Commissioners have signed the decree providing for a new steel bridge over the tracks of the Fitchburg Railroad on Massachusetts Ave. at Porter's Station, to replace present structure.

Aberdeen, S. D.—Local press reports state that bids will soon be asked by the County Auditor for the construction of 5 steel bridges.

Jonesboro, Tenn.—At the county court a resolution was passed appropriating $4,000 for the construction of a bridge across Watauga River at De Vault's Ford.

Youngstown, O.—Press reports state that the Erie Ry. will construct a bridge across the Mahoning River, at a cost of $25,000.

Cleveland, O.—Local press reports state that the park engineer had been instructed to advertise for bids for two bridges on the new lower boulevard in the eastern park system.

Watertown, N. Y.—The Board of Public Works passed a resolution authorizing the City Engineer to advertise for bids for the construction of a new girder bridge, to replace the Pearl St. bridge. Cost not to exceed $5,000.

Memphis, Tenn.—The construction of an iron bridge on the Hindman Ferry road over Wolf River, to cost $5,000, has been petitioned.

Fosters, Ala.—Press reports state that $38,000 bridge bonds have been sold.

Ogden, Utah.—The Council ordered a bridge built over the North Ogden Canal on Seventh St.

Elk City, Neb.—The construction of a steel bridge across the Elkhorn River, between Elk City and Waterloo, to cost about $5,000, is stated to be under consideration.

Lockport, N. Y.—A bill has passed the Assembly, appropriating $16,000 for rebuilding the bridge over the Erie Canal at Chapel St.

Easton, Pa.—The construction of a bridge to cost about $15,000 is stated to be under consideration.

Birmingham, O.—Bids are wanted May 8 for grading the approaches to and constructing the masonry, abutments and piers for the bridge across the Vermilion River; and on May 9 for the bridge. J. C. Hansen, Pres. Co. Commrs.

Toronto, Ont.—Bids are wanted April 26 for concrete and stone abutments for the proposed bridges crossing the Don River at Queen St. East, and the Humber River, at Lake Shore Road. John Shaw (Mayor), Chmn. Bd. of Control.

Rensselaer, N. Y.—Local press reports state that bids for the Washington St. improvement and the bridging of Mills St. were received from the following: Youngstown Bridge Co., Youngstown, O., $5,178.50; O. F. Hill & Son, $5,771.80; Frank Pigeon, $6,369.10; stone not faced, $5,995.

Doylestown, Pa.—Bids are wanted May 1 for repairing the Hulmeville bridge. John T. Poore, Chmn. Co. Commrs.

Grafton, N. D.—Bids are wanted May 3 for 12 combination span bridges. O. M. Fraser, Co. Aud.

Ft. Wayne, Ind.—Bids are wanted April 25 for stone abutments for bridges in sections 17 and 18, Pleasant township; also in section 17, Marion township. Wm. Meyer, Jr., Co. Aud.

London, O.—Bids are wanted May 11 for bridges over Deekcreek, on the London and California Pike, and over Bradford creek, Range township. W. D. Wilson, Co. Aud.

Marengo, Ia.—Bids are wanted April 27 for a steel bridge having 4 50-ft. steel spans. L. E. Brown, Co. Aud.

Lenape, Kan.—A correspondent writes that an $18,000 iron bridge is to be built between Leavenworth and Johnson Counties, near Lenape. J. Bleakley, Co. Commr., Leavenworth.

Honolulu, H. I.—It is stated that bids are wanted May 15 for 7 steel bridges. James A. King, Minister of the Interior.

Binghamton, N. Y.—Bids are wanted May 9 for a bridge across the Susquehanna river at Tompkins St. S. D. Kane, City Clk.

Buffalo, N. Y.—The Grade Crossing Commissioners, on April 11, opened the following bids for building the substructure of Elk St. and Abbott Road viaduct: Christopher Smith, Buffalo, $116,994.76; W. F. Boysen, $114,779.93; B. P. Smth, Rochester, N. Y., $128,712.59, $126,849; A. P. Kehr, $118,465.49, $118,034.10; Williams, McNaughton & Papst, Buffalo, $124,998.30; $123,913.90; Harrer & Mitchell, $118,323; Charles Mosier, $127,010.44; B. I. Crooker, Buffalo, $132,629.44; Brown, Stabell & Griffiths, $122,787.47; Donnelly Contracting Co., Buffalo, $128,037.27.

Terre Haute, Ind.—The following bids were opened April 11 by the Terre Haute & Indianapolis Railroad Co., for steel girder bridges: *a*, bridge No. 93, having 3 spans of 75 ft. each; *b*, bridge No. 103, having 4 spans of 60 ft. each; *c*, totals: Louisville Bridge & Iron Co., Louisville, Ky., *a*, $6,395; *b*, $5,900; *c*, $12,295; Phœnix Bridge Co., Phœnixville, Pa., *c*, $12,478; Detroit Bridge & Iron Works, Detroit, Mich., *c*, $12,810; Wisconsin Bridge & Iron Works, Milwaukee, Wis., *a*, $6,547.50; *b*, $6,285.60; *c*, $12,833; Toledo Bridge Co., Toledo, O., *a*, $6,723; *b*, $6,144; *c*, $12,867; Philadelphia Bridge Works, Philadelphia, Pa., *a*, $6,750; *b*, $6,480; *c*, $13,230; Youngstown Bridge Co., Youngstown, O., *a*, $6,923; *b*, $6,530; *c*, $13,453; Chicago Bridge & Iron Co., Chicago, Ill., *c*, $13,800; King Bridge Co., Cleveland, O., *a*, $7,235; *b*, $6,682; *c*, $13,917. American Bridge Works, *c*, $13,926. Carnegie Steel Co., Pittsburg, Pa., *a*, $7,310; *b*, $6,675; *c*, $13,985. Pittsburg Bridge Co., Pittsburg, Pa., *a*, $7,594; *b*, $6,793; *c*, $14,387. Union Bridge Co., Athens, Pa., *a*, $7,524; *b*, $6,943; *c*, $14,467. New Jersey Steel & Iron Co., Trenton, N. J., *a*, $7,537; *b*, $7,236; *c*, $14,773. Edge Moor Bridge Works, Wilmington, Del., *a*, $7,650; *b*, $7,344; *c*, $14,994. Shiffler Bridge Works, Pittsburg, Pa., *a*, $7,755; *b*, $7,452; *c*, $15,207.

Hartford, Conn.—Edwin D. Graves, Engr. of the Board of Commissioners, Connecticut River Bridge and Highway District, writes that the following bids were received for constructing a steel or stone bridge about 400 ft. long and 66 ft. wide over a portion of the East Hartford Meadows on the line of Hartford Ave.: Berlin Iron Bridge Co., East Berlin, Conn., *$119,917; Boston Bridge Wks., Boston, Mass., $122,000; J. E. Buddington, New Haven, Conn., $124,000; Pittsburg Bridge Co., Pittsburg, Pa., $179,000; Dean & Westbrook, New York City, $142,000; Edge Moor Bridge Wks., Wilmington, Del., $130,000; Elmira Bridge Co., Elmira, N. Y., $138,000; Groton Bridge & Mfg. Co., Groton, N. Y., $135,000; Hilton Bridge Cons. Co., Albany, N. Y., $128,000; King Bridge Co., Cleveland, O., $119,000; F. R. Long & Co., New York City, $122,000 steel and $143,000 stone, informal; Massillon Bridge Co., Massillon, O., $135,790; N. E. Structural Co., Boston, Mass., $110,000, informal; N. J. Steel & Iron Co., Trenton, N. J., $118,000; Norcross Brothers, Worcester, Mass., $148,869 stone, informal; M. J. O'Connor & D. J. Curtis, Hartford, Conn., $178,000 stone; Ryan & Kelly, Philadelphia, $148,000, stone; Toledo Bridge Co., Toledo, O., $138,000; Variety Iron Wks., Cleveland, O., $136,000; Wrought Iron Bridge Co., Canton, O., $135,000; Youngstown Bridge Co., Youngstown, O., $123,000.

*Contract awarded.

PAVING AND ROADMAKING.

Lafayette, Ind.—Bids are wanted April 24 for improving 3 streets; and on May 8 for improving 2 streets. James K. Risk, City Clk.

Boonville, Ky.—It is stated that 28 miles of road, estimated to cost $44,000, have been recommended for improvement in Boon Township. An election will soon be held.

Chicago, Ill.—The South Park Commissioners have decided to replace the macadam pavement on a portion of Michigan Ave. with asphalt.

New Haven, Conn.—Bids will probably be asked at once for Belgian block pavement to be laid in three streets.

Buffalo, N. Y.—The South Buffalo Business Men's Association has adopted a resolution favoring the establishment of a municipal asphalt repair plant.

Champaign, Ill.—An ordinance has been passed providing for the paving of West University Ave.; estimated cost, $34,307.

Danville, Va.—Press reports state that on May 24 a vote will be taken on the proposition to issue $100,000 bonds for street improvements.

Marion, Ind.—The City Clerk has been instructed to advertise for bids for brick and macadam pavement on Third St.

Paris, Ky.—Plans and estimates have been ordered prepared for both brick and asphalt pavements in the principal streets.

Westshoals, Ind.—Bids are wanted May 6 for constructing several macadamized roads in Center Township. Horatio Harryman, Co. Aud.

Joliet, Ill.—Bids are wanted April 24 for the improvement of Lincoln St. Sebastian Lagger, Pres. Bd. Local Improvements.

Athens, Ga.—Bids are wanted May 5 for $100,000 street improvement bonds. J. H. Rucker, Chmn. Finance Com.

Washington, D. C.—Bids are wanted May 20 for laying asphalt block pavements; also for paving several streets with sheet asphalt, as advertised in "The Engineering Record."

Williamsport, Pa.—See "Sewerage and Sewage Disposal."

Hackensack, N. J.—Bids are wanted May 4 for grading and macadamizing several streets and roads in Franklin Township. Daniel Depew, Township Clk., Wyckoff.

Newark, N. J.—Bids are wanted April 27 for 52,300 sq. yds. sheet asphalt and 5,200 sq. yds. of granite block pavement on several streets and avenues. M. F. McLaughlin, Gen. Supt. of Wks., Bd. St. and Water Commrs.

Waterbury, Conn.—The Board of Public Works has been instructed to prepare an estimate for paving Bank St. with cobblestones or brick.

Guntersville, Ala.—Bids are wanted May 1 for $100,000 improvement bonds. A. M. Ayers, Judge of Probate.

Albany, N. Y.—Bids are wanted May 1 for vitrified brick pavement on 2d and Orange Sts. Thomas J. Lanahan, Clk. Bd. Contract and Apportionment.

Bedford, Ind.—The contract for paving 13th and 14th Sts. with Terre Haute brick has been awarded to J. E. Voorhees & Co. of Terre Haute, at $2.84 and $2.80 per ft.

Kalamazoo, Mich.—See "Sewerage and Sewage Disposal."

Glens Falls, N. Y.—Bids are wanted May 15 for furnishing materials and constructing about 18,000 sq. yds. of brick pavement on concrete foundation, as advertised in "The Engineering Record."

Ithaca, N. Y.—Bids are wanted for about 25,000 yds. of brick and stone pavement. Bids are also wanted April 24 for about 15,000 yds. of repressed, vitrified paving bricks.

Indianapolis, Ind.—Bids are wanted May 6 for macadamizing several roads in Center township. Horatio Harryman, Co. Aud.

Turtlecreek, Pa.—See "Sewerage and Sewage Disposal."

New York, N. Y.—Bids are wanted April 28 for broken stone and screenings of trap rock in the Boroughs of Manhattan, Queens, Brooklyn and Bronx, granite paving blocks in the Borough of Brooklyn. James P. Keating, Commr. of Highways.

Cranston, R. I.—At the annual financial town meeting an appropriation of $10,000 was voted for general highway improvements and $5,500 for steam roller.

McKees Rocks, Pa.—See "Sewerage and Sewage Disposal."

Nanaimo, B. C.—It is stated that bids are wanted May 15 for a 12 or 15-ton steam road roller. S. Gough, City Clk.

New Orleans, La.—It is stated that bids are wanted April 24 for asphalt and brick paving on several streets. W. S. Douglass, Compt.

Newport, Ky.—Bids are wanted April 26 for brick pavement on 6th St. W. L. Glazier, City Engr.

Coldwater, Mich.—About 10,000 yds. of pavement has been ordered. Riggs & Sherman, of Toledo, Engrs.

Jamestown, N. Y.—The following bids for constructing about 11,580 sq. yds. of brick pavement, 5,700 lin. ft. of curbing and 210 ft. of curved curbing were opened April 15 by the Board of Public Works. A. A. Amidon, Chmn.: Jamestown Construction Co., $20,738.75; Gust. Burlond, $20,246.65. Bidders both of Jamestown.

Elwood, Ind.—The following bids for 12,000 sq. yds. of block pavement were opened April 17 by John Finan, Jr., City Engr.; O'Brien & Dehonty, Elwood, Ind., $13,560; R. A. Ajur, Elwood, Ind., $13,560; W. W. Hatch & Son, Goshen, Ind., $14,160; Porter, Bowlin & Hadley, Tipton, Ind., $14,880; Foster & Co., Attica, Ind., $14,160.

Akron, O.—John W. Payne, City Engr., writes that the contracts for paving, for which bids were opened April 15, were awarded as follows: To Herring & Son of Mansfield, O., for Crosby St., 5,092 sq. yds. of Akron brick, at 59¾ cts., total contract $4,724.18; to James Wildes & Son of Akron, for Maple St., 11,377 sq. yds. of brick, at 59 cts., total contract $12,230.16.

Scranton, Pa.—Joseph P. Phillips, City Engr., writes that the following bids were opened April 13 for paving Providence Road and North Main Ave. with vitrified brick on a 6-in. concrete base with 10 year guarantee; also setting 6 x 15 in. curb on a bed of 6 in. of concrete. Approximate estimate 40,000 sq. yds. of pavement. 22,433 lin. ft. of straight curb and 1,109 lin. ft. of circular curb:

Name of Bidders.	Pavement per sq. yd.	Straight curb per lin. ft.	Circular curb per lin. ft.	Straight curb with tile drain per lin. ft.	Circular curb with tile drain per lin. ft.	Resetting old curb per lin. ft.	Laying 12-in. pipe per lin. ft.	Receivers, each.
	$	cts.	$	cts.	$	cts.	cts.	$
*George McDonald, Newark, N. J.	1.79	98	1.25	....	...	29	....	....
Girard Construct'n Co., Philadelphia, Pa	1.97	71	1.19	89	1 35	21	25	25
M. H. Dale, Scranton, Pa	1.98	72	1.20	90	1.38	24	26	25

* Bid rejected on account of not having complied with the requirements of the ordinance.

Lafayette, Ind.—W. K. Eldridge, City Engr., writes that contracts have been awarded as follows for asphalt paving in four streets, as advertised in "The Engineering Record":,

To the Barber Asphalt Paving Co., of New York City, for three streets, total amount of contract, $68,179; detail bids as follows: Grading for sheet pavement, 30 cts. per cu. yd.; gravel, sub-base, 70 cts. per cu. yd.; drain tiling, 6 cts. per ft.; stone curbing, 75 cts. per ft.; circle curbing, $3.50 per piece; sheet asphalt paving, $1.95 per sq. yd.; block gutters, $1.60 per sq. yd.; marginal stones, 45 cts. per ft.; cement walks, 13 cts. per sq. ft.; sodding, 1 ct. per sq. ft.

To Wm. F. Frey, Lafayette, Ind., for one street, amount of contract, $14,401; detail bid as follows: Gravel sub-base, 55 cts. per cu. yd.; drain tiling, 5 cts. per ft.; stone curbing, 73 cts. per ft.; circle curbing, $5.94 per piece; grading for block pavement, 25 cts. per cu. yd.; asphalt block paving, $1.95 per sq. yd.; marginal stones, 50 cts. per ft.; cemtn walks, 12 cts. per sq. ft.; sodding, 1 ct. per sq. ft.

POWER PLANTS GAS AND ELECTRICITY.

Wheeling, W. Va.—It is reported that bids will soon be asked by the Consumers Electrical Co. for a plant, to cost about $100,000. S. W. Harper, Pres.

Newark, N. Y.—Edward H. Jenkins, Engr. for the Buffalo Gas Companies, W. B. Cutter and C. L. Ingham, all of Buffalo, are said to be here looking for a site for a $40,000 gas plant, which they contemplate erecting. Four miles of pipe will be laid.

Barrie, Ont.—It is stated that bids are wanted May 1 for an extension to the electric light plant. Cost, about $10,000.

Pensacola, Fla.—Geo. W. Arras has petitioned for a franchise for an electric light plant.

Bangor, Me.—Plans are said to be under way for the installing of an electric light plant at the water-works at a cost of about $25,000.

Butte, Mont.—It is reported that the power plant of the General Electric Co. has been destroyed by fire; loss $40,000.

Newbern, N. C.—See "Water."

Covington, Tenn.—The Senate is stated to have passed a bill authorizing the issue of bonds to extend the electric light system.

New Orleans, La.—See "Government Work."

Sturgeon, Mo.—It is stated that an electric light plant will be established.

Salem, O.—Morris French, City Engr., writes that the following bids were opened April 14 for asphalt block pavement in Ellsworth St.:

Names.	10,500 Excavation.	8,000 Drain Tile.	83,000 Curbing.	60 Angle Blocks.	5,500 Gravel.	1,500 Sand.	15,300 Laying and Rolling.	15,300 Asphalt block, sq. yd.	1,600 ft. 24-in. Sewer pipe.	700 ft. 18-in. Sewer pipe.	Total.
J. C. Carland	$0.20	$0.04	$0.43	$4 00	$0.90	$0.90	$0.14	$1.38	$0.95	$0 70	$35,785
A. G. Pugh	.22½	.04	.45	4.50	.90	.90	.23½	1.40	1.75	1.25	39,003
Alfred & W. H. Adams	.22	.04	.45	4.00	.89	.89	.20	1.40	.85	55	37,315
W. R Johnson	.22	.04	.50	4 00	1.05	1.05	.18	1.38	.95	·55	38,238
Davis & Caldwell	.20	.04	.45	4.00	.85	85	.25	1 38	1 85	1.50	37,294
John Hadley	.25	.03	.44	3.50	1.05	1.05	.18	1.39	70	.45	38,098
G. P. Herring & Son	·23	.03	.44	4 50	1.00	1.00	.20	1.43	1.05	.60	38,516

Other bids were also received at the same time for paving numerous streets, as follows: *a*, East High St., 10,527 sq. yds. of asphalt block; *b*, Franklin Ave., 795,000 bricks; *c*, West Main St., 860,000 bricks; *d*, Mill St., 350,000 bricks; *e*, East Fourth St., 300,000 bricks; *f*, Garfield Ave, 274,000 bricks.

Samuel Buell, *a*, $24,761.66; *e*, $7 753.50.

W. R. Johnson, *a*, $26,445 30; *b*, $21,751.45; *c*, $22,658.07; *d*. $9,889.50; *e*, $8,201.94; *f*, $7,715.50.

Jas. McGlashan, *a*. $25,132.25.

Geo. B. Herring & Son, *a*, $26,659.48; *b*, $20.979.10; *c*; $22,312.41; *d* $9,487; *e*, $8,211.40; *f*, $7,979.58.

Davis & Caldwell. *a*, $26,111.14; *c*, $22.779 20

A. G. Pugh, *a*, $26.411.81; *b*, $22,089.75; *c*, $23,160.56; *e*, $8,318.70.

Pfaff, Ringwald & Smith, *a*, $27,928.15; *b*, $23,658.97; *c*, $24,541.57; *d*, $10,528.50; *e*, $8,843.50.

Adams Bros., *a*, $26,387.79.

J. C. Carland & Co., *a*, $24,851.03; *b*, $19,884 35; *c*, $20,770.55; *d*, $8,919.50; *e*, $7,762.50; *f*, $7,079.51

John Hadley, *a*, $30,668.14; *b*, $20,892.10; *c*, $22,285 83; *d*, $9,398; *e*, $9,490; *f*, $7,723.78.

Geo. D. Smith & Bro., *b*. $20,769.85; *c*. $21,786.23; *d*. $9,141.

M. B. Howell, *d*, $9,180 50; *e*, $7.931.48.

Bids were also received for small brick paving contracts in three other streets.

Saginaw, Mich.—H. E. Terry, City Engr., writes that the following bids were opened April 14 for brick and asphalt paving in Court St.:

Name and Address of Bidders.	Excavation, 9,930 c. y.	Brick Paving, 6,700 sq. yds.	Curbstone Reset, 8,600 lin. ft.	Tile Drain, 520 rods.	Timber B. M., 6,200 ft.	Asphalt Paving, 21,500	Maintenance per yr. for 5 yrs.	Total.
Barber Asphalt Paving Co., Saginaw	$0.17	$1.25	$0.14	$0.75	$16.50	$1.52	$4.00	$44,420 80
F. E. Cole, Toledo	.15	1.29	.17	.70	16.50	1.63	....	47,108.80
	11,550 c. y.	28,200 sq. yds.	8,600 lin. ft.	520 rods.	6,200 ft.			
Lamson & Crowley, Saginaw	$0 23	$1.20	$0.12	$1.25	$18.00			$38,290.10
John C. Davies, "	.20	1.25	.10	1.15	17 00			39,123 40
Scanlan & Crowley, "	·25	1 22	.15	.99	20.00			39,220 30

For paving Hamilton St., 5,700 sq. yds., the bids received were as follows: John C. Davis, $7,389; Lamson & Crowley, $7.540.55; Scanlan & Crowley, $7,664.65; Barber Asphalt Paving Co., $8,942.85; F. E. Cole, $9,460.30.

Lebanon, Pa.—Bids are wanted May 15 for lighting the city with electricity. A. H. Biever, Chmn. Police Com.

San Carlos, A. T.—See "Government Work."

Blissfield, Mich.—The Council is stated to have been petitioned for a franchise for an electric light plant.

Kansas City, Mo.—See "Government Work."

Mayville, N. D.—See "Water."

Park City, Utah.—R. C. Chambers is stated to have received a franchise for an electric light plant.

Nebraska City, Neb.—The Directors of the Water & Light Co. are stated to have appropriated $15,000 for remodeling and improving the electric light plant. D. P. Rolfe, Mgr.

Kaukauna, Wis.—Chas. D. Smith is stated to have petitioned the Council for a franchise to maintain a light, heat and power plant and build and operate an electric street railway.

Worcester, Mass.—See "Public Buildings."

Centralia, Wis.—It is reported that the Twin City Electric Co. will construct a lighting plant.

Niagara Falls, N. Y.—Thos. Dark & Sons of Buffalo are stated to have received the contract for constructing a conduit for electric power lines from the power house of the Niagara Falls Power Co., and also for a sewer and drains to connect with the new plant of the Union Carbide Co.

Redwood City, Cal.—See "Water."

Versailles, O.—It is stated that a company will soon be formed by the business men of this city to construct an electric light plant.

Baltimore, Md.—Bids are wanted April 26 for lighting the city with electricity. Wm. H. Swindell, Gen. Supt. of Lamps, etc.

Whitefish Bay, Wis.—See "Water."

Tarboro, N. C.—Bonds to the amount of $10,000 were voted April 15 for an electric light plant. John A. Weddell, City Clk.

Montgomery, Ala.—The Montgomery Water Power & Electric Co. has been incorporated, to furnish light, heat and power in this city; capital, $100,000. Incorporators: J. S. Pinckard, J. C. Haas, J. McC. Tharin and others.

Columbus, Miss.—See "Water."

Eureka, S. D.—The Eureka Brewing Co. is stated to have decided to construct an electric light plant to furnish light for the city.

Glassboro, N. J.—See "Water."

Midway, Ky.—Bids are wanted May 9 for a franchise for a term of 5 years for constructing, maintaining and operating an electric light system. Matt Winn, Mayor.

Columbus, O.—The Directors of the Columbus Electric Light Co. are stated to have decided to install an entire new alternating system for incandescent electric lighting; also a new building on the river site to be equipped with the latest improved machinery.

South Omaha, Neb.—The Magic City Electric Light & Power Co. is stated to have been incorporated: capital $100,000. Incorporators: Wm. J. McManigal and A. L. English.

Galesburg, Ill.—The Peoples Gas & Electric Co. has been incorporated; capital $100,000. Incorporators: J. T. McKnight, G. D. Crocker and others.

Brookings, S. D.—The citizens are stated to have voted to issue $5,000 bonds to buy and improve the electric light plant.

Williamsburg, Ia.—It is stated that estimates are being prepared for an electric light plant.

Wadena, Minn.—The Council is stated to have decided to purchase a new dynamo and engine for the electric light plant, at a cost of about $3,000.

Berea, O.—E. S. Loomis, City Clk., writes that it is proposed to construct an electric light plant to cost $30,000. L. E. Chapin, of Canton, O., Engr. in Charge.

Havre de Grace, Md.—John H. Reckord, of Belair, Md., has received a franchise to construct an electric light plant.

Austin, Minn.—The Council is stated to have voted to put in an electric light plant.

Sag Harbor (L. I.), N. Y.—The contract for constructing an electric light plant has been awarded to the Artesian Well Drilling Co., 44 Centre St., N. Y. City. Cost of plant $25,000.

Monroe, Mich.—The citizens are stated to have voted to issue $20,000 electric light bonds.

Madison, Wis.—It is reported that a bill has been passed appropriating $35,000 for a State electric light plant to be built on the university grounds.

Madrid, Ia.—A. R. Westberg & Son are stated to have applied for a franchise for electric lighting.

Homer, Mich.—L. T. Van Horn, Village Clk., writes that a special committee has under consideration the proposition of Cortright & Sons to furnish electric lights at so much a year, the committee is also considering the advisability of having a plant built and run by a company.

Darby, Pa.—The Philadelphia Suburban Gas Co., of Darby, is stated to have applied to the Councils of Darby, Colwyn, Sharon Hill, Yeadon and Lansdowne for permission to extend its system to these towns.

Knoxville, Tenn.—The Tennessee Gas & Coke Co. is stated to have petitioned the Council for a franchise. C. C. Howell, Gen. Mgr. of the Knoxville Traction Co., is one of the incorporators.

Brewer, Me.—The City Clerk writes that there is talk of changing the lighting system from arc to incandescent lights.

Winchester, Ind.—See "Water."

Washington, D. C.—Bids are wanted May 13 for lighting the streets and roads in the District of Columbia during the year ending June 30, 1900, with naphtha lamps, as advertised in "The Engineering Record."

ELECTRIC RAILWAYS.

Morton, Pa.—Enos M. Harris is stated to have petitioned the Council for a franchise.

Garden City, Kan.—There is talk of constructing a trolley line between this place and Pueblo.

Indianapolis, Ind.—The County Commissioners on April 14 granted a franchise to P. H. Fitzgerald, Joseph Elliott, Jr., and J. C. Tarkington for the construction of an electric road over the Mooresville road to Martinsville.

Carrollton, Ky.—It is stated that the contract will be let about June 1 for about 40 miles of electric railway by the Carrollton Electric Ry. & Bridge Co. M. L. Down, Secy.

Atlanta, Ga.—The Consolidated Ry. Co. and the Atlanta Ry. Co. are stated to have been consolidated; capital $2,000,000. Some extensions will probably be built.

Sacramento, Cal.—L. T. Hatfield, representing the South Yuba Electric Co., has applied for a franchise through Sacramento County.

Bids for the above franchise will be received by the Supervisors May 3. Wm. B. Hamilton, Co. Clk.

Waynesboro, Pa.—George W. Smith, one of the Directors of the Blue Ridge Electric Ry. Co., writes that the Pennsylvania side of the road will be nine miles long and cost about $150,000 to build and equip, the Maryland part will probably be considerably longer, but is as yet only projective. W. Riley Weaver, 200 Calvin St., Baltimore, Md., is the engineer in charge. Only a portion of the stock has been subscribed, and it is not thought the line will be built before the latter part of 1899, unless arrangements can be made with contractors to accept bonds as payment.

Norwich, Conn.—Judge Shumway, in the Superior Court, on April 15, granted the petition of the Montville St. R. R. Co. to construct its tracks from Norwich to New London, a distance of 14 miles.

Kaukauna, Wis.—See "Power Plants, Gas and Electricity."

Elwood, Ind.—Dr. J. C. Hougham of Perkinsville is said to be interested in the construction of an electric railway from Elwood to Noblesville by way of Anderson.

Chattanooga, Tenn.—The Directors of the Chattanooga Electric St. Ry. Co. are stated to have decided to extend its line to Sherman Heights, a distance of about 4 miles. J. H. Warner, Pres.

Taunton, Mass.—Amos W. Eaton, Town Clk., writes that the construction is contemplated of an electric railway from Taunton to Middleboro.

Fernbank, O.—The Cincinnati, Lawrenceburg & Aurora Electric Ry. Co. is stated to have received a franchise.

Marietta, Ga.—It is stated that the Chattahoochee River trolley line will be extended from Atlanta to Marietta, a distance of about 12 miles.

Platte City, Mo.—Willard E. Winner is stated to have received a franchise through Platte County.

Racquette Lake, N. Y.—The State Railroad Commission is stated to have granted permission to the Racquette Lake Ry. Co. to construct and operate a standard gauge road by compressed air power from the Clearwater station on the Mohawk & Malone Ry. Co. to Racquette Lake, a distance of 16 miles. C. E. Snyder, of Herkimer, is said to be interested.

RAILROADS.

Denver, Colo.—It is reported that the Colorado & Southern R. R. Co. will expend about $300,000 on improvements. B. L. Winchell, Vice-Pres.

Silverton, Colo.—The Silverton, Gladstone & Northerly Ry. Co. has been incorporated to construct a railroad from Silverton to Lake City; capital, $500,000. Incorporators: Circus D. Davis, Fairfield, Me.; John Chipman, St. Stephens, N. B.; Geo. H. Barnes, Silverton, and others.

Clarksburg, W. Va.—A charter has been granted to the West Fork & Southern R. R. Co., with a capital of $2,000, to construct a railroad from near Bartlett Station on the Monongalia River Railroad, to a point near Bartlett, Sulphur Springs, in Harrison County. Incorporators: J. T. Jones, of Clarksburg, and J. M. Wilcox, of Parkersburg, and others.

Hickman, Tenn.—A charter is stated to have been granted to the Lake County Levee & Drainage Co., and to the Hickman & Tiptonville R. R. Co. to build a levee from Hickman to the highlands of Lake County, a distance of 20 miles, and a railroad from Hickman to Tiptonville, a distance of 25 miles; capital, $100,000. Incorporators of both companies are J. C. Harris, P. Davis, J. W. Chambers and others.

Toledo, O.—The Toledo Union Ry. Co. has been incorporated with a capital of $500,000, and will connect Detroit and Toledo. Incorporators: Jas. King Duffy, Benj. F. James and others.

Sioux Falls, S. D.—J. E. Colton, Gen. Mgr. Sioux Falls, Madison & Aberdeen Ry. Co., is said to be interested in the construction of a rialroad between this place and Madison.

PUBLIC BUILDINGS.

(See also Schools and Government Work.)

Columbus, O.—Press reports state that bids are wanted May 17 by the State House Building Commission for a separate heating plant for the State House.

Norristown, Pa.—See "Bridges."

New York City.—Bids are wanted May 11 for plumbing and drainage in the new city prison. Francis J. Lantry, Commr. Dept. of Correction.

Cascade, Ia.—The Tri-City Construction Co., of Davenport, is stated to have received the contract to erect the new St. Martin's Church, at $19,650.

Long Prairie, Minn.—Bids are wanted April 25 for a building. Geo. R. Christie, Chmn. Com.

Decatur, Ill.—W. O. McNabb, of Decatur, is stated to have prepared plans for a $20,000 church.

Chelsea, Mich.—Bids are wanted May 2 for a stone church. O. T. Hoover, Secy. Bldg. Com.

Jamestown, N. D.—Plans and specifications are wanted May 3 for 2 ward buildings. Anton Fried, Secy. Bd. Trustees, North Dakota Hospital for the Insane.

Pittsburg, Pa.—It is stated that a $1,750,000 addition is to be erected to the Carnegie Library.

Chicago, Ill.—Bids are wanted April 27 for steam heating apparatus in the Sheffield Ave. police station. L. E. McGann, Commr. Pub. Wks.

St. Peter, Minn.—Bids are wanted April 28 for a poor house. Philip Dick, Chmn. Bd. Co. Commrs.

Conroe, Tex.—Plans, specifications and bids are wanted May 1 for a steel fire-proof vault. M. S. Cooper, Co. Judge.

Trenton, Tenn.—The Senate is stated to have passed a bill authorizing Gibson County to issue bonds to build a court house; probable cost, $30,000. R. J. Dew, Co. Clk.

Marion, S. C.—Bids are wanted May 5 for a fireproof building. John A. McRae, Chmn. Co. Bd. Commrs.

Buffalo, N. Y.—The Governor is stated to have signed the bill reappropriating $162,978 for the Seventy-fourth Regiment armory.

Concord, N. H.—Bids are wanted May 2 for several buildings, and additions and repairs to buildings at the New Hampshire Asylum for the Insane. John A. Spaulding, Chmn. Com. Trus.

Central City, Colo.—The County Commissioners are stated to have decided to erect a $25,000 court house.

Elwood, Ind.—The plans of J. F. Alexander Lafayette are stated to have been accepted for a $28,000 city building.

Chicago, Ill.—The Trustees of the Eighth Presbyterian Church are said to be considering the matter of erecting a $35,000 edifice. J. K. Stevens, Pres. Bd. Trus., 690 Washington Boulevard.

Statesville, N. C.—The County Commissioners are said to be considering the matter of erecting a $20,000 court house.

Denver, Colo.—The Governor is stated to have signed a bill appropriating $40,000 for a new wing to the insane asylum.

Raleigh, N. C.—Nicholas Ittner, of Atlanta, is stated to have received the contract for the free library hall, at $25,000.

Lincoln, Neb.—The Governor is stated to have signed the bill appropriating $40,000 for a building at the Lincoln Insane Hospital.

Louisville, Ky.—W. R. Brown, Wiggins Blk., Cincinnati, is stated to have prepared plans for the $30,000 church for the Trinity M. E. Church.

Hastings, Neb.—The Governor is stated to have signed the bill appropriating $30,000 for a building at the Hastings Asylum, and $15,000 for a boiler and engine house.

Kansas City, Mo.—Van Brunt & Howe, of Kansas City, are stated to have prepared plans for a $25,000 children's home.

Omaha, Neb.—The Governor is stated to have signed a bill appropriating $25,000 for a building at the Omaha Institute for the Deaf and Dumb.

Charleston, W. Va.—The plans of Harrison Albright, of Charleston, are stated to have been accepted for the Capitol annex.

Gardenville, N. Y.—Geo. J. Metzger, 19 W. Huron St., Buffalo, is said to be preparing plans for a home for the Sisters of St. Francis. The building will be 400x200 and fireproof. Sister M. Xavier, Director.

Beatrice, Neb.—The Governor is stated to have signed a bill appropriating $48,500 for new buildings and improvements to the Beatrice Institution for the Feeble-Minded.

Watertown, Mass.—McKay & Dunham, Devonshire Bldg., Boston, are said to have prepared plans for the $60,000 church for the Baptist Society.

Jeffersonville, Ind.—The Legislature is stated to have appropriated $200,000 for new buildings at the Indiana Reformatory. C. E. Shiveley, Pres., Jeffersonville.

Galesburg, Ill.—Gottschalk & Beadle, of Galesburg, are said to be preparing plans for the $40,000 library.

Indianapolis, Ind.—Vounegut & Bohn, Indiana Trust Bldg., are stated to have prepared plans for a $30,000 temple to be erected by the Hebrew Organization.

Toledo, O.—It is stated that plans have been prepared for a $30,000 church for St. Ann's Catholic Society.

Leon, Ia.—The Supervisors are said to be considering the matter of erecting a $50,000 court house.

Morristown, N. J.—Bids are wanted May 4 for the erection of the south wing of the new hospital building at Morris Plains, as advertised in "The Engineering Record."

Danville, Ill.—Bids are wanted April 29 for heating and ventilating apparatus, plumbing, gas piping and electric lighting apparatus in Barrack Buildings, at the Danville Branch of the National Home for D. V. Soldiers, as advertised in "The Engineering Record."

Janesville, Wis.—The congregation of St. Mary's R. C. Church is stated to have decided to erect a $25,000 edifice.

Whitehall, Wis.—It is stated that bids are wanted May 4 for an insane asylum, to cost about $50,000. O. E. Gibbs, Chmn. Superv.

Easton, Pa.—It is stated that bids are wanted April 27 for fair buildings. J. J. Maus, Secy. Northampton Co. Agricultural Society.

Cincinnati, O.—The Directors of the German Deaconess Home & Hospital are stated to have decided to erect a $40,000 hospital.

Holyoke, Mass.—The plans of G. P. B. Alderman of Holyoke are stated to have been accepted for a $20,000 church for the German Lutheran Society.

Spartansburg, S. C.—It is stated that bids are wanted May 2 for a church. A. H. Twitchell, Chmn. Bldg. Com., Presbyterian Church.

Richmond, Ind.—Bids are wanted April 27 for a building for the Eastern Indiana Hospital at Easthaven. S. E. Smith, Med. Supt.

Harrisburg, Pa.—The following bids have been received for the construction of the State Lunatic Hospital. The first bid given is for blue stone, the second is for Hummelstown: Nesbit & Coder, Harrisburg, *$84,650, $84,900; N. Reide, Harrisburg, $86,600; Girard Construction Co., $87,755, $88,930; H. C. Hoffman & Son, $88,752, $88,052; J. E. & A. L. Pennock, $88,787; W. G. Ball, Harrisburg, $89,493, $88,469; C. H. Miller, Harrisburg, $89,719; McIlvain, Unekeffer Co., Pittsburg, $89,917, $94,314; R. C. Ballinger & Co., $90,593, $94,343; Chas. McCaul, $90,966, $93,366; Ryan & Kelly, $92,947, $96,647; Macey, Henderson & Co., $94,394, $97,467; J. F. Seibel, Harrisburg, $95,693; John A. Burger & Son, $96,356, $91,356; Stacy Reeves & Son, $96,997, $98,397; J. K. Ness, Harrisburg, $97,593, $94,378; A. Wildman, Harrisburg, $97,867; Phillip Anns Co., $97,867; Wm. Gates, Harrisburg, $99,000; Allen B. Rorke, $100,000, $99,900; N. Shumead, $100,000, $96,000. Address of bidders Philadelphia, unless otherwise stated.

*Contract awarded.

BUSINESS BUILDINGS.

Brattleboro, Vt.—Bids are wanted May 1 for an office building. N. A. Plummer, Archt.

Princeton, N. J.—It is stated that a $30,000 building is to be erected for the College Y. M. C. A.

Denver, Colo.—The Knights of Pythias are said to be considering the matter of erecting a $75,000 temple.

Hancock, Mich.—It is stated that J. R. Dee will erect a $25,000 business building.

Glen Falls, N. Y.—Addison B. Colvin is said to be interested in a stock company incorporated with a capital of $25,000 to erect an opera house.

Toledo, O.—The plans of E. O. Fallis, of Toledo, are stated to have been accepted for a $150,000 Y. M. C. A. building.

Richmond, Va.—The American Tobacco Co. is about to erect on East Cary St. a $35,000 factory. Albert F. Hunt, Archt., Richmond.

New Haven, Conn.—A $24,000 brick building is to be erected by the Y. W. C. A. at Chapel and Brewery Sts. Wm. H. Allen, Archt., 82 Church St.

Nashville, Tenn.—The Gray-Dudley Hardware Co. is about to erect a wholesale store at College and Market Sts.

Minneapolis, Minn.—Wm. M. Kenyon, Guaranty Loan Bldg., is said to be preparing plans for the Soo Line freight terminal, to contain a cold storage room; estimated cost $50,000.

Kansas City, Mo.—Swofford Bros. propose to build a $150,000 wholesale store. Shepard & Farrar, Archts., New Ridge Bldg.

Chelsea, Mass.—Plans have been prepared by Wm. Hart Taylor, 296 Boylston St., Boston, for a $40,000 brick building for the Chelsea Y. M. C. A.

Southbridge, Mass.—The American Optical Co. is about to erect a $20,000 factory. Earle & Fisher, of Worcester, Archts.

Reading, Pa.—Plans have been prepared by A. J. Fink, 530 Court St., for a 4-story building, to be erected by F. Heller, at a cost of $16,000, on Penn and Second Sts.

The Keystone Cold Storage Co. proposes to build, according to plans prepared by Muhlenberg Bros., 532 Penn St., a $12,000 addition to its plant. G. F. Mertz, Pres.

NEW YORK CITY.

Permits for the following buildings have been issued; o, signifies owner; a, architect; b, builder, and c, contractor.

316 & 318 E 14th st, br stores & flat, cost, $30,000; o, Julius Dreyfus; a, G F Pelham.

Greenwich & Jay sts, br stores & loft, cost, $100,000; o, Mohlman Estate; a, C W Atkins.

21-24 State st, 1 & 5 Pearl st, 2-6 Bridge st, br & stone office bldg, cost, $500,000; o, R O Chesebrough; a, Clinton & Russell; b, G A Fuller & Co.

533 5th st, br stores & flat, cost, $20,000; o, Simon Jacobs; a, N Langer.

Broome & Suffolk sts, br stores & tenem't, cost, $35,000; o, Harry Fischel; a, Samuel Sass.

Oak & Oliver sts, br stores & tenem't, cost, $28,000; o, Rosenberg & Golden; a, C E Reid.

741 to 745 E 5th st, 2 br stores & tenem'ts, cost, $60,000 all; o, Abraham Perelman; a, Horenburger & Straub.

21 & 23 Rutgers pl, 2 br stores & tenem'ts, cost, $50,000; o, Barnett Hamburger; a, Horenburger & Straub.

68th & Esterior sts, br & stone brewery, cost, $145,000; o, Central Brewing Co; a, Wm Griesser.

8th ave, 151 & 152d sts, 10 br stores & flats, cost, $259,999; o, Daniel Pierce; a, John C Burne.

BROOKLYN, N. Y.

West st, Oak to Noble sts, addition to factory, cost, $20,000; o, American Mfg Co; a, Wm Higginson.

DWELLINGS.

Allentown, Pa.—J. K. Mosser is about to build a $20,000 residence at 453 Hamilton St.

Irvington, N. Y.—Plans are stated to have been prepared for a $15,000 parsonage for the Irvington Presbyterian Church.

Houston, Tex.—D. T. Boyles is about to erect on Main St. a 3-story brick dwelling to cost $12,000. Geo. E. Dickey, Archt., New Orleans, La.

San Diego, Cal.—H. W. Putnam is about to build a $20,000 residence on 4th and Maple Sts.

Madison, Wis.—Cloud & Storck, of Madison, are stated to have prepared plans for a $50,000 apartment house for the Gay Land Co.

Philadelphia, Pa.—Henry E. Cregier, of New York City, will prepare plans for a 10-story addition to the William L. Elkins mansion.

Leavenworth, Kan.—Wm. P. Feth has prepared plans for a $16,000 residence for Fred Harvey.

NEW YORK CITY.

Permits for the following buildings have been issued; o, signifies owner; a, architect; b, builder, and c, contractor.

6th st. & 1st ave, 2 br flats, cost, $60,000 all; o, B Klingenstein; a, G F Pelham.

102 & 104 Orchard st, 2 br tenem'ts, cost, $40,000 all; o, Alterman & Grossman; a, M Bernstein.

87 to 91 Columbia st, 3 br tenem'ts, cost, $75,000 all; o, Gottlieb & Cohen; a, M Bernstein.

21st st & 7th ave, 2 br flats, cost, $86,000 all; o, Estate J M Dodd; a, Thom & Wilson.

5th ave & 80th st, br dwell'g, cost, $128,500; o, F W Wolworth; a, C P H Gilbert.

Madison ave & 81st st, br flat, cost, $125,000; o, Ehrenreich Bros; a, Louis Korn.

Manhattan ave & 118th st, br & stone flat, cost, $100,000; o, Salvadore La Grassa; a, Neville & Bagge.

86th st & Riverside Drive, 2 br flats, cost, $80,000 all; o, E W Kilpatrick; a, Frank Jacobsen.

112th st & 8th ave, 4 br flats, cost, $90,000 all; o, H Nicholsburg; a, S M Holden.

111th st & 8th ave, 4 br flats, cost, $200,000 all; o, Jas H Cassidy; a, L F J Weiher, Jr.

Hewitt pl & 156th st, br flat, cost, $20,000; o, Jos Gallo; a, F J Miller & Co.

3d ave & Wendover ave, br flat, cost, $30,000; o, John Eichler Brewing Co; a, M J Garvin.

Webster ave & 179th st, br flat, cost, $20,000; o, Fred'k W Willcox; a, W C Dickerson.

Courtlandt ave & 157th st, br flat, cost, $20,000; o, Gustav Bartels; a, Herrmann Horenburger.

NEW INDUSTRIAL PLANTS.

The Great Western Mfg. Co. of Leavenworth, Kan., is erecting a new foundry building, 125x50 ft., with additions for core ovens and cleaning castings.

The Business Men's League of Sioux Falls, So. Dak., reports that an organization has been perfected to put up a beet sugar factory with a capacity of 500 tons.

J. H. Hicks and associates are to erect a yarn mill at Talladega, Ala.

Berry Bros. of Norwood, Minn., are to build a 150-bbl. flour mill at Hector, Minn. The main building will be 42x60 ft., three stories high, with an engine room 36x42 ft., both of brick.

The Reeves Pulley Co. of Columbus, Ind., is erecting a 3-story 56x96-ft. addition to its factory, for the manufacture of variable speed counter-shafts.

The McDonald Engineering Co. of Chicago is preparing plans for a 40x60-ft. elevator for the Des Moines Elevator Co. of Des Moines, Ia. Two 100-H.-P. boilers and a 200-H.-P. engine will be needed.

L. E. Campbell of Murphy, N. C., is to erect a laundry building and will probably use a 15-H-P. boiler and engine.

George Z. Sheriff and associates of Mercer, Pa., are to build a 25x50-ft. machine shop, two stories high.

F. W. Killian of Washington, D. C., is erecting a 5-story addition to his laundry and will want several new machines.

L. D. Munford of Grassdale, Ga., will probably rebuild his cotton gin plant, which was recently completely destroyed. The old building was 25x40 ft., 2 stories high, and had two 60-ton gins, with a total capacity of 20 bales per day.

R. D. Kinney, mechanical and structural engineer of Philadelphia, has about completed plans and specifications for new Portland cement works of 2,000-bbls. capacity per day, to be erected near Easton, Pa.

BUSINESS NOTES.

The Harrisburg Foundry & Machine Works, Harrisburg, Pa., have been awarded a contract for furnishing a plant of Harrisburg standard engines with a capacity of over 4,000 H.P. There are ten engines in the order, each of which will develop 350 H.P. and have a maximum capacity of 400. They are for the Great Northern Paper Company, which is erecting in the northern part of Maine one of the largest paper producing establishments in the world. The Harrisburg Company reports that it has been running nights for the last six months in order to keep up with the present rush of orders.

The Berlin Iron Bridge Company, East Berlin, Conn., has received a contract for the new roof on the east armory of the Colt's Fire Arms Manufacturing Company at Hartford. It is 60 feet wide and 500 feet long, and will be covered with the bridge company's anti-condensation fireproof roof lining.

The Continental Filter Company, New York City, has received a contract from the owners of the Louisiana, Mo., water-works for an extension of the filtration plant now in use in that place. This plant will provide for sedimentation in connection with coagulation and is guaranteed to deliver water of a high standard of purity, although the supply is drawn from the Mississippi River and is very turbid at times.

PROPOSALS OPEN.

Bids Close		See Eng. Record
	WATER-WORKS.	
Apr. 24.	Austin, Minn	Apr. 22
Apr. 24.	Wells, Duquesne, Pa	Apr. 22
Apr. 25.	Frederick, Md	Apr. 22
Apr 25.	Mellette, S. D.	Apr. 22
Apr. 26.	Washington, D. C	Apr. 1
Apr. 27.	Removing reservoir, etc., New York, N. Y	Apr. 15
Apr. 28.	Cincinnati, O	Mar. 25
	Adv., Eng. RECORD, Mar. 25 to Apr. 22.	
May 1.	Cullman, Ala.	Apr. 1
May 1.	Martinez, Cal.	Apr. 22
May 1.	College Hill, O	Apr. 22
May 2.	Mayville, N. D	Apr. 22
May 3.	Winchester, Ind.	Apr. 22
	Adv., Eng. RECORD, Apr. 22.	
May 3.	Laurel, Del	Apr. 22
	Adv., Eng. RECORD, Apr. 22.	
May 4.	Lining reservoir, Morristown, N. J.	Apr. 22
	Adv., Eng. RECORD, Apr. 22.	
May 8.	Pima, A. T	Apr. 15
May 8.	Orange, Cal.	Apr. 15
May 8.	San Carlos, A. T	Apr. 22
May 15.	Gallatin, Tenn	Apr. 22
May 15.	Wellsville, O	Apr. 22
May 16.	Ottawa, Ont	Apr. 22
——	Grand Norks, N. D.	Apr. 22
——	Peekskill, N Y	Apr. 15
	Adv., Eng. RECORD, Apr. 15, 22.	
——	Napoleonville, La	Mar. 25
——	Corinth, Miss	Mar. 25
	SEWERAGE AND SEWAGE DISPOSAL.	
Apr. 24.	South Bend, Ind	Apr. 8
Apr. 24.	New Haven, Conn	Apr. 22
Apr. 24.	Fort Dodge, Ia	Apr. 22
Apr. 25.	Jersey City, N. J	Apr. 22
Apr. 26.	Elkhart, Ind	Apr. 22
Apr. 26	Indianapolis, Ind	Apr. 22
Apr. 26.	Cohoes, N. Y	Apr. 8
	Adv., Eng. RECORD, Apr. 8.	
Apr. 26.	Washington, D. C.	Apr. 1
Apr. 27.	Atlanta, Ga.	Apr. 8
Apr. 29.	Springfield, O.	Apr. 22
Apr. 29.	East Cleveland, O	Apr. 22
May 1.	Logansport, Ind	Apr. 15
May 1.	Williamsport, Pa	Apr. 22
May 1.	Toledo, O	Apr. 22
May 1.	Albany, N. Y	Apr. 22
May 1.	Braddock, Pa	Apr. 22
May 2.	Olean, N. Y.	Apr. 22
May 3.	Sauk Centre, Minn	Apr. 1
May 5.	Bridgeport, Conn.	Apr. 15
May 3.	Laurel, Del	Apr. 22
	Adv., Eng. RECORD, Apr. 22.	
May 8.	San Carlos, A. T	Apr 22
May 8.	Elyria, O	Apr. 8
May 15.	Medford, Ore	Apr. 1

May 17. Auburn, Ind.......... ... .Apr. 22
Adv., Eng. RECORD, Apr. 22.
May 20. Auburn, Ind.............. ....Apr. 8

BRIDGES.

Apr. 24. Huntington, W. Va ....Apr. 15
Apr. 24. Toronto, Ont.......................Apr. 15
Apr. 25. Abutments, Ft. Wayne, Ind........Apr 22
Apr. 26. Toronto, Ont.... .. ..Apr. 22
Apr. 26. Chicago, Ill. . ...Apr. 15
Adv., Eng. RECORD, Apr. 15.
Apr. 27. Washington, D C.....................Apr. 1
Adv., Eng. RECORD, Apr. 1, 8.
Apr. 27. Marengo, Ia...... ....Apr. 22
Apr. 29. Steel floor beams, etc., Seneca, Ill..Apr. 22
May 1. Doylestown, Pa. ....Apr. 22
May 3. Grafton, N. D...... ....Apr. 22
May 6. Washington, D. D ....Apr. 22
Adv. Eng. RECORD, Apr. 92.
May 8. Birmingham, O.... ....Apr. 22
May 9. Birmingham, O...... ....Apr. 22
May 9. Binghamton, N. Y..................Apr. 22
May 10. Chicago, Ill............. ....Mar. 18
Adv., Eng. RECORD, Mar. 25.
May 11. London, O...... ....Apr. 22
May 15. Honolulu, H. I.......................Apr. 22
May 17. Norristown, Pa.... ....Apr. 22
May 31. Chicago, Ill. .... Apr. 8
Adv., Eng. RECORD, Apr. 15.
—— Quincy, Ill......... ....Feb. 25
Adv., Eng. RECORD, Feb. 25.
—— Bradford, Pa. ....Apr. 15
—— Randolph, Utah.......................Apr. 15

PAVING AND ROADMAKING.

Apr. 22. Nazareth Pa...... ....Apr. 15
Adv., Eng. RECORD, Apr. 15.
Apr. 24. Boston, Mass.. ....Apr. 15
Apr. 24. Houston, Tex.................. ......Apr. 15
Apr. 24. Vanwert, O ....Apr. 8
Apr. 24. Muncie, Ind...... .... Apr. 8
Apr. 24. New Orleans, La ....Apr. 22
Apr. 24. Ithaca, N. Y.......................Apr. 22
Adv., Eng. RECORD, Apr. 22.
Apr. 24. Joliet, Ill.... ....Apr. 22
Apr. 24. Lafayette, Ind.......... ....Apr. 22
Apr. 25. Bond Hill, O . . . . Apr. 1
Apr. 25. Greenville, Pa. ....Apr. 15
Adv., Eng. RECORD, Apr. 15, 22.
Apr. 25. Jersey City, N. J.....................Apr. 22
Apr. 25. Lynchburg, Va. ....Apr. 22
Apr. 26. Newport, Ky.........................Apr. 22
Apr. 27. Newark, N. J..........................Apr. 22
Apr. 27. Meriden, Conn ....Apr. 8
Adv., Eng. RECORD, Apr. 8.
Apr. 28. Bellefontaine, O ....Mar. 25
Apr. 28. New York, N. Y.........................Apr. 22
May 1. Williamsport, Pa. ....Apr. 22
May 1. Albany, N. Y. ....Apr. 22
May 1. Benwood, W. Va ....Apr. 8
May 1. Bradford, Pa ....Apr. 15
Adv., Eng. RECORD, Apr. 15, 22.
May 3. Cincinnati, O............. ....Apr. 15
May 4. Fort Wayne, Ind......................Apr. 8
May 4. Hackensack, N. J. . ... Apr. 22
May 6. Indianapolis, Ind. ....Apr. 22
May 6. Westshoals, Ind ... .Apr. 22
May 8. Lafayette, Ind...... ....Apr. 22
May 15. Road roller, Nanaimo, B. C.... ....Apr 22
May 15. Glens Falls, N. Y......................Apr. 22
Adv., Eng. RECORD, Apr. 22.
May 20. Washington, D. C.......... ... .Apr. 22
(2 advts.) Adv., Eng. RECORD, Apr. 22.

POWER, GAS AND ELECTRICITY

Apr. 24. New York, N. Y.... ....Apr. 15
Apr 24. Toronto, Ont............. ....Apr. 22
Apr. 24. Camden, N. J. ....Apr. 22
Apr. 25. Nanticoke, Pa.........................Apr. 15
Adv., Eng. RECORD, Apr. 15.
Apr. 25. Fixtures, Worcester, Mass ....Apr 22
Apr. 25. South Amboy, N. J.... ....Apr. 22
Apr. 26. Baltimore, Md.... ....Apr. 22
Apr. 27. Mechanicsburg, Pa ....Apr. 8
May 1. Franchise, Santa Ana, Cal.... .... Apr. 1
May 1. Cullman, Ala.... ....Apr. 1
May 1. Franchise, Fairfield, Cal. ....Mar. 25
May 1. Barrie, Ont .. ..Apr. 22
May 2. Florence, Ala ....Apr. 15
May 2. Mayville, N. D.......................Apr. 22
May 2. Kansas City, Mo........ ....Apr. 22
May 8. Winchester, Ind.... ....Apr. 22
Adv., Eng. RECORD, Apr. 22.
May 8. San Carlos, A. T..... ....Apr. 22
May 9. Franchise, Midway, Ky .... Apr. 22
May 10. Galt, Ont.............. . ...Apr. 15
May 10. Cleveland, O.... ....Apr. 15
May 13. Charleston, S. C.......................Apr. 15
May 13. Washington, D. C.......... ....Apr. 22
Adv., Eng. RECORD, Apr. 22.
May 15. Lebanon, Pa...... ....Apr. 22
May 22. Vincennes, Ind.........................Apr. 8
Adv., Eng. RECORD, Apr. 8, 22.
June 1. Prineville, Ore......... ....Apr. 15
—— Pleasantville, O.... ....Dec. 24

GOVERNMENT WORK.

Apr. 24. New York City..........................Apr. 1
Adv., Eng. RECORD, Apr. 1 to 22.
Apr. 25. Dynamo, etc., mint, New Orleans, La......................... .... Apr. 22
Apr. 26. Dredging, New York City...... ....Apr. 1
Adv., Eng. RECORD, Apr. 1 to 22.
Apr. 26. Dredging, Cleveland, O.... ....Apr. 1
Adv., Eng. RECORD, Apr. 15, 22.
Apr. 26. Plumbing, etc., Mobile, Ala.... ....Apr. 22
Apr. 27. Ventilating, etc., Raleigh, N. C....Apr. 22
Apr. 27. Washington, D. C ....Apr. 1
Adv., Eng. RECORD, Apr. 1 to 22.
Apr. 27. Detroit, Mich...... ....Apr. 8
Adv., Eng. RECORD, Apr. 8, 15.
Apr. 28. New York City..........................Apr. 1
Adv, Eng. RECORD, Apr. 1 to 22.
May 1. Duluth, Minn......... ....Apr. 1
Adv. Eng. RECORD, Apr. 1 to 22.
May 1. Fort Hancock, N. J...... ....Apr. 8
May 1. St. Paul, Minn ....Apr. 8
Adv., Eng. RECORD, Apr. 8, 15.
May 2. Dredging, New York City.... ....Apr. 8
Adv., Eng. RECORD, Apr 8 to 22.
May 2. Power plant, Kansas City, Mo. .....Apr. 22
May 3. Dredging, New York City.... ....Apr. 8
Adv., Eng. RECORD, Apr. 8 to 22.
May 4. Bldg., Atlanta, Ga... ....Apr. 15
May 6. St. Louis, Mo.... ....Apr. 8
Adv., Eng. RECORD, Apr. 8 to 22.
May 8. New York City...... ....Apr. 15
Adv., Eng. RECORD, Apr. 15, 22.
May 8. Brockton, Mass. ....Apr. 15
Adv., Eng. RECORD, Apr. 15, 22.
May 8. San Carlos, A. T...................... Apr. 22
May 9. Chicago, Ill......... ....Apr. 8
Adv., Eng. RECORD, Apr. 8 to 22.
May 10. New London, Conn. ....Apr. 15
May 10. Buffalo, N. Y.... . ...Apr. 15
Adv., Eng. RECORD, Apr. 15, 22.
May 10. San Francisco, Cal.....................Apr. 22
May 11. West Point, N. Y. ....Apr. 15
Adv., Eng. RECORD, Apr. 15, 22.
May 12. Mobile, Ala..............................Apr. 15
Adv., Eng. RECORD, Apr. 15, 22.
May 13. Charleston, S. C. ....Apr. 15
May 13. Chattanooga, Tenn. ....Apr. 15
Adv., Eng. RECORD, Apr. 15, 22.
May 15. New York City ....Apr. 15
Adv., Eng. RECORD, Apr. 15, 22.
May 15. Cleveland, O....... .. ..Apr. 22
May 16. Ellis Island, N. Y Harbor ....Apr. 22
Adv., Eng. RECORD, Apr. 22.
May 17. Milwaukee, Wis......... ....Apr. 22
Adv., Eng. RECORD, Apr. 22.
May 17. New York, N. Y.......... ....Apr. 22
Adv., Eng. RECORD Apr. 22.
May 17. Wreck, Boston, Mass .. ..Apr. 22
May 18. Baltimore, Md.... ....Apr. 15
Adv., Eng. RECORD, Apr. 15, 22.
May 18. Ellis Island, N. Y. Harbor ... .Apr. 22
Adv., Eng. RECORD, Apr 22.
May 18. Dredging, etc., New London, Conn. Apr. 22
May 19. Pier, St. Joseph, Mich...... ......Apr. 22
May 20. Buffalo, N. Y.............................Apr 22
May 31. Armor plate, Washington, D. C....Apr 8
May 31. St. Louis, Mo...........................Apr. 22
Adv., Eng. RECORD, Apr. 22.
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SCHOOLS.

Allegheny, Pa.—Bids are wanted May 5 for plumbing in new school in 3d ward. Chas. P. Lang, Secy. School Dist., Pittsburg, Pa.

Pittsburg, Pa.—A correspondent writes that bids are wanted April 27 for a school.

Poughkeepsie, N. Y.—C. L. Howland, City Chamberlain, writes that the election called for April 18, to vote on the issue of $59,300 bonds for new schools, has been postponed until May 11.

Brookline, Mass.—The citizens are stated to have voted to appropriate $50,000 for the erection of the Pierce Grammar School.

Carlisle, Pa.—It is stated that bids are wanted April 24 for a school; cost, $35,000. Walter Stewart, Pres. School Bd.

Huntington, W. Va.—It is stated that a $12,000 addition will be erected to the State Normal School.

Lacona, Ia.—Bids are wanted April 29 for a school in sub-district No. 6, White Breast Township. W. W. Campbell, Secy.

Bedford, Ind.—Harry C. Sense, of Lafayette, has received the contract for a stone school at $15,775.

Annapolis, Md.—Bids are wanted April 25 for a school. F. Eugene Wathen, Co. School Examiner.

Beattyville, Ky.—Bids are wanted June 1 for a school. Thomas Pryse, Secy.

Washington, Pa.—The citizens are stated to have voted $25,000 bonds for a school.

Waterbury, Conn.—Bids are wanted April 24 for the mason and carpenter work, plumbing, ventilating and heating in a school on Woodlawn Terrace. A. I. Goodrich, Chmn. Dist. Com.

Marshall, Minn.—The Angus McLeod Co., of Minneapolis, is stated to have received the contract for the high school at $39,737.

Allegheny, Pa.—Bids are wanted May 1 for remodeling the heating plant in the high school. G. W. Gerwig, Secy. High School Com.

Paris, Ill.—The plans of O. H. Reeves, of Peoria, are stated to have been accepted for a $13,500 school for the 4th Ward.

Millersburg, O.—Bids are wanted May 6 for a school in sub-district No. 1. Otto Negelspach, Clk.

Craft, Wis.—Bids are wanted April 27 for a school in Wheaton Township. Address J. W. Close.

Washington, D. C.—Bids are wanted April 26 for a hot-air or hot-blast steam heating apparatus, with mechanical ventilating appliance combined with each system, for the Lovejoy school. John B. Wight, Commr., D. C.

Cranston, R. I.—The citizens are stated to have voted to erect a $20,000 school.

San Carlos, A. T.—See "Government Work."

Allegan, Mich.—A $20,000 high school will be erected.

Denison, Ia.—Bids are wanted May 6 for a school in Washington township. C. R. Carpenter, Secy.

West Chester, Pa.—Harry M. Burns, of West Chester, is stated to have received the contract for a building for the West Chester State Normal School, at $32,000.

Utica, N. Y.—It is stated that plans are being prepared for a $19,000 school for the 3d Ward.

Bristol, R. I.—Bids are wanted April 24 for ventilating and heating the Byfield school. J. Howard Manchester, Chmn. Repair Com.

New York City.—The following permits have been issued for schools to be erected by the city: C. B. J. Snyder, 585 B'way, is the architect for each: Five-story brick school on 76th St., near Third Ave., to cost $85,000.

Three-story brick extension on Patchen Ave., near Macon St., Boro of Brooklyn, to cost $42,000.

Bids are wanted May 1 for alterations, repairs, etc., to several schools in the Borough of Manhattan.

Omaha, Neb.—Plans are being prepared by J. W. McDonald, 41 Barker Blk., for a $150,000 high school, and plans are also being prepared by John Latenser, new Gov. Bldg., for 3 grammar schools; total cost, $100,000.

STREET CLEANING AND GARBAGE DISPOSAL.

New York, N. Y.—Bids are wanted May 2 for steel dumping carts. Francis J. Lantry, Com. of Correction.

Lexington, Ky.—The Mayor has been authorized to advertise for bids for street cleaning for a period of 2 years.

Brooklyn, N. Y.—The Council has passed the issue of bonds for the street cleaning plant, amounting to $569,000.

Lowell, Mass.—The contract for the collection and disposal of swill, garbage, offal, ashes, etc., has been awarded to the Lowell Garbage & Cremation Co., at the rate of $26,500 per year for five years.

Camden, N. J.—Articles of incorporation have been filed by the Camden Reduction Co. The objects of the corporation are to collect and dispose of garbage. The capital stock is $100,000. The incorporators are B. F. Howland and Charles B. Livezy, of Philadelphia, and H. M. Knight, of Camden.

Glens Falls, N. Y.—George P. Slade, City Engr., writes that the purchase of a road sweeper is contemplated. Address, D. J. Finch, Street Commr.

Louisville, Ky.—According to local press reports the following bids were opened for the construction of a garbage crematory: Smead Crematory & Power Co., of Toledo, O., $58,000; cost of incineration, 22½ cts. a ton; Dixon Garbage Crematory Co., of Toledo, $60,000, $58,000 or $56,000; the cost per ton, 29 cts.; Engle Sanitary and Cremative Co., of Des Moines, $75,000; cost per ton is 35 cts.; American Sanitary Engineering Co., of Detroit, $119,000; cost 25 cts. a ton; Thackeray Incinerating, Fertilizing & Developing Co., of Cincinnati, to erect a furnace with a capacity of 250 tons a day for $59,650; to construct and operate a furnace for one year for $39,529, the city having the privilege to purchase within the year; to erect a furnace and charge an annual rental of $39,129.

GOVERNMENT WORK.

New Orleans, La.—Bids are wanted April 25 for furnishing a 125 H.P. steam boiler, 25 H.P. high-speed automatic cut-off engine, 12 kw. 125-volt dynamo and other machinery, in the U. S. Mint. C. W. Boothby, Supt. U. S. Mint.

Mobile, Ala.—Bids are wanted April 26 for plumbing, etc., in the U. S. Custom House and Post Office. James Knox Taylor, Supervising Archt., Treas. Dept., Washington, D. C.

Buffalo, N. Y.—Bids are wanted May 20 for hire of dredging plant for excavation in Niagara River. Maj. T. W. Symons, Corps Engrs., U. S. A.

Washington, D. C.—Plans are being prepared by James G. Hill for the new Government Printing Office, estimated to cost $2,000,000. Lieut. Sewell, Corps Engrs., U. S. A., is in charge of construction.

Cleveland, O.—Bids are wanted May 15 for dredging channels and constructing jetty and bar protection of brush and stone at Sandusky Harbor. Col. Jared A. Smith, Corps. Engrs., U. S. A.

New London, Conn.—Bids are wanted May 18 for dredging in Stamford Harbor and for removal of rock from Mystic River, and dredging in Thames and Housatonic rivers, Conn. Maj. Smith S. Leach, Corps. Engrs.

Atlanta, Ga.—Wm. E. Eames, Columbia Bldg., St. Louis, is stated to have been selected by the Superv. Archt., Treasury Dept., at Washington, to prepare plans for the Federal prison.

San Carlos, A. T.—Bids are wanted May 8 for a school, water and sewerage system, and gasoline gas plant at the San Carlos Agency. W. A. Jones, Commr. Indian Affairs, Washington, D. C.

Boston, Mass.—Bids are wanted May 17 for removal of wreck in channel of Weymouth River, Col. Chas. R. Suter, Corps. Engrs., U. S. A.

San Francisco, Cal.—Bids are wanted May 10 for a commandant's house and officers' quarters at the U. S. naval training station on Yerba Buena Island. A. S. Crowninshield, Ch. Bureau of Navigation, Navy Dept., Washington, D. C.

Ellis Island, N. Y. Harbor.—Bids are wanted May 18 by the Superv. Archt., Treas. Dept., Washington, D. C., for heating and ventilating apparatus for the main buildings at the U. S. Immigrant Station, as advertised in "The Engineering Record."

Kansas City, Mo.—Bids are wanted May 2 for installing an electric light and power plant in U. S. Court House and Post-Office. H. A. Taylor, Asst. Secy., Treas. Dept., Washington, D. C.

Raleigh, N. C.—Bids are wanted April 27 for a low-pressure return circulation, ventilating and steam heating apparatus for the U. S. Court House and Post-Office. James Knox Taylor, Super. Archt., Treas. Dept., Washington, D. C.

New York, N. Y.—Bids are wanted May 17 at the U. S. Engineer Office for dredging and rock excavation in channel of Port Chester, Harbor, N. Y., as advertised in "The Engineering Record."

St. Louis, Mo.—Bids are wanted May 31 by the Mississippi River Commission for constructing and delivering two self-propelling hydraulic dredges complete, as advertised in "The Engineering Record."

Milwaukee, Wis.—Bids are wanted May 17 at the U. S. Engineer Office for dredging at Menominee River, Oconto, Green Bay, Two Rivers, and Milwaukee harbors, as advertised in "The Engineering Record."

Ellis Island, N. Y. Harbor.—Bids are wanted May 16 by the Super. Archt., Treas. Dept., Washington, D. C., for the erection of the kitchen and restaurant building and the disinfection, bath house and laundry building at the U. S. Immigrant Station, as advertised in "The Engineering Record."

Washington, D. C.—According to local press reports, the street cleaning contracts have been awarded as follows: For hand cleaning, to Daggett & Dugan for one year, at 21¼ cts. per 1,000 sq. yds.; approximate area, 320,000,000 per annum; for machine cleaning, to Lily & Robinson for one year, at 19 cts. per 1,000 sq. yds.; approximate area, 150,000,000 sq. yds. per annum; for cleaning unimproved streets and alleys, to R. V. Rusk for one year, at $66.50 per day; for cleaning improved alleys, to Daggett & Dugan for one year, for 33 cts. per 1,000 sq. yds.

Louisville, Ky.—The following bids were opened April 14 by the Superv. Archt., Treas. Dept., Washington, D. C., for ventilating and heating apparatus at the U. S. Marine Hospital, as advertised in "The Engineering Record.": Aug. Suber, Louisville, $3,366; A. M. Ramsey, Louisville, $4,000; Jos. McWilliams & Co., Louisville, $3,978; F. S. Clegg & Co., Louisville, $4,038.65; McGuiness, Smith & Co., Pittsburg, $4,276; Pittsburg Steam Heating Co., $4,747; Barger Bros. & Co., Columbus, $4,834; Gaylord & Eitapence, Binghamton, $3,743; L. L. Lord, Meadville, Pa., $5,413.67; Chafer & Becker, Cleveland, $4,370; Blake & Williams, New York City, $4,526; W. H. Drayer, Middletown, O., $4,400.

San Francisco, Cal.—The following bids were opened April 17 by the Superv. Archt., Treas. Dept., Washington, D. C., for masonry work, roof covering, etc., for the U. S. Post-Office, Court House, etc., as advertised in "The Engineering Record," *a*, granite; *b*, marble: City Street Improvement Co., San Francisco, *a*, $934,648.46; *b*, $1,288,790.20. California Bridge & Construction Co., San Francisco, *a*, $818,811; *b*, $868,811. Richardson & Galt, San Francisco, *a*, $890,000; *b*, $1,075,000. Geddis & Seeni Co., Denver, *a*, $842,000; *b*, $899,000. F. E. Knowles, Oakland, Cal., *a*, $830,680; *b*, $1,020,000. California Bridge & Construction Co., Oakland, *a*, $916,504; *b*, $948,814. Bentley Construction Co., Portland, Ore., *a*, $859,525 Norcross Bros., Worcester, Mass., *a*, $1,128,000; *b*, $1,160,000. John Pierce, New York City, *a*, $889,500; *a*, $899,000; *a*, $919,000. W. H. Ellis, Cincinnati, O., *a*, $659,500 and $684,500; *b*, $775,000.

St. Joseph, Mich.—Bids are wanted May 19 for repairing government pier. Capt. Chester Harding, Corps Engrs., U. S. A., Grand Rapids, Mich.

Cincinnati, O.—Press reports state that the following bids were opened April 12 by Mayor W. H. Bixby: For building weirs, piers, abutments and a portion of the pass at Dam No. 6, in Ohio River: Evansville Contract Co., Evansville, Ind., $174,980; A. W. McDonald, Steubenville, O., $193,531.84; Wm. B. Rodgers, Pittsburg, Pa., $198,394.87; Sloan, McIlvaine & Graham, Allegheny City, Pa., $200,575.85; George F. Eagan, Allegheny City, Pa., $216,483.11; I. J. Hoag, Jr., Allegheny City, Pa., $233,950.53.

CUBA.

ELECTRIC RAILWAY AND LIGHTING.—The San Juan & Rio Piedras R. R. Co. has been incorporated at Albany, N. Y., to operate an electric railroad and to furnish electric light in Porto Rico. It has purchased the steam road running from San Juan to Rio Piedras, a distance of about 8 miles, and will change the power to electricity. Incorporators: H. McMillan and F. K. Curtis of 30 Broad St., N. Y. City, and J. J. Kennedy, R. B. Merchant, Warren H. Spurge and Robt. Seager of 29 B'way, N. Y. City.

MISCELLANEOUS.

Boston, Mass.—A bill has passed the House authorizing the city to borrow $500,000 outside the debt limit for continuing the construction of public parks.

Tiptonville, Tenn.—A bill has passed the House authorizing Lake Co. to issue $100,000 levee bonds.

Tyrone, Pa.—The contract for the construction of a tunnel on the main line of the Pennsylvania R. R., east of Tyrone, has been awarded to the Drake & Stratton Co. of Pittsburg for a sum approximating $200,000.

Toronto, Ont.—Bids are wanted April 26 for furnishing brick and cement for one year. John Shaw (Mayor), Chmn. Bd. Control.

Port Allen, La.—Bids are wanted April 26 for the construction of the Evergreen levee in the parish of Iberville. T. G. Sparks, Pres. Bd. Commrs., Atchafalaya Basin Levee Dist.

Morristown, N. J.—Bids are wanted May 4 for constructing a tunnel or subway to connect the new building of the State Hospital at Morris Plains, with elevator shaft, sewer pipes, etc., in the old building, as advertised in "The Engineering Record."

Washington, D. C.—Bids are wanted May 6 for furnishing 40,000 bbls. of natural hydraulic cement, as advertised in "The Engineering Record."

Hickman, Tenn.—See "Railroads."

Great Bend, N. Y.—Frank A. Hind, Engr. of Watertown, writes that the following bids were opened April 13 for excavating 300,000 cu. yds. of earth and rock for a hydraulic canal for the St. Regis Paper Co., near Great Bend, as advertised in "The Engineering Record." Dyer & Huntington, Buffalo, $120,349.83. Belden & Seely, Syracuse, $125,172.06. Dunfee, Taylor & Co., Syracuse, $127,805.65. G. M. & C. V. Busch, Buffalo, $128,145.81. Warren-Scharf Co., New York, $131,983.79. Cogan Bros. & Forschner, Boston, Mass, $140,755.44. Monty, Higby & Co., Sandy Hill, N. Y., $143,742.06. Walter Bradley & Co., Oswego, $146,482.05. F. H. Clement & Co., Kittaning, $159,552.21. J. & M. O'Connor, Chaumont, $160,467.87. Rexford Bros., New York, $169,637.34. O'Brien & Hoolihan, Syracuse, $170,784.06. D. F. Minnehan, Orange, N. J., $186,602.79. Beckwith & Quackenbush, Herkimer, $210,439.98. McDonough & Cunningham, Troy, $222,039.72. Bids were all rejected, and work has been let on a private contract.

PROPOSALS.

PROPOSALS FOR NAPHTHA STREET lighting in the District of Columbia.—Office of the Commissioners, D. C., Washington, D. C., April 15, 1899.—Sealed proposals will be received at this office until 12 o'clock M., Saturday, May 13, 1899, for lighting the public streets, avenues, alleys and roads in the District of Columbia during the year ending June 30, 1900, with naphtha lamps. Specifications and blank forms of proposals may be obtained at this office. JOHN B. WIGHT, JOHN W. ROSS, LANSING H. BEACH, Commissioners, D. C.

PROPOSALS.

Notice to Brick Manufacturers

The Paving Commission of the Cit Ithaca desires sealed proposals for the nishing of from 10,000 to 15,000 yards o pressed, vitrified paving bricks. Man turers are requested to furnish sample each bid submitted. Bricks to be deli upon the streets of the City of Ithaca, piled under the direction of the Sup tendent of the Paving Commission. bids must be received on or before 24, 1899.

The Commission reserves the right t ject any and all bids.

CHESTER C. PLAT

Clerk of Paving Commission, City

Ithaca, N. Y., April 14, 1899.

Street Work.

ITHACA, N.

The City of Ithaca, N. Y., wants pr als from Contractors for furnishing a 25,000 yards of paving of both brick stone; also for about 10,000 ft. of M stone curbing.

For specifications apply to

CHESTER C. PLA

Clerk of Paving Commission, Ithaca,

PROPOSALS FOR LAYING ASPH. Block Pavements.—Office of the Con sioners, D. C., Washington, D. C., Ap 1899.—Sealed proposals will be receiv this office until 12 o'clock, noon, Satu May 20, 1899, for laying asphalt-block ments. Blank forms of proposal, spec tions and necessary information ma obtained at the office of the Engineer missioner, D. C. JOHN B. WIGHT, J W. ROSS, LANSING H. BEACH, Con sioners, D. C.

PROPOSALS FOR PAVING STR and Avenues with Sheet Asphalt.—Offi the Commissioners, D. C., Washingto C., April 18, 1899.—Sealed proposals w received at this office until 12 o'clock, Saturday, May 20, 1899, for paving va streets and avenues with sheet as Blank forms of proposal, specification necessary information may be obtain the office of the Engineer Commissi D. C. JOHN B. WIGHT, JOHN W. R LANSING H. BEACH, Commissio D. C.

PROPOSALS FOR RAISING THE I Highway Bridge Crossing Klingle Road on the Line of Connecticut Av Extended.—Office of the Commissio D. C., Washington, D. C., April 18, Sealed proposals will be received at office until 12 o'clock, noon, Saturday, 6, 1899, for raising the iron highway b crossing Klingle Ford Road on the l Connecticut avenue, extended. Blank of proposal, specifications, and all nece information can be obtained at this JOHN B. WIGHT, JOHN W. ROSS, SING H. BEACH, Commissioners, D.

PROPOSALS FOR DREDGES.—Mi sippi River Commission, Fullerton ing, St. Louis, Mo., April 19, 1899.—S proposals, in triplicate, for constru and delivery of two self-propelling draulic dredges complete with machi cabin, outfit, etc., will be received her til 12 o'clock noon, standard time, M 1899, and then publicly opened. Inf tion furnished on application. MASO PATRICK, Capt., Eng'rs, Sec'y.

TREASURY DEPARTMENT, OF Supervising Architect, Washington, April 17, 1899.—Sealed proposals will ceived at this office until 2 o'clock P. the 16th day of May, 1899, and then op for the erection and completion (heating apparatus and electric wire duits and wiring), of the "Kitchen and taurant" building) and the "Disinf Bath House and Laundry" building U. S. Immigrant Station, Ellis Island, York Harbor, in accordance with the ings and specifications, copies of may be had at this office or the off the Superintendent of Repairs, U. S. House and Post Office building, New City. JAMES KNOX TAYLOR, Sup ing Architect.

U. S. ENGINEER OFFICE, Building, New York, April 17, 1899.— proposals for dredging and rock e tion in channel of Port Chester Harb Y., will be received here until 12 noon, May 17, 1899, and then p opened. Information furnished on a tion. H. M. ADAMS, Major, Engrs.

PROPOSALS FOR FURNISHING ural Hydraulic Cements.—Office o Commissioners, D. C., Washington, 13, 1899.—Sealed proposals will be re at this office until 12 o'clock M., Ma 1899, for furnishing 40,000 barrels, m less, natural hydraulic cements. forms of proposal, specifications a necessary information may be obtai this office. JOHN B. WIGHT, JOH ROSS, LANSING H. BEACH, Comm ers, D. C.

U. S. ENGINEER OFFICE, MIL kee, Wis., April 10, 1899. —Sealed pr for dredging at Menominee River, to, Green Bay, Two Rivers, and Mil harbors, will be received here u o'clock noon, standard time, May and then publicly opened. Informati nished on application. J. G. WA Capt., Engrs.

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The Engineering Record.

Volume XXXIX. Number 22

TABLE OF LEADING ARTICLES.

The Engineering Record, conducted by Henry C. Meyer, is published every Saturday at 100 William Street, New York. Its opinions on technical subjects are either prepared or revised by specialists.

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THE PROTEST OF ST. LOUIS AGAINST THE CHICAGO CANAL.

About six months ago the Mayor of St. Louis appointed a commission of four representative business men of that city, together with President McMath of the Board of Public Improvements, Water Commissioner Holman, Sewer Commissioner Colby and Health Commissioner Starkloff, to investigate the Chicago Drainage Canal. The report of the commission has just been made public. It declares in substance that the canal is bound to be a failure; if an attempt is ever made to use it there will be epidemics in the valleys of the Desplaines, Illinois and Mississippi Rivers and complications will arise with the national government and Canada over the right of the trustees to draw the proposed volume of water from Lake Michigan. The city of St. Louis is interested in the matter because the use of the canal will mean that the water supply of the community during times of low water in the Mississippi may be expected to contain one or two per cent. of Chicago sewage; it has mud enough in it already without further contamination. The subject is of such great importance, involving the rights of municipalities, states, and, possibly, the United States and Canada, that the report of the commission deserves careful attention.

The canal is being constructed by a Sanitary District which is not the same in area as the city of Chicago; the district was created in order to avoid constitutional restrictions on the debt limit of the city. The sewage of the city has been discharged into the Chicago River and Lake Michigan, and it is absolutely essential to the public health to divert it because of the pollution of the water supply. The Chicago River has been practically a cesspool for many years. During heavy rainstorms it may have a slight flow toward the lake, but generally its current is reversed, because nearly 50,000 cubic feet a minute is pumped from it into the famous Illinois & Michigan Canal. The new drainage canal is intended to do on a large scale what this old commercial canal has been doing in a small way for many years. Incidentally Chicago has seen visions of fleets of barges hurrying to and from wharves and warehouses along portions of its big ditch, and other commercial advantages entirely distinct from its main sanitary purpose.

The St. Louis Commission presents some figures regarding the character of the flow in the drainage canal which are not pleasant to contemplate. It is assumed that the sewage of the Sanitary District is about 25,000 cubic feet per minute, or the same as the water supply. The canal is to have a capacity of 300,000 cubic feet per minute, and 8 1/3 per cent. of its discharge will therefore be sewage. The minimum flow of the Mississippi River at St. Louis is stated to be about 2,000,000 cubic feet per minute. If the drainage canal is put in service, it will result in one part of sewage being mixed with every ninety parts of other liquid in the stream from which the city draws its water supply.

The report is strongly adverse to any such methods of flavoring the St. Louis water. It says: "That Chicago was allowed to begin the discharge of sewage through the Illinois & Michigan Canal in 1871 may possibly be excused; but there can be no assent to the position that a vested right has been acquired. Even in the act under which the work is being done, the State has expressly reserved the right to alter, amend or repeal the act, or to impose conditions, restrictions or requirements, other, different or additional to any now imposed. A mistake was made when the present plans were adopted, and the State of Illinois authorized a scheme which has for its basis the unwarranted assumption that sewage can be made harmless by the dilution proposed. It is therefore a proper suggestion in the line of the advance made in sanitary science since the Sanitary District act was passed, that the act should be amended and the condition imposed that Chicago purify its sewage before discharging it into the Desplaines River. That is practicable, but it requires radical changes in the present plans of both city and Sanitary District."

The report quotes the following testimony given by the chief engineer of the Drainage and Water Supply Commission of Chicago in 1887 before a joint committee of the Illinois Legislature: "The English river commission have made a very thorough examination of this question, and the amount which they thought barely enough to prevent nuisance in their rivers (reducing it to the terms we use here) would amount to 9,000 cubic feet per minute for every hundred thousand people, or 50 per cent. more than Chicago is now pumping. I have proposed in our plan for the disposal of the sewage of Chicago to assume a quantity equal to double the limit in England, or, in other words, 18,000 cubic feet for every hundred thousand inhabitants." The St. Louis Commission protests against doubling an English "thought" and increasing the double by its ninth part as an unscientific method of arriving at the present Chicago standard of dilution, 20,000 cubic feet per minute for each 100,000 inhabitants. In considering this objection reference may well be made to the important figures given by Mr. F. P. Stearns, in an article on the pollution and self-purification of streams, printed by the Massachusetts State Board of Health in 1890. He found from a study of the free and albuminoid ammonia, dissolved solids and chlorine in water and sewage that if the flow of pure water falls below 2½ cubic feet per second per thousand persons discharging sewage into it, a nuisance is pretty sure to result. When the flow exceeds 7 cubic feet per thousand persons offensive conditions are not likely to result; that is to say, the Chicago limit of dilution is very much nearer Mr. Stearns' figure for certain nuisance than that for certain safety. It is, of course, true that the dilution of sewage in any given instance involves many local considerations which make general rules of but partial applicability. Aeration, the nature of the channel through which the sewage laden stream passes, the thoroughness with which the sewage is mingled with the water, the amount of free oxygen in the water, the fluctuations in stream flow and other features of the problem must be considered independently in each case.

The St. Louis Commission by no means places its entire objection to the drainage canal on the pollution of the St. Louis water supply, as it says that "the greatest wrong is to the citizens of Chicago and the drainage district." While the nature of this "greatest wrong" is not distinctly pointed out, the inference is that it lies in the expenditure of $28,000,000 for the portions of the work which have now been completed. The various acts under which the Board of Trustees of the Sanitary District is organized are quoted to show that the use of the canal can be indefinitely postponed by litigation under the statutes of the State of Illinois. There is also the further menace to the operation of the canal that the United States Government has not yet considered the draft of 300,000 cubic feet of water per minute from Lake Michigan, and until its permission is received to take this water from the lake the canal cannot be put in use. The United States Government has to consider the effect on the water level in the Great Lakes of such a continued withdrawal of 300,000 cubic feet per minute, subject to future increase to 600,000 cubic feet per minute, the latter amount being probably about 4 per cent. of the mean discharge of the Niagara River. Inasmuch as Canada has rights to the waters of the Great Lakes as well as the United States, it will be seen that the subject has an international aspect.

The acts governing the Sanitary District Trustees make it necessary for them to provide, not only a channel of a capacity of 300,000 cubic feet per minute, but also that volume of water. When the canal is ready for service the Governor is to appoint a commission of three persons, who, with the assistance of engineers, are to examine the work and report if it has been properly carried out to meet the requirements of the laws. Until this commission reports that the work is satisfactory, the canal cannot be used. The Governor has no authority under the drainage acts to investigate the manner by which the water is to be brought into the canal. According to the St. Louis report, if the Chicago River cannot discharge 214,000 cubic feet per minute into the canal the drainage act will be violated, and the Sanitary District will then be empowered to collect an emergency tax to carry into effect any orders of the courts which may be made as a result of this failure. The report indicates that such a special emergency assessment is inevitable; and that it will be necessary to construct a canal from the Calumet River to the main drainage canal. Under the existing laws this must have a capacity of 300,000 cubic feet per minute and a depth of 14 feet. The two canals, in conjunction, are required to discharge 600,000 cubic feet per minute, but this volume of water, under the laws of the Drainage District, cannot be discharged into the Desplaines River until the Federal Government shall improve the Desplaines and Illinois Rivers and provide for the payment of all damages which any extra flow above 300,000 cubic feet per minute may cause to private property. The United States may not see fit to do this, and these costly works will devolve upon the Sanitary District if it continues to use the canal.

It is evident from this brief review of the report of the St. Louis Commission that its members believe their city should take immediate steps to prevent the operation of the canal in the manner proposed. It is but natural they should desire to have the sewage of Chicago purified before it is discharged into a water course which will ultimately conduct it into the Mississippi. The commission believes that all cities must, sooner or later, be prevented by acts of Congress from polluting the natural water courses of the country with sewage, and it advises immediate action in the St. Louis case. Whether the Federal Government will permit the use of the canal as intended, is another matter, although it seems hardly probable that the authorities of the Sanitary District would spend $28,000,000 without some understanding that the water may be obtained when the canal is ready to receive it. Whatever may be the outcome of the report, it cer-

tainly has the merit of bringing distinctly before the people of one of the leading cities of the country important facts concerning the possible pollution of their water supply, and if the authorities of St. Louis carry the matter into the highest courts, the legal restrictions under which sewerage works are undertaken will be clearly defined, because the interests involved are located in different states and the questions are largely those for Federal courts to settle.

HYDRAULIC LIFT LOCK ON THE TRENT CANAL.

The Department of Railways and Canals of Canada is now constructing on the Trent Canal, at Peterborough, Ontario, a hydraulic lift lock of notable dimensions, and "The Engineering Record" is indebted to Mr. R. B. Rogers, M. Can. Soc. C. E., the chief engineer of the canal, for the following description and preliminary plans of the work.

The first lock on this principle was built in England by Mr. Edwin Clark, of Messrs. Clark, Standfield & Clark, about 1875, to connect the River Weaver with the Trent and Mersey Canal at Auderton. The lift is 50 feet, and the lock chambers proper are 75 feet long by 15 feet 6 inches wide, inside measurements. The depth of water in the canal is 5 feet 3 inches.

A second of this class of locks, differing slightly in some points, was built at Les Fontinettes, near St. Omer, France, about 1888, and a third at La Louviere, near Mons, Belgium, about the same time. Both of these locks were under the direction of Mr. Clark, and they were of nearly the same dimensions. The La Louviere lock, which is the larger of the two, has a lift of 50 feet 6¼ inches, and the internal dimensions of the chambers are 141 feet length by 17 feet 8½ inches width, with a depth of water on the sill of 7 feet 10½ inches. The Belgian Government has now under construction three others of the same size as La Louviere.

The dimensions of the Canadian lock are considerably greater than any of those already built. The lift is 65 feet and the internal dimensions of the chambers 139 feet by 33 feet, with a depth of water on the sill of 8 feet. The side elevation, Figure 1, gives a general idea of the side of the lock as it will appear when completed.

The upper reach of the canal is divided into two branches, each closed by a movable gate fixed in a heavy concrete wall. The lower reach is divided in a similar way and also terminated by movable gates. Between each of these corresponding branches, the ends of which are 140 feet 11 inches apart, measured horizontally along the center line of the canal, is a steel bank or chamber nearly 141 feet long and having the same area as the standard ordinary locks. Each chamber is closed at both ends by movable gates hinged on the lower side, and is capable of being given a vertical motion equal to the difference in level between the two reaches. Thus there are on each of the branches three separate constructions; first, the upper reach ended downstream by gates; second, a movable chamber closed at both ends by gates; third, the lower reach terminated upstream by gates. If the movable chamber be brought opposite the end of say the lower reach and the adjacent gates be opened, the chamber forms a continuation of the lower reach into which a vessel may float. By closing the two gates the connection between the chambers and the lower reach is broken and the chamber becomes an isolated structure with a vessel floating in it. If now the chamber be raised to the upper level with its end opposite that of the upper reach and the two adjacent gates here be opened, the vessel can leave the chamber and enter the upper reach.

Each of the chambers is balanced under its center on the head of the ram of a hydraulic press, and the presses are connected to each other by means of a pipe. The quantity of water in the presses is arranged so that one chamber is at the top of its stroke when the other is at its lowest position. The upper chamber is stopped so that its floor is say 10 inches lower than the top of the upper sill, and the lower one is stopped so that its floor is level with that of the lower reach. Now, if the chambers be held in this position by closing the communication between the presses by a valve in the connecting pipe, it is easily seen that when the adjacent gates are opened—that is to say the two gates that are together at the upper level, and the two together at the lower level—that the upper chamber will contain 10 inches more water than the lower one, the depth of water in the two reaches being, of course, the same. That is to say, when the gates are again closed the upper chamber will be heavier than the lower one by an amount equal to the weight of this surcharge of 10 inches. When the valve in the connecting pipe is opened the heavier chamber descends, forcing the lighter one up, the weight of surcharge required being that necessary to overcome the friction of the moving parts and to compensate for the displacement of the emerging ram. It will be seen that vessels may pass each other going in opposite directions during the lockage, one vessel on its way up the canal and another on its way down being handled just as readily as one only.

The chambers are carried by double cantilever trusses, with a floor system of crossbeams and stringers, and all the connections are riveted throughout. The load thus brought on to the head of the ram by each chamber is, in round figures, 1,800 tons.

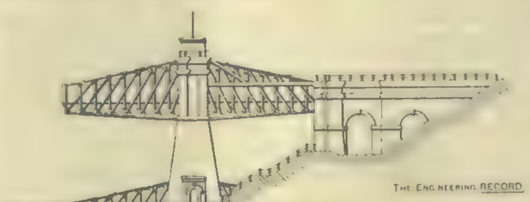


Fig. I Side Elevation.

The method of operation of the gates can be seen from Figure 3. This style of gates was adopted in order to have the total length of the chamber available, and also to avoid having to lift the gates through such a height as would be necessary in order to get the 25 feet clear headroom above the water, which the Government requires. The gates will be buoyant, so that very little power will be required to operate them.

The main presses for raising the chambers will work under a gauge pressure of about 600 pounds per square inch. Each press is composed of cylindrical steel castings, 3½ inches thick, bolted together through outside flanges. The rams are of cast iron, built up in a similar manner, the metal being 3¼ inches thick; and the diameter is finished to 7½ feet. It was originally intended to make the presses themselves of cast iron, in sections, banded with steel hoops like those used at La Louviere, but with the recent developments in the art of making steel castings the department decided to accept the alternative tender of the contractor to build presses of the simpler construction.

The lock theoretically requires no operative power other than that obtained directly by gravity from the water of the upper reach, but in practice there are unavoidably slight leakages to compensate for. The same water, after being filtered carefully, will be used constantly in the presses without changing, and that lost by leakage will be made up with filtered water supplied from an accumulator. The construction of the accumulator is shown in Figure 4. It is of the regular Armstrong type, being a small press with a ram 20 inches in diameter, which is loaded with iron ballast placed in a cylindrical box, which for convenience surrounds the press. The pressure in the accumulator is made slightly greater than that of the main presses, and may be increased or lessened by the addition or removal of some of the ballast. By this pressure it is possible to add water to either one of the main presses for the purpose of making up for leakage or, if necessary, for adjusting the stroke. The accumulator is supplied by double-acting pumps driven by a turbine which utilizes the head of water between the upper and the lower reach. The accumulator is also employed for working the small presses used to open and close the lock gates, as well as for operating the capstans, which haul vessels into and out of the chambers.

The capstans are of the three-cylinder engine type, one located on the central entrance pier at the up-stream end, and the other in a corresponding position down-stream.

Water-tight connections between the ends of the chambers and the corresponding faces of the ends of the reaches are secured by means of a collapsible air tube fixed to each of the reach ends. Before the gates are opened the tube is inflated with compressed air, at 30 pounds per square inch, obtained from a Taylor air compressor, which is installed in the main wall of the masonry.

The whole lock will be under the management of three men, one assistant for the two pairs of gates and the capstan downstream, another having similar duties upstream, while the lock master in control and complete charge, will be stationed in the operator's cabin on the top of the central tower. In this position he has an unobstructed view of everything under his care. The levers for the main valve and for the accumulator valves are placed in his cabin, and all the other levers for the gates and the compressed air tubes are interlocked so that they cannot be worked out of their proper order or at an inopportune time by the assistants, thus guarding against delay or possible accident. There are also on the 12-inch pipe connecting the main presses, valves which are closed automatically by the motion of the chambers themselves.

Some distance above the lock in the upper reach is a guard gate which is under the charge of the lockmaster. Its purpose is to prevent the emptying of the reach in case of accident, and it will be closed as soon as a vessel passes it.

The total estimated weight of metal in the superstructure is about 1,500 tons, the large presses weighing about 550 tons, and the chambers, gates, machinery and other parts about 950 tons.

The contractors for the superstructure here are the Dominion Bridge Company, Limited, of Montreal, Canada.

The whole of the substructure, with the exception of the press foundations, is of concrete, and is included, with the rest of the work of the section now under construction, in the contract of Messrs. Corry & Laverdure of Ottawa. The site is admirably adapted for the construction, being on the side of a hill. The excavation is chiefly clay and hard pan, with occasional pockets of sand. The strata are nearly horizontal. Rock is found to follow approximately the level of the lock chamber pits, and it is of a fair quality of limestone, although the beds are not very thick. Very little excavation in the rock will be required. The wells for the main presses will be entirely in the rock, and will be finished with a concrete lining to a diameter of 14 feet 2 inches. As the total load of a chamber will be concentrated at the base of each press, together with the weight of the press and ram, and the water within the press, a foundation of granite is to be provided, as shown in Figure 4, and the intensity of pressure is thus reduced to about 230 pounds per square inch on the limestone formation.

The main retaining wall which forms the end of the upper reach is 40 feet thick and 126 feet long, and has been designed with plumb sides throughout its height, which is about 83 feet. The wing walls have wide footings to provide against undue settlement away from the main wall, their foundations being on

earth at a considerable height above the rock. The walls of the lower reach are carried up to the level of the roadway and form buttresses and stairways for access to this level. Suitable footings will be provided on the rock for the towers, which have to contain the guides for steadying the lock chambers in their vertical course. The possible rotation of the chambers is more directly provided against by shoulders for guides in the main retaining wall at the upstream end.

A roadway is formed through the main wall as a means of access from one side of the canal to the other, thus doing away with the obstruction of a swing bridge; and directly beneath this is located the pump room, where are installed the turbine and pumps for the accumulator. It is also arranged to have in this room a dynamo for the generation of electricity for lighting purposes and for the operation of a number of swing bridges as well as the lock gates which are on this section. The pump room, 12 feet wide by 110 feet long, gives ample space for a tool room and a general machine room for repairs, and its position is decidedly

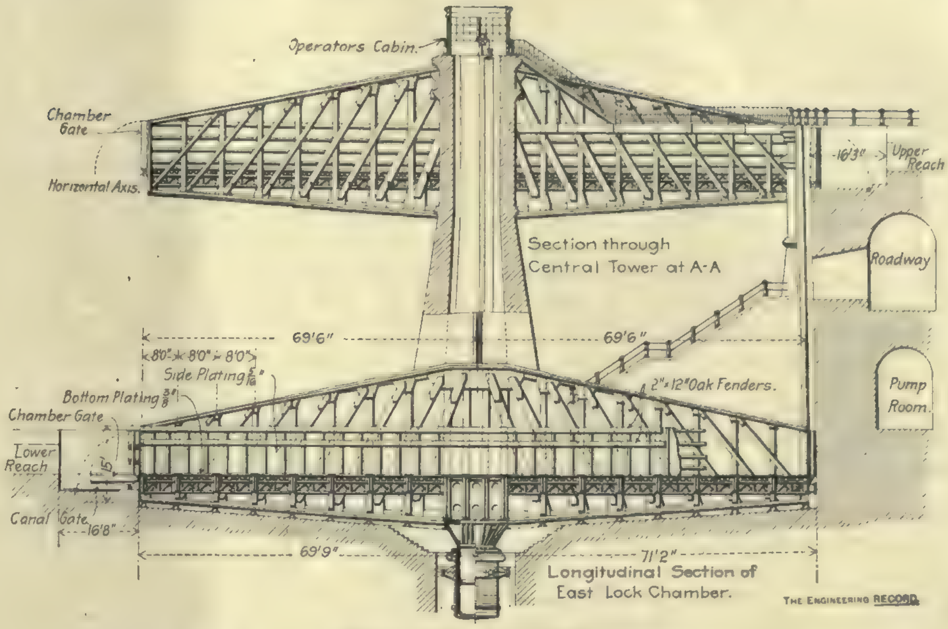


FIG.3 Longitudinal Section

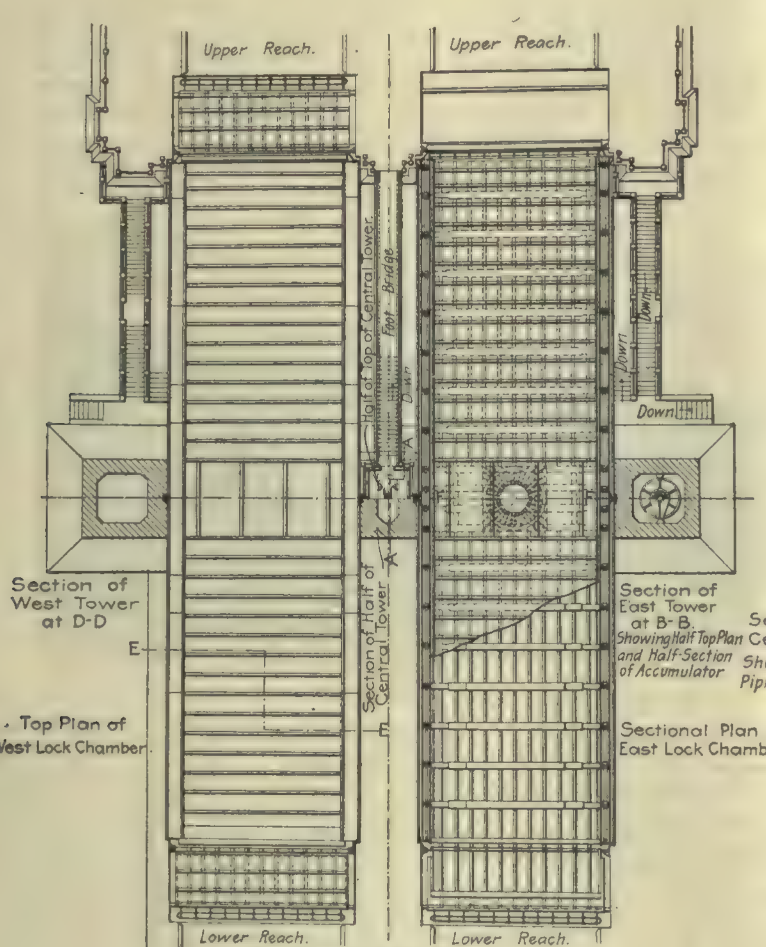


FIG.2 Floor Plan.

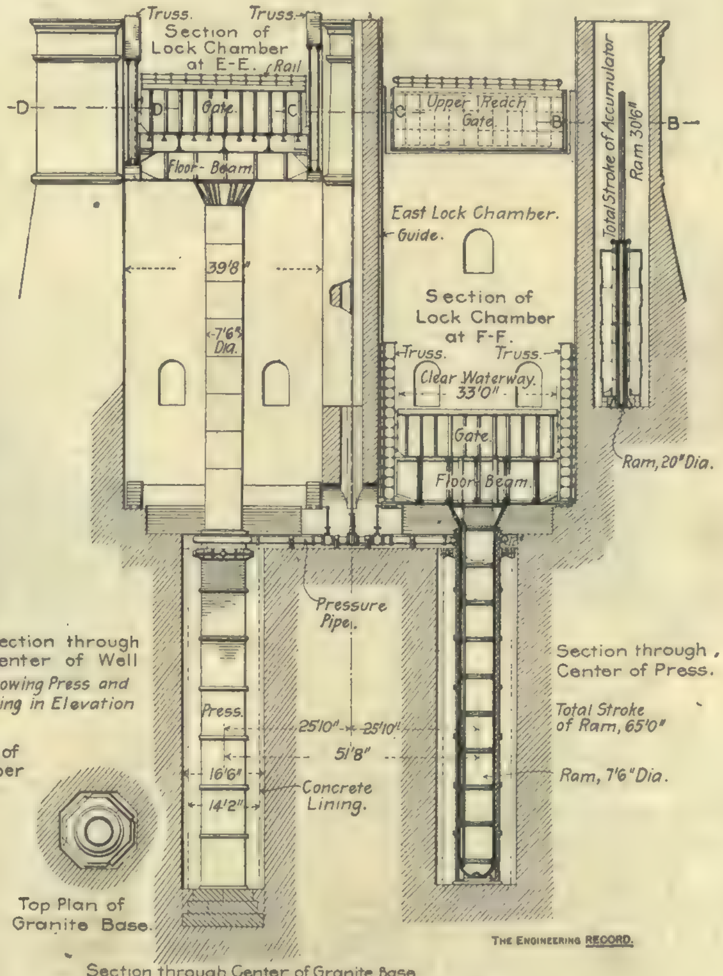


FIG.4 Transverse Sections.

LIFT LOCK ON TRENT CANAL: R. B. ROGERS, M. C. SOC. C. E., CHIEF ENGINEER.

advantageous, commanding directly, as it does, a head of water of 60 feet. The accumulator is installed in one of the side towers, while the void in the central tower is utilized for the rods of the main valves. The presses for operating the gates are located between the two branches of the reaches, and are directly connected to their work. Advantage has been taken in using concrete to form all the voids and channels necessary for pipe runs, drains, stairways and like purposes.

In comparing the advantages of such a lock with those of the usual type, Mr. Rogers says: "As to capacity, we might as well try to make a comparison between a double-track railway and a single track one. As to consumption of water, the hydraulic lift lock utilizes its surcharge, which is in volume between 8¼ and 12 inches, by the area of one chamber, while the ordinary one consumes a volume equal to the height of the lift by the area of the lock. Indeed, under certain conditions of traffic and operation, it would be possible to transfer water from the lower reach to the upper, if such were desirable. As to time, we may say the saving of the hydraulic lift lock over the ordinary will be at least one hour, at the usual rate of figuring the rate of lift of the common lock. Of course the time required for the operation of the hydraulic lift lock depends on the handling of the capstan and gates, the friction of the guides and of the packing of the presses, and the amount of surcharge used. It is estimated that the whole operation of locking a vessel through will take about 15 minutes.

The Saving in Coal Bills due to the use of mechanical draft, which made possible a change to a cheaper grade of fuel, was very marked in the plant of the United States Cotton Company, Central Falls, R. I. It seems that power was supplied by a Harris-Corliss compound engine developing about 1,550 horse-power. Three Babcock & Wilcox boilers, rated at 335 horse-power each, were used, and these were fired with a Cumberland semi-bituminous coal on account of the lack of draft necessary to burn a cheaper grade. A mechanical draft plant costing about $600 was installed, after which it was possible to burn a mixture costing $2.29 a ton. This brought about an annual saving of $6,500 in the fuel bill. At the end of 52 weeks, after running a total of 2,998 hours, 7,800,000 pounds of the mixture, costing about $8,900, had been burned. The composition of the mixture was: Buckwheat, 78 per cent.; anthracite dust, 15 per cent.; Cumberland, 7 per cent. The fuel cost per indicated horse-power per year of 2,998 hours, was found to be $5.80. The draft plant consisted of a fan built by the B. F. Sturtevant Company of Boston, driven by a direct-connected engine, the speed of which varied with the steam pressure.

ERECTION OF A PLATE GIRDER SPAN BY DISPLACEMENT.

The method of erecting girder spans by sliding them complete to the former position of the old structure is not unusual, although the work is more often done piecemeal, the renewal made gradually and the same abutment seats reoccupied. A recent renewal of an old through span on the Boston & Albany Railroad near East Brookfield, Mass., was somewhat special in that the new bridge seats were lower, longer and closer together than the old ones, that the old span was removed bodily without much dismantling, and abandoned its masonry, while the whole completely assembled new structure, comprising six main girders, was almost simultaneously moved into the approximate position of the old one. It was moved by the use of several sets of tackle and two derrick cars, instead of the hydraulic jacks often used. A rope anchorage was devised to secure a direct pull from eccentric points. A comparatively large amount of falsework for that class of girders was constructed, and operations were so conducted that the new structure was safely used for train service, while actually in transit, the whole work being evidently accomplished with convenience, expedition and safety.

The old bridge was a double track pony truss about 71 feet long. The new bridge is a deck plate girder span 65 feet long, about 5 feet 9 inches deep, with three girders under each track, and weighs about 93 tons. New abutment masonry was built in front of the old with the bridge seats at the proper elevation for the new bridge. Trestles were built out from each bridge seat both north and south. Those on the north side were level with the old bridge seats, and those on the south side level with the new ones. On these and extending the length of the bridge seats were laid rails, which, at the time of moving, were thoroughly greased.

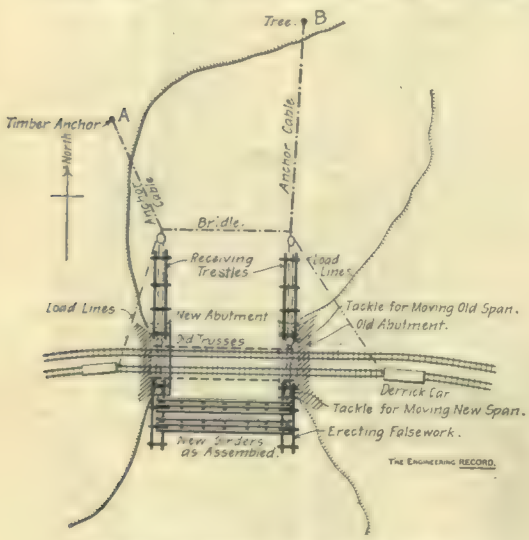


FIGURE 1.—METHOD OF MOVING SPANS.

The new girders were placed on the trestles on the south side and permanently connected together by cross frames and laterals. These were pretty much all riveted before the bridge was moved. The men did not even stop riveting when the bridge was moved. They kept at their work riding on the bridge while it was in motion.

For moving the bridges two sets of tackle were used at each end, one set for pulling out the old bridge the other for pulling in the new one. Figure 1 is a diagram showing the arrangement before the old or new spans were moved. Figure 2 is a view from the south showing the old span still in service, and the new girders assembled together on the falsework ready to be moved transversely to the new masonry which is seen projecting beyond the old.

At A a large timber was set in the ground to which was fastened a cable which connected with the tackle at the west end. At B on the highway was a large tree, to which another cable was fastened which connected with the tackle at the east end. The ends of the cables from A and B were also connected by a bridle so that the direction of the pull would be straight out from the bridge. On the south track, beyond the ends of the bridge, were stationed steam derrick cars to operate the tackles. Everything that could be done was completed by Saturday night, so that on Sunday the work of preparation consisted in taking the rails off the old bridge, jacking it up and placing rails underneath for it to slide on, placing the derrick cars in position and connecting the lead lines.

It was the intention to commence the work soon after 9 o'clock in the morning, immediately after a passenger train had gone east. There was then from that time about four hours in which to do the work without interference from passenger trains. This time would have been ample if it could have been utilized, but fate decreed otherwise. The train which was being waited for did not come, and finally proved to be several hours late. Instead of 9 o'clock in the morning it was nearly 2 o'clock in the afternoon before work was commenced.

The old bridge was moved out to the north in about six minutes. Then the movement of the new bridge into the former position of the old one was started, but had to be stopped when its north track was in line with the south track on shore, to allow a passenger train to pass, after which the bridge was moved into its final position. The actual time taken for pulling in the new bridge was probably not over thirty minutes. Notwithstanding the delay in beginning the work, it was successfully accomplished and no train materially delayed. The contract for this bridge was let to the Boston Bridge Works, and the shop work on the girders was executed for them on a sub-contract by the Elmira Bridge Company. The girders were delivered on the falsework by the railroad company, which also assisted in the transfer of spans, the assembling and riveting being performed by the Boston Bridge Works.

The work was executed under the direction of Bridge Engineer W. G. S. Chamberlain and Assist. Engineer E. E. Stone. Acknowledgment is made to Mr. Chamberlain for description and illustrations of this work.

FIGURE 2.—VIEW OF GIRDERS READY TO MOVE.

A BRITISH VIEW OF THE ATBARA BRIDGE CONTRACT.

The award of a contract for an Egyptian bridge to an American firm was not such a strange proceeding as some technical papers have tried to make out. In military operations it is essential to move quickly and if an American company can turn out a bridge more rapidly than any other, a progressive War Office like that of the Khedive will naturally buy an American bridge when it is in a hurry to perfect its communications. This War Office had previously come to this country for Baldwin locomotives to operate the railway which took Lord Kitchener's army to the Atbara, and had already learned that America was distant from Egypt only in space, not time. The award of the bridge contract naturally called forth many comments in the British press, and among them the following from "The Engineer," a journal which has been noted for its antipathy to American practices. The article is too long to be quoted entire, but the extracts reflect its tenor:

"In a leading article last week we referred to the effect of the Great George Street engineers on the locomotive trade of this country. Although not quite in the same galley, the case of the Atbara Bridge, of which we have heard so much lately, affords a very similar example of the manner in which trade which should be particularly British gets transferred to other countries. The main facts are well known and are sufficiently simple. . . . Put broadly, the whole case is this. The Egyptian War Office decided, rather late in the day, to order a bridge to span the Atbara River in order to facilitate connection between Khartum and Northern Egypt. Certain British firms were asked to tender, and they were told, following the usual practice of this country, of what type the bridge was to be. Before any final steps had been taken with regard to these tenders, it was found that the sort of bridge ordered was unsuited for the purpose because it could not be launched from one side of the river to the other, but demanded the construction of falseworks, and, consequently, more time than could be given if the work was to be completed before the rising of the Nile in July. The plans were therefore withdrawn, and, as we understand, a specification in which no special type beyond that it was to be suitable for launching, was insisted on, was sent to several firms at home and in America by telegraph. As every-one knows, the English firms could not guarantee an early delivery, whilst the American firm with whom the order was placed not only promised to deliver in a very short space of time—forty-two days at New York—but actually anticipated the time by several days. An attempt has been made to attach a certain amount of mystery to what is now seen to be a very simple story.

"The incident, however, brings us face to face with a fact on which we have dwelt before. How is it that American firms can undertake work of this sort at a lower price, and complete it in a shorter time than English firms? It is obvious that such a thing is only rendered possible by stocking large quantities of materials, and it is well known that some United States firms do to all intents and purposes keep practically ready for use a certain type of pin bridge which can be made up in required lengths. We do not wish to imply that the girders lie in their yards actually put together. That is improbable, but there is no question that, as bridge building has been to a large extent standardized in America, makers have not only all the parts in readiness for immediate use, but have at hand all necessary tools and templates

for commencing work on any particular type at a moment's notice. How different is the case in this country. Here it has become so largely the custom for every designer to get out proportions which differ from those of other people, and, moreover, to insist on having them, that no ironmaster dare roll large quantities of rails, girders, etc., and, of course, to stock pieces cut ready for making up with rapidity is out of the question. Take up the section list of any of our big makers of angles, channels, rails, etc. The numbers are multiplied altogether out of proportion to requirements. There is no attempt whatever at standardization, and no assistance or suggestion such as not a few American firms give in their books. . . . As a rule, only the barest particulars are given in British lists, and the engineer is, consequently, led either to order from a foreign maker or to get out a section of his own designing. We are glad to be able to say that although this has been in the past a fruitful cause of the multiplication of sections, makers have of late taken to giving more details of the sections of rails they roll. In the matter of joists and girders the case is not quite so bad, because the number of firms who make them is very limited. Of course this evil of heterogeneity has grown with our expanding trade, and the blame cannot be laid heavily on the makers' shoulders. The contracting engineer and designer are quite as much and more to blame. Whilst they continue to specify sections which do not exist, they not only cause delay by necessitating the turning of special rolls for that particular order, but they put the manufacturer in such a position that he is nervous about stocking such great quantities as the Americans can with safety put in store. That the price must be higher for both reasons is obvious.

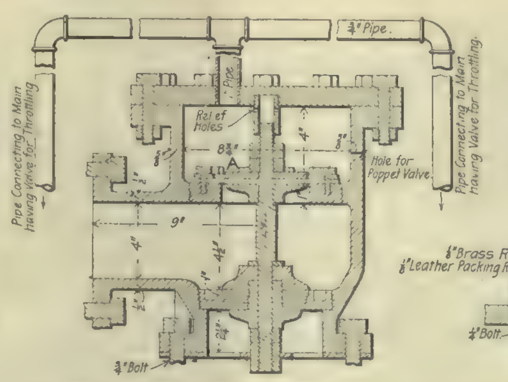
"It would be rash to say that there is a ready way out of the difficulty. It might seem at first sight that if the makers resolutely set their faces against the rolling of odd sections, and only supplied those made to recognized standards, an improvement would be brought about. Doubtless it would, but the difficulties in getting such a combination of interests as is involved in that proposition are very great. However, something of the sort has been done in Belgium with the best results, and in America standardization of structures, engines, tools, etc., as well as of sections, has beyond all doubt been the key to the success American commerce in mechanical branches has attained. Before leaving a subject upon which very much more yet remains to be said, we should like to ask one question, on the chance that some of our readers may be in a position to present a solution of what appears to us to be the only mystery connected with these foreign orders. How is it, then, that whereas the British manufacturer is hampered by all sorts of restrictions, many of them almost frivolous, the American manufacturer is practically given carte blanche. Why should an order to America run, so many locomotives 'of your standard type,' or a 200-ft. bridge 'to your usual specification,' when the English tenderer is harassed with useless particulars as to the chemical composition of his steel, the particular design, maximum strains, and so on?"

NEW AIR-RELIEF AND PRESSURE-RELIEF VALVES.

Automatic valves for relieving a pipe line from air and from excess pressure caused by water hammer have recently been patented by Mr. George T. Prince, M. Am. Soc. C. E., chief engineer of the Omaha Water Company, Omaha, Neb.

The air-relief valve shown in Figure 1 is placed at or near the summit of a main containing water or other liquid, with a gate valve between it and the main. In putting the apparatus in service it is partly filled with water, the gate being closed. The float, which is practically a pail of water, should be half submerged when the air escape at the end of the long arm is closed, and in this position the counterweight is supplied with just sufficient shot to balance the float. If the valve is to operate under pressures exceeding one hundred pounds per square inch, the float should be counterbalanced when submerged more than one-half, and in extreme cases this adjustment should be made with the float wholly submerged to provide for the unbalanced pressure at air escape outlet. The valve is then ready for service, the top plate is bolted in place and the gate on the connection with the main is opened. Should air bubbles be coursing along the main they will accumulate in the air chamber and the weight of the float is increased by the difference between the weight of accumulated air and the water which it displaces. When this amounts to enough to overcome the friction of the working parts, the float will fall and open the air escape, allowing the accumulated air to pass out. The water then rises within the chamber until normal conditions are restored, when the float rises and shuts off the further escape of air. The action of the valve is thus dependent on the amount of displacement of the float. If the water level rises, it is the same as if the weight of the float were reduced, and, on the other hand, the lowering of the water level virtually increases the weight of the float. The counterweight is supposed to be submerged at all times.

The stem passing through the stuffing box in the top plate, immediately above the point of



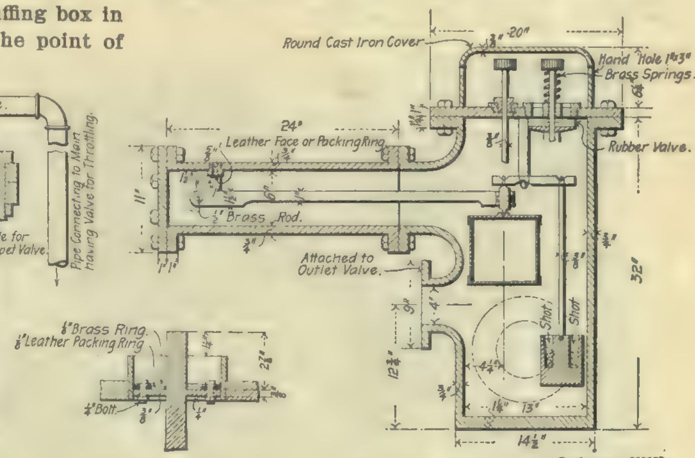


FIG.2 Pressure Relief Valve. Modification of Valve at A. FIG.1 Air Relief Valve.

NEW AIR AND PRESSURE RELIEF VALVES FOR PIPE LINES.

attachment of the float, is for the purpose of ascertaining the condition of the valve by forcing it through the stuffing box and depressing the float until air or water appears at the waste valve. It is intended only for purposes of inspection, and is usually raised so as not to interfere with the working of the lever arm. The 4-inch outlet valve, placed directly below the arm of the valve, is intended for hand use. When the pipe line is being filled the small air escape is inadequate and this 4-inch valve must be opened and closed by hand. In order to prevent a partial vacuum in the pipe, the air chamber is fitted with a poppet valve opening inward. The knife edges and all bearing parts are made of brass.

The pressure-relief valve shown in Figure 2 consists essentially of two valves with a chamber and escape pipe between them. It is attached to the main by a branch fitted with a gate valve. The valve nearer the main is similar to the ordinary hydrant valve of the compression pattern. The upper valve is somewhat larger, and is a rubber or metal diaphragm, suitably secured to the stem, and also to the brass bushing, by a composition ring and tap bolt. Above the diaphragm valve is a chamber to which a small pipe, about one inch in diameter, is attached, which branches into two lines of pipe, both connected with the main within a foot or two of the relief-valve. The chamber above the upper valve is fitted with a small poppet valve. On the two small branch pipes there are valves for shutting off and for throttling the pressure.

The first step in the use of this apparatus is to almost close the valves on the small branch pipes after allowing the outer chamber to fill with water by raising the poppet valve for the air to escape. When this chamber is filled and the valves on the small branch pipes are nearly closed, the stop valve connecting with the main is opened and the relief valve is ready for service.

When water hammer occurs, the shock is first felt by the valve nearer the main, which immediately opens, allowing some water to escape through the 4-inch branch. This reduces the pressure and the valve is gradually closed by the greater pressure exerted upon the diaphragm through the small branch pipes, this action being retarded because of the throttling. The office of the small poppet valve in the outer chamber is to allow the diaphragm valve to move when acted upon by the concussion imparted by the lower valve.

The upper valve is also made in a form to allow of free action instead of a diaphragm, and this form should be used on mains carrying large quantities of water moving at high velocities. Flexible brass plates should be employed for the diaphragm when the valve is used with steam, gases or any destructive liquids. To test the efficiency of this valve it was used in some experiments in which the water pressure was 80 pounds. By means of a quick-closing shut-off the pressure was suddenly run up to 120 pounds without causing any injury when the valve was in use. With the valve out of service the black iron pipe delivering the water was split from end to end, the pressure going beyond the scope of the gauge.

MOVING LARGE MAINS IN SERVICE.

The abolition of grade crossings on Pennsylvania Avenue in the heart of Philadelphia has made it necessary to lower the tracks of the Philadelphia & Reading Railway for nearly two miles, and there has just been constructed for them at great expense a subway involving 6,330 feet of open cut and 2,711 feet of tunnel work. The subway is crossed by 32 water mains and many gas pipes. The largest water mains are 48 inches in diameter and the largest gas mains are 30 inches in diameter. All of them had to be raised or lowered from their original position, and various methods were adopted for handling them.

Two general methods were adopted when the mains crossing the line of the subway required to be depressed. In most cases where it was required that the flow should be maintained, the old main was left undisturbed until a trench had been excavated sufficiently to one side to prevent accident. A new main was laid in the trench and completed except at the ends, where special castings were used to make the connections. When all was in readiness the old main was cut and the connections made. The old

main was then removed in the course of the excavation. In the case of the 48-inch mains the work in making the connections usually occupied about 24 hours.

When it was practicable to abandon the old main temporarily, it was cut and the new line made on the old alignment.

When it was necessary to cross the subway below the level of the tracks, usually requiring a lowering of from 25 to 30 feet, the mains have the appearance of an inverted siphon, the connections between the high and low levels usually being made at an angle of about 45 degrees rounded off with special curves of about 15 feet radius.

The maximum distance the main had to be raised to cross over the top of the subway did not exceed 4 feet. In such a case the main was usually supported on blocking and trestles and carefully wedged up as the excavation was made. After the side walls had been built the pipe trench was opened for a sufficient distance each side of the subway and the main raised to the necessary height by screwing up suspension loops supporting it at every joint. This adjustment was made in a total length of 140 feet in the worst case. One man was stationed at each bearing of the suspension rods, or two men for 48-inch mains, and all the nuts were simultaneously turned one revolution at a signal. Then the men moved to an adjacent section and repeated the operation, and so on until the whole main had been raised, the end nuts being turned a little less than the others. Then commencing a short distance from one end they side of a 4 x 8 x 1-inch steel plate, which supports the shoulders of a pair of semicircular cradle pieces made as shown in Figure 2. The bearing faces of the upper nuts and plates were smoothed and oiled and they were turned with 3-foot steel wrenches.

In order not to obstruct the subway construction, trestle falsework was omitted from about 38 feet of these pipes, as shown at the left of Figure 1. While thus unsupported there was a wreck on the railroad track on the bank above the skew back masonry. The tender of an ordinary freight locomotive was derailed and fell down about 6 feet on top of this pair of pipes, and remained lying there, wholly supported by them for about three hours. This accident did not break the pipes nor cause any considerable leakage under the water pressure of about 27 pounds then carried, and it did not cause any serious displacement nor distortion of alignment. Some leakage always occurred at the joints of the large pipes when they were raised or lowered, but it was usually negligible until the operation was completed, when it was remedied by recalking. In some cases the mains have been carried across and beneath the subway in rock tunnels driven before the subway was excavated. Here, of course, the new pipe was laid in the tunnel and the corresponding length of old pipe was removed. Some of the mains were suspended from the highway bridges crossing the subway, and there the suspended portions are at a higher level than the adjacent sections in the trenches and are connected to them by special castings on easy curves.

FIGURE 3.—PIPES OVER ARCH.

would, on the contrary, be able to sustain any load likely to be applied to it. Therefore it was thought entirely proper to cut away a portion of the arch.

At Twenty-fourth Street an entirely different method was adopted under similar circumstances, where there was insufficient room to carry the 48-inch main between the top of the tunnel arch and the surface of the street. About 18½ feet of the old main was removed on each side of the center line of the tunnel and replaced by two special sections reducing the diameter continuously to 30 inches and made so that the upper side is nearly horizontal. This gave all the slope of the reduction to the bottom of the pipe and brought it tangent to the arch near the crown. The two small ends of

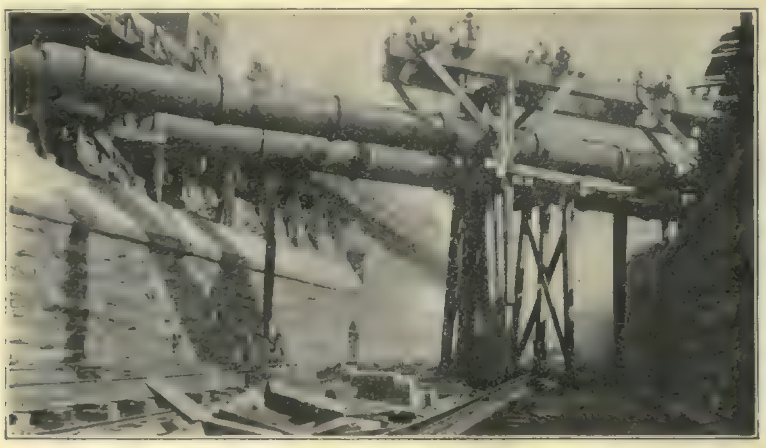


FIGURE 1.- RAISING A 48-INCH WATER MAIN.

FIGURE 5.—A TEMPORARY GAS MAIN.

worked back to near the other end in the same manner, and thus continued going back and forth with a slightly diminished length of main each time until the main had been lifted to the required height at the center. By this method a 48-inch main was raised 3 feet by 50 men in 15 hours.

The operation of screwing up a 48-inch main at Twenty-fourth Street is illustrated in Figure 1, where two mains are shown crossing Pennsylvania Avenue. One of them is still supported on the low trestles, which carried both of them across the excavation. A taller trestle was afterward erected and carried a pair of 18 x 24-inch lifting beams parallel to and on each side of the nearest main and above its final position. Pairs of 10 x 10-inch cross pieces were laid on top of these beams and between each pair at each end was a vertical 1¾-inch screw rod by which the pipe was suspended, as shown in Figure 2. These rods were about 10 to 12 feet long, with a screw cut 3 inches on the lower end, and on all but about 3 feet of the rest of the rod. There is a nut on each end, the upper one bearing on an 8 x 8-inch cast-iron saddle plate across the tops of the beams and the lower one taking bearing on the under-

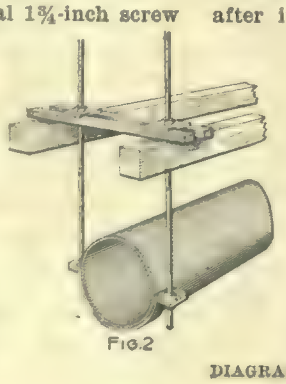


FIG.2

The Fairmount Avenue main is 48 inches in diameter and just before it crosses the tunnel it divides two 36-inch parallel branches which rise about 4 feet with a reversed curve and after crossing the arch descend similarly and again unite into a single 48-inch pipe at the grade. As there was not sufficient room for even the 36-inch pipes on top of the arch, grooves about 18 inches in maximum depth were cut for them in the brickwork across the crown which had a minimum original thickness of 3 feet. This brought the pipe to the necessary depth below the surface, as shown in Figure 3. It is believed that the straight pipe itself would alone have been nearly self-sustaining without support between the subway walls, and that with the considerable arch action of the two reversed curves, it would have no tendency to deflect after it was thoroughly settled in place, but

the reduced section were united by a double bell piece 30 inches in inside diameter and 16 inches long, into which both were calked, as shown in Figure 4. The inside of the reducer pipe was bored smooth and coated with hot coal tar to diminish friction and prevent obstructions lodging there. Piezometer tests showed that with a velocity of 4.5 feet per second at the throat the discharge was 14,300,000 gallons in 24 hours, and the loss of head 0.018 pounds, and with a velocity of 16.38 feet, the discharge was 51,900,000 gallons, and loss of head 0.233 pounds.

Except as noted, the changes in the water mains were made by ordinary methods, and some of the gas main crossings were similarly handled. At Twenty-second Street a 20-inch gas main crosses over the tunnel, and to avoid obstructing the steam shovel which was used for

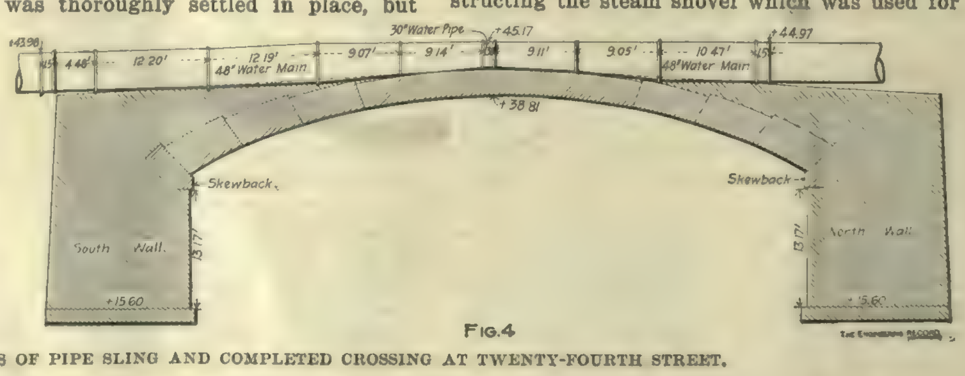


FIG.4

DIAGRAMS OF PIPE SLING AND COMPLETED CROSSING AT TWENTY-FOURTH STREET.

excavation here, the main was, at the commencement of operations, elevated about 20 feet with a couple of 90-degree offsets, and a section 40 feet long was carried across overhead on a temporary Howe truss combination bridge of about 33 feet clear span, as shown in Figure 5. After the completion of the tunnel at this point the main was lowered to its final position resting on top of its masonry.

The subway work has been done by the Department of Public Works, Bureau of Surveys, Mr. Geo. S. Webster, M. Am. Soc. C. E., chief engineer; Mr. Samuel Tobias Wagner, M. Am. Soc. C. E., first assistant engineer. The changes in the water pipes have all been planned and carried on under the direction of the Bureau of Water, Mr. A. J. Fuller, assistant engineer, assisted by Mr. John Montgomery, water purveyor of the Fourth District. The gas mains were moved by the United Gas Improvement Company.

THE USE OF LAYERS IN CONSTRUCTING EARTH DAMS.

The following communication relative to layer construction in earth dams has been received from Mr. A. M. Welles, chief engineer of the Castlewood dam, which was described in these columns on December 24, 1898. He states in a note accompanying the article that he is aware he is antagonizing a time-honored theory generally accepted to-day, but is encouraged to make known his convictions because this is not the first or oldest generally-accepted theory which has been proved at fault.

"In 'The Engineering Record' of April 15 there appears a most excellent article in many respects relative to the construction of high earth dams. It embodies, however, one principle to which the writer wishes herein to call attention, viz., that of depositing the earth in the form of layers wetted and rolled. The writer, in the construction of numerous earth dams of various heights, and in the observation of the operation of these and others, has experimented largely and observed closely their efficiency, with the result of absolute disapproval of layer construction. First, in the construction of stone structures of this kind, the nearer they approach a monolith the better. Likewise in the construction of an earth dam, the more perfectly they can be formed of one mass of homogeneous texture the safer and more efficient they must become. Hence, in their construction by methods of layers the following conditions must exist; the layer first deposited properly, moistened and rolled, must have a section or thickness of unequal density. The surface or upper face coming in direct contact with the roller is, it must be admitted, the most compact. This compactness or greater density, it must also be admitted, decreases with depth and reaches a condition at the bottom proportionate to the thickness of the layer, and this ratio holds good in all the different classes of material used. In the depth of layers quite commonly employed, the lower plane has been but slightly compressed comparatively, and is in a more or less granular condition. The following layer is now applied to the extremely compressed upper surface of the first, and, the same conditions existing as in the first, it will be seen that two faces of unequal density are brought into direct contact and an indisputable plane of least resistance formed along which the water, especially under some considerable hydrostatic pressure, may be forced.

"Then again in the construction of dams in India, in the western portion of the United States, or in any arid region, and especially such as impound bodies of water largely drawn upon, leaving the reservoir for lengthy periods empty, or but partly filled, such embankments subjected to an arid climate and a burning sun's heat are quite liable to dry out, especially through their upper or lighter cross-section, with the result that these separate strata, each of unequal density, will to some extent fold or warp, uniting more firmly at certain points and tending to separate at others. The writer can cite many instances in the early life of structures constructed after this method where breaks have occurred from the most unaccountable causes, and will refer particularly to the Rifle Creek dam in western Colorado, built on the rolled layer principle, in the most painstaking manner, of excellent material and proportions, which upon the first filling suddenly emitted water about half way up its face, while the surface of water in the reservoir was but little above this point."

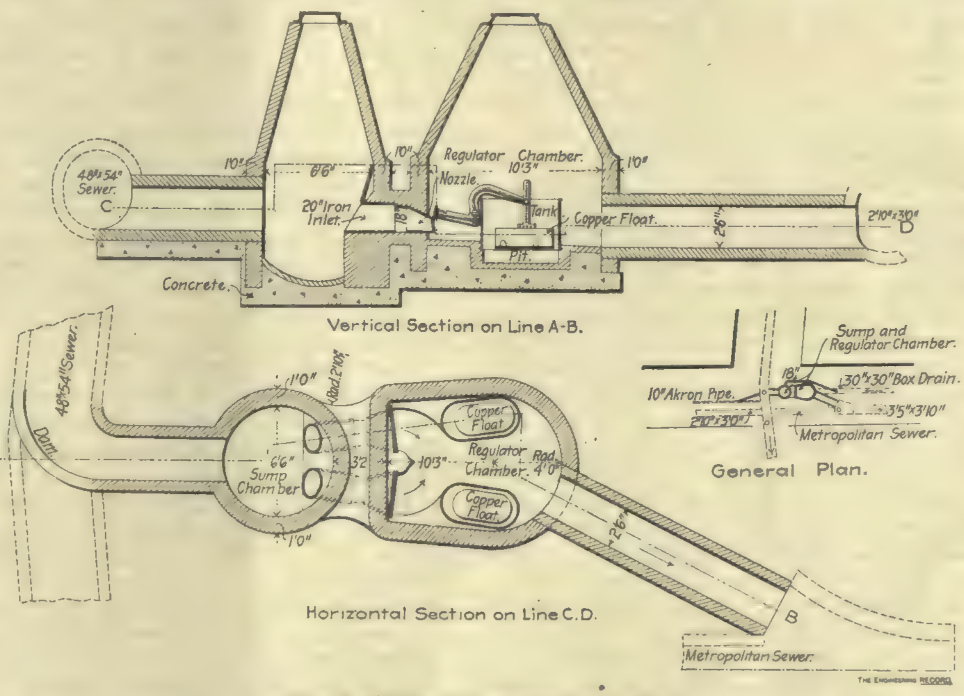
SEWAGE REGULATOR AT CAMBRIDGE, MASS.

Regulator devices are of frequent use where connections are made between sewers for house sewage only, and those carrying storm water as well. The designs vary somewhat in different cities in order to meet the local conditions. Such regulators in use in Providence, R. I., Boston and Woburn, Mass., have been illustrated in "The Engineering Record" of August 11, 1894, December 22, 1894, and June 15, 1895, respectively. Their principal features are, in general, the same. They usually include a sump chamber where sand and gravel are collected and prevented from passing into the intercepting sewer, and a regulator chamber containing a float for automatically closing the opening from the sump chamber and thus regulating the flow of sewage into the intercepting sewer.

The accompanying illustration shows a type of regulator, or manhole, designed by City Engineer L. M. Hastings of Cambridge, Mass., for the connections of the sewerage system of the city with the Metropolitan outfall works.

To avoid the use of the large type of regulator where the present flow of sewage is comparatively small, the regulator chamber was designed to contain two of the smaller sets of apparatus as shown in the illustration. There are two passages from the sump chamber into the regulator chamber, of which one is sufficient for the present flow of sewage and the other will remain filled with masonry until such time as the increased flow will require its use. For the same reason, but one tank and float has been placed in the regulator chamber. This float, by rising and falling, controls the opening from the sump chamber in the usual manner.

Connected with the movable arm of the regulator float is an automatic registering device designed by Mr. Hastings for keeping a record of the opening of the inlet pipe. It is not intended to keep an exact record of the amount of the opening, but rather to show the relative position of the gate, whether open, three-quarters, one-half, one-quarter open, or shut. The dial is of ordinary paper ruled to show these divisions and is fastened to a disk of aluminum, which is attached to the center or hour spindle of a strong eight-day clock contained in a box of sheet copper. The marker carrying the pencil is a simple rod, with a light spring to press the pencil against the paper, and moves vertically just the distance between the outer and inner lines on the dial. This machine, ready to place in the chamber, costs about $30, without connections, and has given excellent satisfaction.



SEWAGE REGULATOR, CAMBRIDGE, MASS.

TEST OF A NORDBERG QUADRUPLE-EXPANSION ENGINE.

A test has recently been made by Prof. R. C. Carpenter of Cornell University on a 6,000,000-gallon pumping engine built by the Nordberg Manufacturing Company of Milwaukee for the Pennsylvania Water Company, Wildwood Station, Pittsburg, Pa., of which Mr. James H. Harlow, M. Am. Soc. C. E., is president. This test breaks the record for efficiency on a heat-unit basis, for the duty obtained was 162,948,824 foot-pounds per million heat units. The duty on the basis of 1,000 pounds of dry steam was 150,254,138 foot-pounds, which has been exceeded by several engines. The following description of the engine and test has been prepared from advance proofs of an article by Professor Carpenter in the "Sibley Journal."

The pump in question is a quadruple-expansion engine of the direct-acting type, provided with crank and flywheel. The plungers are two in number, double-acting, outside packed, one being directly beneath cylinders I and III, the other directly beneath cylinders II and IV. The engine was designed for a capacity of 6,000,000 gallons in 24 hours against a pressure of 275 pounds per square inch. The boiler pressure was to be 200 pounds and the piston speed 250 feet per minute. The steam cylinders are 19½, 29, 49½ and 57½ inches in diameter, the plungers are 14¾ inches in diameter, the plunger rod 4.5 inches in diameter, and the common stroke 42 inches. The valve gears are of the Corliss type, excepting the exhaust valves on No. III cylinder, and all on No. IV cylinder, which are single-beat poppet valves. The clearances of the engine are given in the table of the results of the test.

The chief peculiarity of the engine is the series of heaters through which the condensed steam is successively passed on its journey from the hot well to the boiler, and in which it is warmed by steam drawn from the low-pressure cylinder, the receivers and the jackets. A surface condenser is employed which is kept at low

temperature by large quantities of injection water drawn from and discharged into the suction main. The condensed steam is delivered by the air pump into a hot well, from which it is pumped into an oil purifying tank located on the outside of the building and standing at a comparatively high level. From this tank the feed water passes to a heater in which is arranged a series of shelving, over which it falls in a series of drops through the ascending current of exhaust steam from the low-pressure cylinder; this heater is under the same vacuum as the condenser, and is termed the exhaust or pre-heater. The water discharged from the preheater is pumped into heater No. 1, which is of similar construction to the pre-heater, heat being taken from the low-pressure cylinder, however, for warming the feed water. The steam is drawn into the heater through a pair of auxiliary valves in the low-pressure cylinder which are opened at about the seven-eighths part of the stroke and after cutoff. From heater I the feed water is discharged into heater II by gravity. In heater II the feed water is further warmed by discharge of steam from receiver III. The water is then pumped from heater II to heater III, where it is warmed by steam from receiver II and by the jacket-discharge from cylinders III and IV. It is thence pumped to heater IV, where it is further warmed by steam from receiver I and by the discharge of water from the jackets of cylinders I and II and the reheaters of the receivers. The temperatures which were actually obtained by the admission of steam as described in the various heaters are as follows: Starting with the water in the outside tank at 88 degrees it is raised in the exhaust heater to 105 degrees; in heater I to 136 degrees; in heater II to 193 degrees; in heater III to 260 degrees; and in heater IV to 311 degrees. The temperature rise actually obtained was about 15 degrees less than expected by Mr. Nordberg. The various pumps required for forcing the feed water through the various heaters are compactly arranged, especially constructed for pumping hot water, and are all mechanically driven by attachment to the main pumping engine. The work of operating the pumps is included in the test as a portion of the friction of the main engine. The actual work of lifting the feed water from the point of discharge to an elevation equivalent to boiler pressure is equivalent to about 2.3 horse-power.

The steam for the main engines passed through a separator, the drip of which was removed by a tank pump and returned to the boilers. The various cylinders of the engines were jacketed on the barrels and the receivers between the cylinders were provided with reheating pipes. Steam for the jackets was drawn from the main steam pipe between the boiler and the separator. The jackets of cylinder I were supplied with steam of boiler pressure, it thence passed through a reducing valve and was reduced in pressure to 116 pounds, thence into the jacket of cylinder II, it thence passed into the reheating tubes of receiver III at a pressure of 105 pounds, thence into the receiver tubes of reheater II, at a pressure of 103 pounds, thence into reheater tubes of receiver I at a pressure of 102 pounds, thence was discharged through a trap into heater IV. Jacket steam for the barrels of cylinder III was taken from the main steam line at the same point on the line previously described and passed through a reducing valve which lowered the pressure to 40 pounds per square inch, it thence passed to jacket of cylinder IV, in which it had a pressure of 39 pounds, and from thence was discharged through a trap into heater No. III.

Three series of tests were planned; the first to be the regular duty test 48 hours long, during which time all the condensed steam should be carefully weighed, pressure and indicator diagrams taken, and the water delivered measured in order to determine the capacity and duty of the pump on the basis of the contract requirements. The second run was to last six or seven hours to determine the duty of the pump, the economy of the engines, etc., when the feed water heaters were not in operation, in order to determine the saving due to the heaters. The third run was to be six hours in duration and made with the connections so arranged that the distribution of heat to the various parts of the engine could be determined.

At eleven minutes before the end of 36 hours, during the duty run a gasket in the feed pipe leading from the engine and near the feed pump was blown out, causing a small leak. On account of this it was decided to close the duty run at the end of 36 hours, making corrections for the leak in the feed pipe for eleven minutes. After repair of the feed pipe and a few hours of needed rest a run of six and one-half hours was made without the heaters in use, and two days later a run of seven hours in which the distribution of heat to the various portions of the engine plant was measured.

The arrangements for testing consisted in disconnecting the pipe leading to the boiler and arranging it so that its temperature could be measured when kept under substantially boiler pressure, then passing it through a cooling coil of considerable extent by means of which the temperature was reduced to about 110 degrees, then delivering it to a receiving tank having a capacity of about 1,100 pounds, which stood at a sufficient elevation so that the water could flow from the receiving tank to a tank standing on a pair of scales in which it could be weighed. The scales were carefully tested before beginning the test, all thermometers and pressure gauges calibrated and the errors of the indicator springs determined.

During the heat run all the water discharged into the outside purifying tank was also weighed, the discharge from the various jackets measured and the quality of steam between the various cylinders, receivers, etc., taken as completely as possible with calorimeters.

The general results of the duty test show the duty of the pump to be 162,948,824 foot-pounds per 1,000,000 B. T. U. which the steam supplied the engine contained in excess of the feed water returned to the boiler. The duty reckoned on the basis of 1,000 pounds of dry steam was 150,254,138 foot-pounds per 1,000 pounds of dry steam. The indicated horse-power during the test was equal to 712, the dry steam per indicated horse-power per hour was 12.263 pounds, the heat units per indicated horse-power per minute was 185.96. The capacity of the engine on the basis of plunger displacement is 6,225,052 gallons against a head of 602.7 feet. The test without the heater shows a steam consumption of dry steam of 11.4 pounds, per indicated horse-power per hour, a duty of 147,525,550 foot-pounds per 1,000,000 B. T. U. supplied and a duty of 159,824,700 foot-pounds per 1,000 pounds of dry steam. It will be noted from this that the effect of the heaters is to increase the duty from 147.5 to nearly 163. millions, an amount slightly over 11 per cent. The withdrawal of steam for use in the heaters, on the other hand, reduced the duty on the basis of 1,000 pounds of dry steam used by the engine in the ratio of nearly 160 to 150. This computation would indicate that the gain from the use of the heaters was not compensated for by the higher economy in steam consumption of the engine when running without the heaters, or, in other words, that there is a distinct gain in using the heat of steam which has done some work in raising the temperature of the feed water.

During the entire series of tests duplicate observers were provided for the feed water and other important data. During the test the Pennsylvania Water Company was represented by Mr. Harlow, Mr. George R. Harlow, Mr. W. A. Alexander, superintendent of the company, and two assistants for taking duplicate logs. The Nordberg Manufacturing Company was represented by Mr. Bruno V. Nordberg, chief engineer of the company; Mr. R. H. Corbett, erecting engineer, and two asistants. Professor Carpenter was assisted in making the test by Professor A. W. Richter of the University of Wisconsin; Professor John H. Barr of Cornell University, and a party of advanced and graduated students.

The accompanying data show the dimensions of the engine, the average of the principal observations and the general results of the duty trial:

TEST OF NORDBERG PUMPING ENGINE, WILDWOOD STATION, PITTSBURG, PA., MARCH 24 TO 26, 1899.

Dimensions.

No. of steam cylinders	I	III	II	IV
Length of stroke, in.	42	42	42	42
Diam. of steam cylinders "	19.5	49.5	29.0	57.5
H.P. per 1 lb. M.E.P., 36.5 revs. top	1.1162	7.499	2.517	10.052
H.P. per 1 lb. M.E.P., 36.5 revs. bottom	1.095	7.410	2.496	10.013
Clearance steam cylinders per cent.	1.25	0.55	1.30	0.36

Diameter of plunger .... 14.75 inches.
Weight of water pumped per rev., lbs. 988.65

Pressures.

Boiler pressure, lbs.	199.87
Barometric pressure, in.	28.90
Vacuum gauge, in.	26.60
Jacket No. 1, lbs.	199.81
Receiver No. 1, lbs.	85.47
Jacket No. 2, lbs.	116.05
Receiver No. 2, lbs.	24.77
Jacket No. 3, lbs.	39.78
Receiver No. 3, inches of mercury	—1.59
Jacket No. 4, lbs.	38.74
Reheater No. 1, lbs.	102.08
Reheater No. 2, lbs.	103.69
Reheater No. 3, lbs.	105.36
Force main, lbs.	258.12
Vacuum gauge, inches	6.80

General Data.

Duration of trial, hours	36
Revolutions per minute	36 52
Head in feet force main, ft.	595.57
Suction in feet below pressure gauge	6.92
Total head from gauge, corrected, ft.	602.69
Water pumped	42.65 degrees Fahr.
In outside upper tank	88.15 " "
In pipe to exhaust heater	88.06 " "
Between exhaust heater and heater I	104.9 " "
Between heater I and heater II	136.5 " "
In heater II	193.3 " "
In heater III	260.43 " "
In heater IV	311.0 " "
Boiler feed	310.8 " "
Receiver II to heater III	198.32 " "
Quality of steam to engine, per cent.	98.74
" " " " jackets "	97.99
Temperature of feed water	310 degrees Fahr.
Heat absorbed per lb. steam	909.8

Work of Steam Cylinders.

Number	I	III	II	IV
M. E. P., top	69.35	12.85	35.16	8.85
M. E. P., bottom	70.68	14.02	33.98	9.33
I. H. P., top	77.56	96.58	88.64	89.14
I. H. P., bottom	77.55	104.09	84.99	93.63
I. H. P.	155.11	200.67	173.63	182.77
I. H. P., total				712.18
Dry steam per I. H. P. per hour				12.263
B. T. U. per I. H. P. per minute (above feed water temp.)				185.96

Results of Pump Test.

Capacity in 24 hours 36.52 revs. by plunger displacement, gals.	6,225,052
Work of lifting water from pump diagrams, H. P.	662.67
Work consumed in overcoming friction, H. P.	49.51
Work consumed in overcoming friction, per cent.	6.95
Friction head in pipe, difference between survey and gauge readings	2.5 ft. to 4.0 ft.
Friction head in pipe, difference between survey and gauge readings, per cent.	0.41 to 0.61
Reduced friction of engine, per cent.	6.12

Duty of Pump.

$$\text{Per 1,000,000 B.T.U. } \frac{595849.49 \times 2191}{8850.4 \times 909.8} = 162{,}948{,}824 \text{ ft. lbs.}$$

$$\text{Per 1,000 lbs. dry steam } \frac{595849.49 \times 2191}{8732.4 \times 1000} = 150{,}254.138 \text{ ft. lbs.}$$

A Triple-Expansion Pumping Engine of 20,000,000 gallons capacity, built by the E. P. Allis Company of Milwaukee for the city of Cleveland, Ohio, was recently tested by Superintendent M. W. Kingsley of the water department, aided by his assistant, Mr. C. F. Schultz, and by the respresentative of the buiders, Mr. J. H. Lewis. According to the report of the test, the engine gave a duty of 161,687,714 foot-pounds per 1,000 pounds of dry steam. The trial run lasted 24 hours and the capacity of the pump was estimated by the plunger displacement. The steam cylinders are 34, 62 and 92 inches in diameter and the stroke 64 inches. The steam pressure during the test was 149.4 pounds, the vacuum was 13.61 pounds, and the total head 202.25 feet. The piston speed was 199.7 feet per minute.

MASONRY.

Among the most interesting engineering papers presented before technical societies during the past year, was one on masonry, read by Mr. George S. Morison, Past President Am. Soc. C. E., before the Western Society of Engineers. Although masonry has been the building material of history, and many of the finest masonry works now in existence were constructed at a time of which there are no records outside of the land in which they are found, the subject is still one of great importance. It is impracticable to reprint the whole of the paper, which takes up 31 pages in the Society's "Journal" for December, 1898, but the following abstract is believed to present the leading features of those sections of most interest to the readers of "The Engineering Record."

Under the head of brick masonry it was stated that the harder and less absorbent the brick the better and more durable will they prove, although burning should not be carried to such an extent as to make a smooth, vitrified surface to which mortar will not adhere. In brick masonry, mortar joints are frequent; they form so large a portion of the whole that the strength of a brick wall is determined by the strength of the mortar. In a perfect wall the mortar and brick would be of equal strength; it is only when the bricks are very poor and the mortar very good that a wall fails by the breaking or crushing of the brick. With good brick and good mortar, well put together, so that all the joints are thoroughly filled, brick masonry is one of the most durable things that man can build. Some varieties of stone may resist the elements better, but no other material is as well fitted to resist fires; a heavy brick wall will stand almost uninjured when a granite wall close by will be splintered into pieces. The durability and excellence of brick work are illustrated by its use in Rome. The acqueducts which cross the Campagna and the enormous buildings built in the days of the empire were almost entirely made of brick, though facings and finishings, of which they have now generally been robbed, were of sculptured marble. The Roman bricks were very thin and hard burned, but their strength and durability has been due quite as much to the far-famed excellence of the Roman mortar.

A good concrete should be absolutely solid; there should be enough cement in the mortar to fill all the voids between the grains of sand, and there should be enough mortar in the mass to fill all the voids between the stones; the mass should be thoroughly mixed that this distribution actually takes place, a result which is seldom accomplished in quick, hurried work. Where stone cannot be had, it may be omitted, and some of the best concrete ever made is formed entirely of cement and sand. While concrete is perhaps the most modern form of masonry, it is by no means new; while the Romans generally used brick for the unseen portions of their construction, in many cases they used concrete; in Eastern buildings much of the interior work is of rubble masonry, containing so large a proportion of mortar that it is really concrete. Concrete is in very general use in Europe, and its use is extending rapidly in America. Prejudices have been raised against it through inferior work done in this country when it was first introduced, but it is within the limits of possibilities that an artificial stone can be made in this way which will be as good and as durable as the natural stones which are commonly used; when this is accomplished the advantages of a truly monolithic construction will make concrete the best building material, and, except for the facings of monumental works, where nothing can take the place of the finest stones from nature's laboratory, it may be universally used.

The ideal masonry would be absolutely monolithic. This result, however, is never obtained except in concrete. In all other kinds two conditions are relied upon to produce this result in some measure. The first of these is the friction of the stones upon each other; as friction is directly proportionate to pressure, the best results are obtained when the maximum pressure is combined with the least tendency to move on the lines of friction; this condition obtains on planes which are at right angles to the line of pressure, so that the pressure on the plane is a maximum and has no component in the only direction in which the stones can slide. Furthermore, this friction should be utilized to tie the successive stones together as much as possible; the stones in one course should tie together those in the course below; that is, the stones, instead of being superimposed on other stones, should be placed over the joints between the stones below, so that stones cannot be pulled apart without overcoming this friction. This breaking of joints is a fundamental principle of good masonry. The most perfect form of a pier intended to resist weight would be one formed of successive courses, each consisting of a single stone, the pressure being taken at the successive joints on planes at right angles to the line of pressure. In very small structures this is sometimes done with excellent results; in larger works the nearest possible approach to this is obtained by using successive courses separated by parallel planes, the stones of one course breaking joints with those of the course below and binding those stones together by this frictional resistance. The best quality of ashlar masonry fulfills this condition better than anything else; well bonded brick work does it also.

The other condition which tends to produce monolithic work is the use of mortar, with which all interstices should be filled, and which has the double effect of reducing the pressure by distributing it over surfaces instead of taking it on points, and of very greatly increasing the coefficient of friction by its adhering to the stone. With the mortars which are now used it may be said that the closer the work the truer the fitting; and the less the amount of mortar required to fill all voids, the better the work will be. With ordinary workmanship, however, there is danger of carrying this too far. It is better to have a thick bed of mortar which will absolutely fill the space between two courses of stone, so that every bed is supported throughout by the mortar, than to have a thin joint in which this is not done. It is much harder to fill thin joints than thick ones, and in ordinary practice it is not wise to make the joints too thin. Mr. Morison generally introduces a clause into specifications for first-class masonry providing that thin horizontal mortar joints will not be insisted on, but that every joint shall be set in a full bed of mortar and settled to a proper bearing.

There is a common idea that the same degree of excellence or inferiority should be permitted in all features of a piece of work; in other words, that in second-class masonry, in which little pains are taken in fitting the beds and joints, a poorer mortar may be allowed than would be required in first-class ashlar work. This is entirely wrong; the closer the work, the nicer the fitting and the more perfect the shape of the stones, the greater is the work done by friction and bonding and the less is the duty which the mortar performs. If poor mortar is to be permitted at all it should be allowed only with the very best of stone work. The inferior classes of masonry, like rubble work, if they have any considerable duty to perform, are only safe when laid up in the very best quality of mortar. This is illustrated by the work of different nations. The closest stone cutters the world has ever seen were the ancient Egyptians; the Great Pyramid is a mass of ashlar masonry, though the face stone was stolen by Mohammedan invaders to build the mosques and seraglios of the city of Cairo; but in one place, where the sands in the desert had been uncovered from a small remnant of facing near the base of the pyramid Mr. Morison found a joint on the top bed of a stone which did not exist on the face; a careful examination showed that this could not be a real joint, but must have been simply the mark of the tool which was used in trimming the end of the stone which formerly stood in the course above, and yet the real joint was so close that it could scarcely be distinguished from this tool mark. The pyramids were laid up in mortar, but the amount used is almost infinitesimal, and was simply an inferior lime paste; the excellence of the stone work rendered the mortar unimportant. The masonry of India is very different; it is made largely of small stones, with a facing of fine work, but the mortar, the work of the patient, mild Hindoo, is very good; the masonry is of excellent character and very strong; the smallness and poor fitting of the stones are made up for by the excellence of the mortar.

As an instance of imperfect specifications, the paper mentioned a case of a wall of rubble masonry, with poorly bonded stones and irregular beds, laid in inferior mortar, which was run up quickly to a height of nearly 50 feet, when suddenly the exact result which was to be expected occurred. The mortar in the lower courses yielded, the stones moved on each other and the entire wall collapsed into a heap of loose stones and looser mortar. Poor as the mortar was, if the wall had been built of cut stone, well bonded, it would have compressed a little and have stood. Poor as the stone was and weak as the bonding was, it would have stood if the mortar had been good enough to bear a moderate pressure and adhere to the stone; the mortar neither adhered to the stone nor was able to carry the weight of the wall. Fortunately destruction came before the building was completed.

Mortar plays a very important part in all except dry masonry, and especially in concrete and the inferior forms of stone work. A lime mortar does not set, but hardens slowly; a cement mortar sets quickly and then continues to harden. The hardening of the lime mortar is a slow chemical action between the lime and other elements; the best results are obtained by mixing the mortar some weeks before it is used and not subjecting it to any great strain until a considerable time after it is laid. The action of cement is different; the cement itself contains all the elements necessary to the setting and hardening; a briquette of pure cement will set harder and be stronger than a briquette containing even a small portion of sand. The function of sand in a cement mortar is simply that of a dilutant and is precisely similar to that of broken stone or coarse gravel in concrete. In a cement mortar there should be enough cement to fill all the voids between the grains of sand, which implies a coating of the entire surface of every grain and enough more than this to provide for the contingency of imperfect mixing. The more perfect the mixture the less the amount of cement that will be required, and the finer the cement is ground the less cement it will take to coat every particle of sand.

In both lime and cement mortar the best results are due to work; the more complete the incorporation of the ingredients the better the mortar will be. In lime mortar, which hardens slowly, time need not be considered, and this incorporation can be done slowly. In cement mortar, where a set takes place early, it is important that too much time should not be spent in mixing. In the alluvial deposits of the Ganges is found a kind of limestone of irregular shape known as kunker; the Hindoos make a mortar of kunker lime and brick dust which becomes as hard as Portland cement. The piers of the great bridge across the Ganges at Benares are laid in this; its excellence is due to work. A similar excellence is found in all their mortars. When the lime has been slaked they grind it in a hand mill, then they

grind the sand in a similar mill, and then they grind the lime and sand together, all of this work being done by women. The mixture is then wet and ground in a mortar mill by bullocks, and when it is used it is pounded for hours. They will take this mortar, plaster a wall, pound it and rub it down, and the final result of their patient work is a plastered wall with a polished surface as smooth as that of porcelain, which will stand the weather of their frostless climate for more than a century. The secret of good mortar is work. In India, where labor is hardly worth 5 cents a day, this can be done by hand; in this country it cannot be afforded, and it is cheaper to use the most costly cements; but even cement mortars are better if thoroughly worked, and Mr. Morison hopes to see the time when machine mortar mixers are as common on masonry walls as power riveters are now in bridge shops.

The first and simplest use of masonry is as a support to carry weight, as in a column or a bridge pier. For this purpose it is an absolutely appropriate material, and the satsifactory results which have been obtained are illustrated by the heavy columns of the ancient Egyptians and by the excellent work of the Greeks, and the slender shafts which preserve to this day the beauty which we imitate but do not equal. For bridge piers masonry is by far the most suitable material. An ordinary trussed bridge is so designed that practically no horizontal strain is imparted to the masonry, which simply carries the weight imposed upon it. If made of good stone, masonry is better able to resist the action of water and air, combined with changes of temperature, any anything else. A bridge pier should be built of ashlar masonry, with horizontal beds and well bonded stones. Rubble backing may be used if thoroughly filled with first-class mortar, but a backing of stone with horizontal beds of the same thickness as the face stone is better. The class of work preferred by Mr. Morison is indicated by the following extracts from the specifications for the bridge across the Missouri River at Bellefontaine Bluffs:

"Each bed of every stone shall measure at least 26 inches in each direction, except that where the thickness of the course is less than 24 inches the bed need not exceed 1½ times the thickness of the stone.

"The bottom bed shall always be the full size of the stone, and no stone shall have an overhanging top bed.

"Stretchers shall not be less than 4 feet nor more than 7 feet long, and stretchers of the same width shall not be placed together vertically, but this shall not apply to the ends of stretchers where headers come centrally between stretchers.

"Headers shall be at least 5 feet long and shall be at least three-fourths their full width for the whole length. There shall be at least three headers on each side of every course between the shoulders.

"Joints shall be cut vertical and at right angles to the face of the stone, unless otherwise shown on special plans. The cutting for at least 12 inches back from the face shall be the same as that required for the beds.

"Joints shall be broken at least 15 inches on the face.

"The backing shall be composed of stones of the same thickness as the face stones, with beds cut in the same manner as required for the face stones, and with no overhanging top beds. The spaces between the large stones shall not occupy more than one-fifth of the entire area of the pier inside of the face stones, and these spaces shall be filled with good rubble masonry, carefully laid up in full mortar beds and well rammed."

A pier has two functions: It must carry weight and it must pass water with the least disturbance to the latter. This calls for the same kind of lines which are needed in a boat; corners are to be avoided and the best results are obtained by piers which are pointed at both ends, but have no other angles. A form of pier which Mr. Morison has found to give the best results has straight parallel sides terminating in circular curves, to which the sides are tangent. A considerable variation can be found in the radius of the ends of curves, but a radius equal to about three-fourths of the thickness of the pier gives very good results. The downstream end may be made semi-circular without seriously injuring the form, though it creates more disturbance in the passage of the water. Sometimes a semi-circle may be used at the upstream end, but in rivers carrying any considerable amount of drift this is liable to cause trouble. A common form of pier is hexagonal, with parallel sides, a right angle at each end and an angle of 135 degrees at each of the four shoulders; this, however, is not a good shape, as the angle at the shoulder is sharp enough to make a great disturbance in the passage of water. Nearly twenty years ago Mr. Morison adopted a plan of bridge pier which he has never considered it necessary to change. The cross-section between high and low water is of the kind described; above high water the ends are made semi-circular; the piers are finished with projecting coping and a belting course under it on top, and the offsets near high water are covered by small copings. The pier is very plain, but is perfectly adapted to its purpose and always looks well. It is perfectly symmetrical, so that the pressure on the foundation is as nearly uniform as possible. In low bridges where the piers finish but little above high water, no change in the shape is made. The long raking ice breakers which were formerly popular are rarely needed with heavy piers of good masonry; when used they necessarily throw the center of pressure outside of the center of masonry and make unequal weights on the foundation.

Another proper use of masonry is that of retaining walls, including the abutments of bridges. The duty of a retaining wall is double. It has to carry its own weight as well as any weight that may be put on it, like the superstructure of a bridge when it is an abutment, and it has also to resist the horizontal thrust of a mass of earth behind it, the resultant of the horizontal and vertical strains being a curve more or less inclined. To produce the best results the masonry should be laid up in inclined courses, the joints being everywhere normal to this resultant curve; in some cases this has been done. The wall must be so proportioned that the resultant curve shall never pass outside of the middle third, and this means that the weight of the masonry which acts down ward must be greatly in excess of the thrust of the earthwork which acts horizontally. The principal duty, therefore, of a retaining wall is to provide weight, and a large amount of cheap masonry may be better than a smaller amount of first-class masonry. Good rubble masonry and concrete are excellent materials for retaining walls. One of the most satisfactory in Mr. Morison's experience was built of Louisville cement concrete faced with a single thickness of brick, which were bonded into the concrete by making every other brick a header in every second course.

There is no class of structure in which the determination of the strains is more uncertain than a retaining wall. The principal difficulty lies in the uncertainty of the thrust of an earth embankment, which varies with the amount of saturation, by the method of which it was made, and by irregularities of both time and place. It is perhaps as safe to follow arbitrary rules as to make close calculations; a common rule being to make the thickness of a retaining wall never less than 40 per cent. of its height above such thickness; with some favored soils this may be reduced to 30 per cent., but where subject to vibrations or other disturbances it should be increased to 50 per cent. It must also be remembered that nearly all foundations are compressible, and that the pressure on the foundation of a retaining wall may increase from nothing at the back to twice the average at the face, which means that a retaining wall on a yielding foundation will move forward to an extent which can seldom be estimated, but must generally be provided for.

One of the commonest and most beautiful forms of arches is the full-centered or semicircular type. This is the form usually adopted for monumental work; it is, however, a form which requires very careful treatment. If the filling above the arch is built up solid, the weight distributed over the arch does not correspond to the form of the arch and rupture is likely to occur in the haunches. This is obviated by using a hollow filling over the hunches, which may be accomplished either by cellular construction, or better by building up the spandrels with cross walls supporting small arches. A favorite form, and the best in many respects, is the segmental arch, preferably one with the rise about one-quarter of the span. With these proportions there is less difficulty in conforming the load exactly to the curve of the arch.

The essential characteristic of an arch is that it should act only in compression in resisting strains which follow the curve produced by weights, thus implying a thrust at each end. This thrust can be taken by tension rods, but in monumental structures should be resisted, like the thrust of the earth against a retaining wall, by the weight of the masonry. These features of construction are absolutely necessary; without them, whatever the shape, no arch exists. People who are influenced by the vagaries of amateur art talk of finding the Gothic arch in the meeting boughs of overhanging trees or finding the circular arch in the bent sapling with which a savage constructs his rude hut; both ideas are absurd. The first arch was built when two inclined stones were first balanced against each other; such an arch may still be seen at the entrance to the passage leading into the Great Pyramid. The next step was to use three stones instead of two, and from this progress was rapid to the perfect arch. To understand an arch, it is absolutely necessary to remember what it does, and the duties of overhanging trees or of bent saplings are entirely unlike the duties of an arch.

The arch should be used cautiously in monumental works. The fundamental idea of a monument is indefinite duration; it is built to commemorate some event; it is to be the eternal record of that which has itself passed, and it should also be a pleasant thing to contemplate. The idea of indefinite duration is agreeable only when occupied with an idea of rest. The Nirvana of the Buddhist is the most soothing of ideas; the labors of Sisyphus were the most excruciating of tortures. Structurally the idea of compression is one of rest, as when the whole weight of the body is supported. The idea of tension, which calls for muscular resistance, is an idea of strain. It is said that the ancient Egyptians never used the arch, because it did not comport with the feeling of rest which characterizes all Egyptian architecture. This is hardly correct; even an Egyptian pyramid does not typify rest more than a stone arch thrown across a mountain gorge. The feeling of strain does not come from the arch itself, but from the apparent efforts of the abutments to resist its thrust; and in a monument this appearance can be removed by making the abutments of such dimensions as not only to resist the strain, not only to bring the resultants within the middle third, but to give such a superfluity of material that the idea of effort never occurs to the observer.

The dome seems like a modification of the arch, being, as it were, the solid produced by the rotation of the arch. The dome, however, is not an arch, but a construction of very different character, the strength of which is determined by different conditions. An arch is self-sustaining only when it is complete; it

must be supported in some other place until the keystone is placed. A dome has no keystone; the central portion may be entirely omitted without impairing its stability; it may be built up without falsework; each successive ring is completely self-sustaining as soon as it is built; it is only necessary to support the stones or bricks of each separate ring until that ring is completed, and there are various simple devices by which this can be done. This element of stability in a dome is understood when it is remembered that neither an arch nor a dome can fall unless it falls forward from its support. In an uncompleted arch there is nothing to prevent this; an uncompleted dome cannot fall forward without diminishing its diameter, and the diameter of a circle of masonry cannot be reduced without crushing the material of which it is made. At its base the dome exerts a thrust outward in every direction, but the thrust inward toward the center is resisted by a horizontal circular arch.

But though the dome requires no keystone, its weight must be carried downward from the axis toward the circumference where it is supported, and the weights of a dome carried down in this way produce, like those of an arch, a resultant curve. This curve represents only the strains in planes radial to the axis and does not include any of the circumferential strain by which the dome is always self-sustaining. This resultant curve is dependent on two forces, the vertical action of weight, and the horizontal strains which are resisted by the circular form of the dome. The weights are known quantities; the resultant curve may be assumed to be in the middle of the masonry, in other words, to conform to the curve of the dome; the problem is the determination of the horizontal strains with the vertical weights and the resultant curve given. When these horizontal strains represent forces acting toward the center, the dome is stable; if, however, they represent forces acting outward, the dome is unstable and will burst unless held by a metallic band. Two classes of strains will always exist; those following the vertical curve of the dome, and the circumferential strains which are everywhere equal to the radial horizontal strains multiplied by the horizontal radius of the dome in the same plane.

As in the case of the arch a form of dome may be found which corresponds to every condition of symmetrical loading, and a form of loading may be found which corresponds to every form of symmetrical dome. The forms and loadings, however, vary greatly, and many forms of stable domes are excluded by the inconvenient shapes which they involve. Furthermore, any dome may be made stable by strapping it with iron at the place where it tends to rise, a method which has been often adopted in domes which are supposed to be entirely of masonry.

A dome of uniform thickness is always stable when the height does not exceed one-quarter of the span, but such a dome would at once become unstable if loaded with a heavy central lantern. It is a significant fact that low domes of this proportion are almost always pleasing to the eye. The dome exerts an outward thrust at the base, and this thrust can be resisted in two ways, either by a weight of masonry in the same manner as the thrust of an arch is resisted, or by a hoop of iron which straps the whole together. The former is the true restful method of masonry construction, the latter is a mechanical device perfectly proper in a utilitarian construction, but wrong in monumental work, and this leads to a suggestion of a class of domes which can be used for many purposes and be very effective. If a dome be built of concrete with a series of parallel steel rings imbedded in it, it will be able to resist both tension and compression horizontally throughout, and can neither rise nor fall. Such a dome could be built very light, and could be made of almost any symmetrical shape. Various details of construction could be introduced which would admit light through such a dome and it would form an admirable covering in many large rooms.

Domes have generally been built of circular horizontal section. Half domes, however, are equally stable if provision is made for taking the horizontal thrusts on the terminal diameters. This can be done by turning an arch of the same curve between two half domes or by other more complicated methods. A room of the form of a rectangle with semi-circular ends can be covered by two half domes over the semicircles and an arch over the rectangle, the arrangement being perfectly stable provided the walls are heavy enough to resist the thrust of both domes and arch, the latter being the more intense. A dome may be made entirely of elliptical section which would be perfectly stable and entirely satisfactory, but it would require varieties of loading, which would vary the horizontal thrusts to conform to the eccentric shape. It is an interesting problem to work out.

The really fine domes are comparatively few; many of those which are best known are humbugs, more false than the false arches of the East, in that they are made of wood and pretend to be entirely unlike what they are. The upper portions of the famous domes of St. Mark's at Venice are of wood, the dome of the Invalides in Paris is of wood; the outer dome of St. Paul's in London is of wood, the lantern being carried on a brick cone inside. The dome of St. Peter's at Rome is of stone, but it proved unstable and had to be strapped with iron. The dome on the Pantheon at Rome is perfect, with its central opening to the sky and bound by the weight of the massive circular brick walls. The development of the dome reached its highest perfection in the sixth century, when, in the capitol of the Eastern Empire, was erected the great church, which, after serving for nine centuries as a Christian church and for half that time as a monotheistic mosque, still stands, the finest specimen of ecclesiastical architecture ever built, its impersonal name being significant of the skill of its design, Sancta Sophia, the Church of Divine Wisdom.

MODERN PRACTICE IN STEAM HEATING AND VENTILATION.

(By William S. Monroe.)

Chap. II.—Steam Heating—Systems of Piping and Steam Supply.

The three systems of steam heating as described in the last paper—the direct, indirect and direct-indirect radiation—are governed by much the same laws in the matter of piping arrangement and steam supply, the two latter requiring only special rules for proportioning the amount of heating surface besides also the arrangement for air supply. As regards piping, there are the one-pipe and two-pipe systems, with several varieties and combinations of each, and as regards the steam supply, there are high and low pressure systems, exhaust systems, gravity systems, vacuum systems—terms more or less indefinite and somewhat mixed in their application.

The essential requisites of a steam heating system comprise: First, a source of steam supply, which may be either an independent boiler or a heater or tank of some description supplied with exhaust steam from an engine. Second, a system of piping to conduct the steam from the source of supply to the radiators. Third, a series of radiators or radiating surfaces consisting of enclosed spaces in which the steam is condensed by the cooler air of the room on the outside of the surface. Fourth, a system of return pipes through which the water condensed in the radiators is conducted away; and fifth, a receptacle into which this water is drained.

The second and fourth of these requisites may be either wholly or in part embodied in one, as may also the first and fifth. It might be more briefly stated, therefore, that the prime requisites are only the source of steam supply, the radiating surface and a system of piping connecting the first two. But even though the supply and the return pipes be embodied in the same system, it is just as necessary that they be so arranged as to dispose of the water of condensation as that they supply steam to the radiator, which fact should never be lost sight of. The simplest possible heating system therefore is one which would be known as a one-pipe, gravity system, such as is indicated in Figure 1. The steam is generated in the boiler, flows through the pipes to the radiators, the water condensation as it is formed in the radiators draining out along the sides of the pipes and back to the boiler by gravity to be re-evaporated into steam. Such a system as this could be applied only to a very small plant, and one in which the pipes could be made comparatively large size and given a very decided fall toward the boiler from all directions.

The more usual system of piping, and that first employed, is known as the "Two-Pipe System," and is represented in Figure 2. In this each radiator has one pipe for supplying steam, and another to conduct away the water of condensation. The only object in the two-pipe connection is to provide a freer and more positive flow of steam and condensed water, but this is a very important consideration. In a one-pipe system, such as indicated by Figure 1, the water of condensation flows from the radiators back to the boilers against the current of steam, falling through the steam in the vertical pipes, and flowing along the bottom of the horizontal pipes. Such a simple system as this of Figure 1 might be employed, and to considerable extent, if the pipes are of ample size and if also there were no valves on the radiators, so that steam would be turned on to the entire system at all times. In this case there would be a constant and practically uniform flow of water through the pipes, and if these were properly laid out the system might give perfect satisfaction. But it is impracticable to have all the radiators of an entire system turned on at one time, and the difficulty with such a system is made evident the minute steam is turned into a cold radiator. At such times the steam coming in contact with a perfectly cold radiator, a large amount is condensed at once in heating the cold iron and as soon as the pressure becomes adjusted this bulk of water flows out of the radiator connection all at one time and drops down the vertical pipe. When it reaches the horizontal main in the basement it is picked up by the current of steam and carried to other parts of the system, filling up the pipes in places, and as it is relatively much colder than the steam, the latter, in trying to get by it, is suddenly condensed, disturbing the equilibrium of pressure, as we might say, and producing the disagreeable, crackling and pounding noises which are always encountered in poorly constructed heating systems, and which are commonly known under the name of water hammer. This noise, beside being very annoying to the occupants of the building, interferes with the circulation of steam and also produces undue strains in the piping.

The two-pipe system to a certain extent does away with these difficulties, that is, in using the two-pipe connection it is generally easier to avoid the water-hammer and other difficulties incident to imperfect circulation; but unless the pipes are properly proportioned and properly drained, the same difficulties will be encountered. The simple one-pipe system, indicated in Figure 1, is therefore, as before stated, rarely, if ever, used, but there are a number of modifications of it which are used with decided success and in some of the largest installations.

The simplest one-pipe system usually employed is represented in Figure 3. In this the horizontal steam main in the basement is pitched so as to drain away from the boiler and at its extreme end a return pipe is taken off and led back to the boiler entering it below the water line. In this way the flow of steam and

water of condensation is in the same direction in the mains, and any sudden charge of water, such as due to the turning on of a cold radiator, falls down the risers against the current of steam, but in the main it is propelled along in the same direction with the steam current. If the mains are extensive, moreover, they can be drained at several different points. This system is extensively used for residences and buildings of only a few stories in height, but it has also been used in more extensive installations. The Chicago Athletic Club, a building ten stories in height, is heated by exhaust steam with this system of piping with a pressure of not over two pounds in the coldest weather, and with little, if any, difficulty with water hammer. In such a case the risers, as well as the mains, must be of ample size, and the latter must have sufficient pitch and be thoroughly drained. The consideration of these questions as affecting the size of the pipes will be taken up in a subsequent chapter.

The only system of single pipe connection which has been very extensively used in high buildings, such as the modern office building, is that known as the one-pipe overhead system and is indicated diagrammatically in Figure 4. In this system the steam is conducted through a large main supply pipe to the attic of the building, or to the ceiling of the top floor, and from this the mains are taken off and run around the building to supply the risers. The risers are connected in the basement to the return mains. It will be seen that in this system the current of steam and water of condensation is everywhere in the same direction except in the connections to the radiators, and the risers should be sufficient in number so that these connections may be comparatively short. It has the very decided advantage over the ordinary upward supply one-pipe system that the water of condensation that falls down the risers from the radiators does not, when it reaches the horizontal pipe at the bottom, encounter the main current of steam, as the horizontal pipe is only a drain pipe, in which there is practically no steam current, and which is designed solely to dispose of this water.

The principle of the two-pipe system is much the same in all cases, but special adaptations of it are made to meet special conditions. There is, for example, a two-pipe overhead system in which steam mains are in the attic as in the one-pipe over-head, but there is a separate set of return risers which connect into the return mains in the basement. But each supply riser should also be drained into the basement returns. The arrangement has been but very little used.

It must be remembered that in any system there is always a certain amount of water in the supply mains and risers due to the radiation from the pipes themselves. If the pipes are thoroughly covered with a good non-conductor of heat there is but very little water from this cause, but little as it is, the mains must be so run that it will flow to certain points, where it must be drained into the return or into proper receptacles. If the steam pipes are arranged so that water can accumulate at any point, trouble is sure to follow. It is a fundamental principle in steam heating that pipes shall be so graded that water of condensation will tend, by the action of gravity, to flow with the current of steam to certain points, where it can be properly drained off.

The various systems of piping are sometimes more or less combined in the same installation, and when radiators are of very large size they should, if possible, be given both a supply and return connection, as the principle advantage of the double connection lies in the internal circulation which tends toward the more rapid removal of air and water. More will be said on the subject of radiator connections in a subsequent chapter on radiators.

In the above discussion and the accompanying diagrams we have assumed that the water of condensation returns through the return pipes directly to the boiler, there to be re-evaporated into steam by the fire on the grate. This is what is known as the "Gravity System" of steam supply and is self-regulating as to water consumption, except for such small amount of steam and water as may be lost by leaks. It is but one of the many methods of steam supply, though the one now most employed where the plant is used only for heating and there is no steam power.

In the gravity system the water stands in the return pipes and risers at practically the same level as that in the boiler, though in the remote parts of the system it rises above the boiler level by a height equivalent to the pressure required to effect the circulation through the system. For this reason gravity systems should be designed for free circulation, with pipes of ample size, the difference of pressure required between the steam mains and the most extreme point of the returns never exceeding a pound or two per square inch. Gravity systems are therefore generally run at very low pressures, though frequently, in very cold weather, as much as 15 pounds is carried for the sake of the higher temperature of steam. The operation of this system is the same at any pressure. The gravity system is a comparatively recent development, the earliest steam heating systems being generally auxiliary to a steam power plant. In these the steam was taken direct from the boiler supplying the engine and the return water was run through a steam trap into an open tank, from which the water supply was taken for the boilers. This method is still employed in many old plants.

But the greater economy in high pressure steam for engines gradually increased the boiler pressure used for steam power and with this increase in pressure it became difficult to heat a building directly from the same boiler that supplies steam to the engines, as steam heating at high pressure was found unsatisfactory for many reasons, principally on account of the very high temperature of the radiators and the liability to leaks and the increased danger from water hammer. And furthermore, the same searching for greater economy which increased engine pressures called the attention of steam users to the value of the latent heat in exhaust steam for heating purposes.

A brief study of the steam engine shows us that not more than about 12 per cent. of the heat energy put into the engine is developed into mechanical work, and by far the major part of the wasted heat escapes in the latent heat of the exhaust steam. This heat, though it is thus far impossible to transform it into mechanical energy, is readily available for heating purposes, but a generation ago when it was first proposed to use exhaust steam for heating, it involved the then serious question of back pressure on the engines. Heating systems at that time were built to accommodate the high pressure then in use and with what would now be called very small pipes, and putting exhaust steam into such a system required a considerable pressure on the exhaust side of the engine to force steam through the piping and radiators and the water of condensation out through the returns.

The back pressure necessary frequently amounted to ten or fifteen pounds per square inch, and certainly made a decided reduction in the economy of the engine. It at once became a question whether the saving by using exhaust steam exceeded the loss on account of back pressure on the engine. If the back pressure was very high in comparison to the mean pressure in the engine cylinder, there might be difficulties in the practical operation of the engine, but as far as the theoretical consideration of the coal pile goes, it is more economical to use exhaust steam even at a high back pressure.

As heating systems are now designed, one which requires a pressure of 5 pounds to ensure good circulation is defective in design and 2 pounds is more than ought to be required in most cases. A back pressure of this amount on an engine running at 50 pounds mean effective pressure would increase the coal consumption but a fraction of one per cent. while taking the heating power that is available in the exhausts directly from the boiler would increase the coal consumption over 60 per cent.

Another consideration enters, however, into the question of circulation in a steam heating apparatus. Besides merely forcing the steam and water through the radiators and piping, it is necessary to force out the air which accumulates, and to do this the system must carry a pressure somewhat above that of the atmosphere.

Theoretically it would be possible to operate a simple gravity system below the atmospheric pressure if the whole system was perfectly air tight and the air was all boiled out of the water and forced out of the system in the first place. In such a case if the fires were put out and the system allowed to become cold the condensation of steam would leave a perfect vacuum, and on starting up the fire steam could be carried at any pressure below or above the atmospheric, according to the intensity of the fire.

But if it were attempted to run below atmospheric pressure, the slightest leak anywhere in the system would rapidly break the vacuum and allow air to accumulate. It is, however, impossible to make a system theoretically air tight, and further than this, steam invariably contains some air as water will absorb several times its own volume and even in a gravity system, fresh water has to be put in occasionally. Some air is, therefore, an evil that cannot be avoided, and it rapidly accumulates in the radiators or ends of pipes where the flow of steam is slowest. Consequently an air valve is almost a necessity on every radiator, and those which are now almost universally used are automatic, that is, they close as soon as the hot steam comes in contact with them, and open if air accumulates and they become cold. To some extent these automatic air valves enhance the air problem, inasmuch as when the radiator is cold it entirely fills with air at atmospheric pressure. In any case the result of the air problem is that the pressure of steam in the system must be sufficient to force the air out, though for this purpose a fraction of a pound above the atmosphere should suffice, and frequently better results are obtained with such a slight excess than with a greater pressure. A subsequent chapter on radiators will discuss the action of air and position of an air valve.

This brings us to a discussion of the methods by which low pressure exhaust steam is employed for heating. The simplest method and the one usually employed in exhaust steam heating consists in dividing the main exhaust pipe, which receives the exhaust steam from all engines and pumps about the steam plant, into two branches, one leading to the atmosphere, the other being connected to the heating system. On the pipe to the atmosphere is placed a back-pressure valve, the object of which is to automatically maintain a uniform pressure upon the exhaust and upon the heating system, so that the steam may flow into the heating system as fast as it condenses in the radiators. Two forms of back-pressure valves are shown in Figure 5, A and B, the essential feature consisting of a disc that is weighted so that when the pressure on the inlet side exceeds a certain amount, the disc rises and allows sufficient steam to escape to the atmosphere. The water formed by the condensation of steam in the heating system is carried back through the main return pipe to some kind of receiver, and is pumped into the boilers. It is generally made to pass on its way to the boiler through some kind of an exhaust steam "feed water heater." The pump is also usually operated automatically, as will be discussed later.

The feed water heater is an essential in all steam plants and its purpose is to utilize as much as possible of the heat in the exhaust

steam in heating the water fed to the boiler. As, however, not more than 18½ per cent. of the exhaust steam can in any case be required to heat the coldest feed water to the full temperature of the exhaust steam, 212 degrees Fahr., there is always a considerable quantity left, which can be utilized in heating the building, and furthermore as the hot return water is always in one way or another fed back to the boiler, the more steam that is required for the building the more return water there is and the less is needed to heat cold feed water. If the heat in the exhaust steam is not thus used in heating the feed water or heating the building, or both, it would be wasted and its equivalent in coal would have to be used under the boiler to replace it.

There are two distinct classes of exhaust steam feed water heaters; the closed or pressure heaters and the open heaters. In the former the feed water is pumped through the heater against the boiler pressure; the exhaust steam passing into an inlet chamber, and generally through a series of tubes into the outlet chamber, the tubes being set in wrought iron

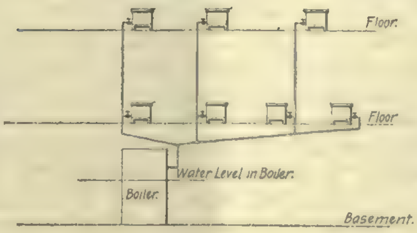


Fig. 1

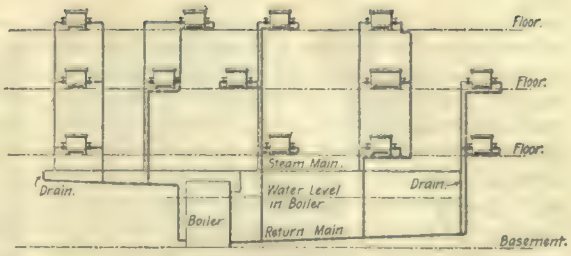


Fig. 2

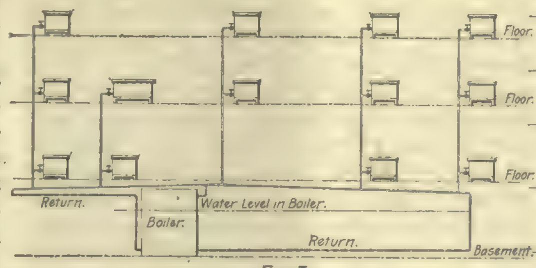


Fig. 3

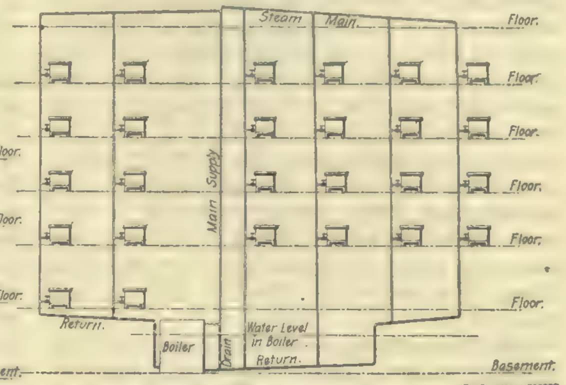


Fig. 4

THE ENGINEERING RECORD.

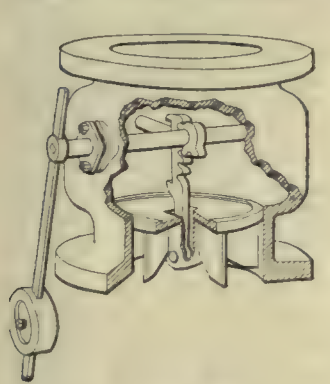


Fig. 5 A

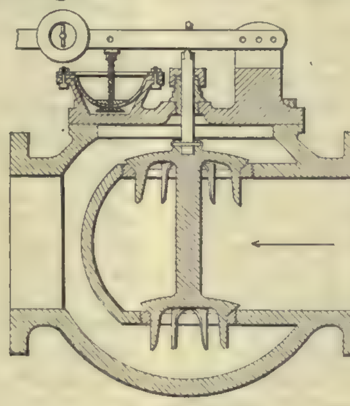


Fig. 5 B

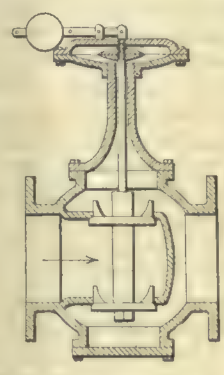


Fig. 5 C

THE ENGINEERING RECORD.

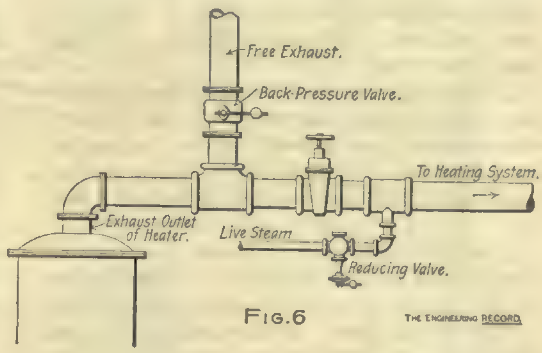


Fig. 6

THE ENGINEERING RECORD.

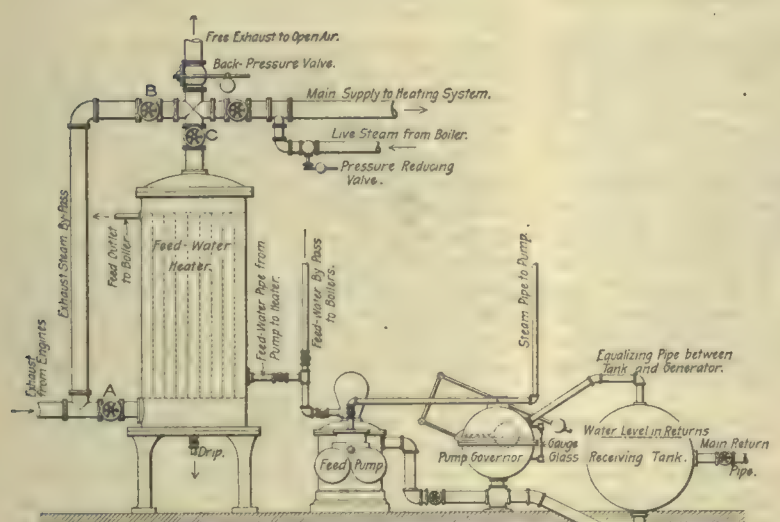


Fig. 7

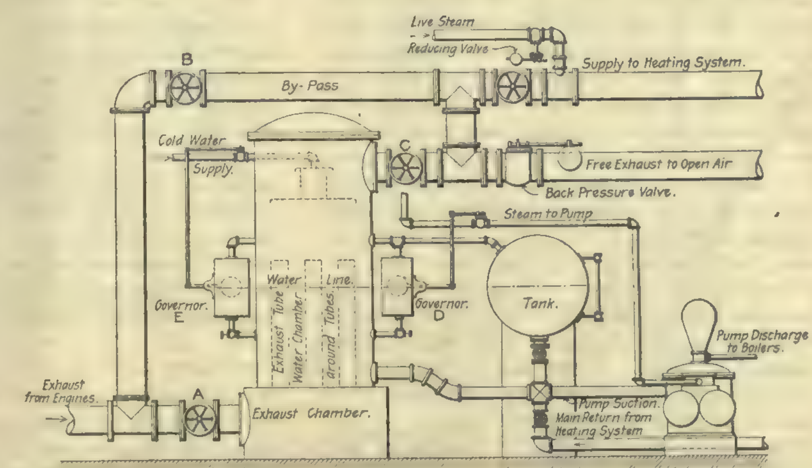


Fig. 8.

THE ENGINEERING RECORD.

plates, which divide the inlet and outlet chambers from the water space around the outside of the tubes. In the open heater the water and steam are practically together in the same chamber, the water flowing in from some source against only the pressure of the exhaust steam. The suction of the feed pump is connected to the heater and the delivery direct to the boilers. With the closed heater cold water is pumped through the heater to the boiler, while with the open heater hot water from the heater is pumped direct to the boiler.

The scheme of steam supply described is represented in Figure 6, and is, with various modifications of detail, almost universally employed in heating systems in which exhaust steam is used. It will be noticed that in the figure the pipe to the heating system is provided with a live steam connection. This is necessary in a great many plants where in extremely cold weather the exhaust steam is not sufficient to heat the building. In modern practice, such a connection is always provided with a reducing-pressure valve. These valves, one of which is represented at Figure 5 C, are of such construction that they can be set for any desired difference between the high and low pressure sides. The reducing valve must always be set for a pressure somewhat lower than that at which the back-pressure valve opens, as otherwise some live steam from the reducing valve might pass through the back pressure valve to the atmosphere and thus be wasted.

Figure 7 shows a connection with a pressure heater which is much employed in steam heating systems. The exhaust steam enters the bottom of the heater and goes out at the top. The connection is also provided with a by pass, so arranged that in case it is necessary to shut out the heater for repairs or cleaning, the valve B in the by pass may be opened and the valves A and C closed, so that the steam will pass around the heater. In ordinary use the valve B in the by pass is closed and A and C opened. The arrangement of the supply to the heating system, which is connected to the outlet of the heater, and the back-pressure valve on the free exhaust, is the same as indicated in Figure 6. The main return pipe is run into a cylindrical receiving tank from which the water is pumped through the heater. Attached to the receiving tank is an automatic pump governor which, by means of a float operating on the steam supply to the pump, regulates the level of water in the receiving tank. As soon as the water in the tank rises above the proper level the pump is started up by the float and when it falls below this level the pump is stopped.

Figure 8 represents an arrangement with an open heater. The steam connection is precisely similar in principle, but a different arrangement of details is indicated, the valves being lettered to correspond with those in Figure 7. The returns are run into a receiving tank similar to the other arrangement, but this tank is connected directly to the heater, and practically forms a part of it. The automatic float which controls the operation of the pump is generally, in such cases, connected directly on to the heater, as indicated in the governor marked D.

In Figure 8, on the left of the heater, is indicated another float governor E, which is frequently attached to heaters of this character. This operates on the cold water supply. In this connection it will be noted that frequently in

moderate weather only a portion of the exhaust steam is needed to heat the building, the remainder escaping through the back pressure valve. In such cases it is necessary to make up the loss of water by taking a certain amount from the city mains, or other source of supply. With the open type of heater this is generally run directly into the heater, and sprayed through the current of exhaust steam. It is for the control of this cold water supply that the governor E is provided. In this case the governor on the cold water supply should be set for a level of water a few inches below the level which operates the feed pump. Otherwise the cold water might be let into the heater while the pump was running, and when it was not needed. The open heater should in all cases be provided with an overflow connected to a low pressure trap. This outlet should be a few inches above the water line, but should be low enough to prevent the possibility of a sudden inflow of return water flooding the exhaust tubes.

With the arrangement shown in Figure 7 the cold water may be supplied by a pipe running direct to the receiving tank, and it may be regulated by hand according to the level of the water, shown by the gauge glass, or by a float governor, similar to the one indicated on the open heater in Figure 8.

In large plants also there are frequently two or more feed pumps, one of which has a suction connected to the cold water supply, or the boilers are provided with injectors. Further details of piping will be discussed in a subsequent chapter.

It will be seen that, in connection with the open heater, the receiving tank is merely a part of the heater, forming an additional reservoir for the return water. It is possible to do away with the tank entirely, connecting the returns direct into the water chamber of the heater, but as the water space of the heater is generally comparatively limited, the water level in such cases is subject to more or less extreme fluctuations, due to the fact that the return water does not always come back with precisely uniform flow. This is especially the case with large office buildings, when the building is being heated in the morning and a number of cold radiators are apt to be turned on at nearly the same time. In the same way it is possible also to do away with the receiving tank represented in Figure 7, but this is subject to the same objection as in the other case, only to a more extreme degree, as the small governor provides scarcely any reservoir volume for the return water and the pump is subject to sudden changes in speed. In the case of Figure 7 the main return pipe is generally connected at the point F and not directly to the tank.

The writer has installed a number of large plants with open heaters and no receiving tanks whatever, which have given perfect satisfaction, and recently also installed a plant having over 16,000 square feet of radiating surface with practically the same arrangement as indicated in Figure 7, but without any receiving tank. This system requires rather careful attention, especially in the early morning, but it was impracticable on account of local conditions to put in a receiving tank, and the system has given thorough satisfaction.

It should be noted here that the system represented in Figure 8 is strictly a gravity system. The heater and tank taking the place of the boiler represented in Figures 1 to 4, and acting both as steam producing chamber and reservoir for return water, both being at this point under precisely the same pressure. The water level in the return pipes and return risers will stand at a higher level than in the heater or boiler in the case of Figures 1 to 4, by a distance representing the difference in pressure required to force the steam through the system, just as in the ordinary gravity system. As a matter of fact, also, it is found that in the system shown in Figure 7 that the pump operates much more smoothly and uniformly if the system is made a gravity system by connecting a small equalizing steam pipe between the main steam supply of the heating system and the top of the receiving tank and governor. If the plant above referred to operates without a tank this was found to be practically a necessity. In any case an equalizing pipe above the water line between the heater and its tank or the heater and the governor is necessary to maintain the same pressure above the water level in the tank as exists elsewhere in the return water reservoirs.

The water line of the heating system sometimes becomes an important consideration, especially when it is desired to place radiators in the basement of a building. If these are placed so low that the return water is liable to rise above the connections the radiators will fill with steam when turned on and will be sure to give trouble from water hammer. Besides this, with anything except the overhead supply systems, the water from the returns will back through the radiator and run down the supply riser, and it is therefore generally necessary to set radiators several feet above the water line, according to the maximum pressure which is necessary to create circulation of steam through the system in coldest weather. If the system is designed for very low pressure, one or two pounds, the radiator may be placed within four feet of the water line, but should never be lower than this, especially in parts of the building far removed from the heater. For this reason basements are usually heated by steam coils set on the ceiling or on the walls near the ceiling; although radiators are sometimes put on brackets set up on the walls; frequently, in order to lower the water line, the pump, governor and heater also, when the open heater is used, are placed in a pit. There are, however, special arrangements of radiator connections which may be used with safety, even though they are set below the water line. These will be discussed in the chapter on radiators.

There are many combined automatic pumps and receivers designed for taking care of the return water, which are very satisfactory, but all work on the same principle of a tank with a float governor to operate the pump. There are also some special automatic traps designed to return the water of condensation from the exhaust steam heating systems direct to a high pressure boiler by means of an ingenious combination of float valves, traps, reservoirs and check valves, and without using a pump, and some of these work with considerable satisfaction if carefully watched and kept in good repair.

In many mills and factories which use condensing engines and in which, consequently, exhaust steam is not readily available for heating, steam for this purpose is taken direct from the boilers through a reducing pressure valve and used at the heating system at a pressure of 5 to 20 pounds per square inch. In such systems the water is generally returned to the boilers by an automatic pump and receiver, or by one of the special styles of traps referred to, which for operating at such pressures can be made much simpler than when used for the extremely low pressure of the ordinary exhaust systems.

As a refinement of exhaust steam heating there has been developed within the last decade what is known as vacuum systems of steam heating, the object of these being to exhaust the air from the system by artificial means so that circulation may be affected at atmospheric pressures with absolutely no back pressure on the exhaust pipes from the engines. There are two distinct forms, one known as the Paul system, the other as the Webster. The former system provides each radiator with an automatic air valve of special construction and connects a very small pipe, usually ¼-inch, to each of these valves, bringing them together in pipes of proper size in the basement of the building, and connecting to a special exhauster, which maintains a constant suction on the entire system of air piping. The steam and return pipes for this system are entirely independent of the air pipe and may be installed on any of the systems previously mentioned.

The Webster system operates on an entirely different principle in that it employs an automatic air and water valve at the return outlet of the radiator. This thermostatic valve, as it is called, is constructed on a principle much like the automatic air valve, but is of larger proportions. It is adjusted so that it closes automatically when it comes in contact with the steam temperature of 212 degrees and opens when water or air collect about it, and the temperature is reduced. The system is necessarily a two-pipe system, the returns being connected to these thermostatic valves, but no other air valves or air piping are used. The return pipes are connected in the basement to a vacuum pump, which puts a strong suction on the returns, and by means of which both air and water are drawn through the thermostatic valves, the water being delivered by the vacuum pump to an open heater or receiving tank, while the air is separated by an automatic device. The return pipes of this system are very small, just sufficient to take care of the water, no steam being allowed to circulate in them. The steam mains, where necessary, are drained into the return pipes through thermostatic valves. The return mains being under suction and having no direct connection with the steam pipes can, to a certain extent, be run independent of the necessity of draining by gravity, in some cases the water being lifted out of radiators placed below the return pipes.

Plants equipped with vacuum systems frequently operate slightly below the atmospheric pressure and besides entirely doing away with back pressure on engines and removing the air from the system, there are many incidental advantages in the operation of plants of this character which will lead to a very extended adoption.

The recent development of vacuum pumps has been of great value to steam heating work. Pumps of this class are now made which will not run away when all the water is pumped out of the suction and the water end of the pump receives only air and steam. They will run along slowly under such conditions, taking care of the water as it comes, and speeding up as it comes fast enough to fill the cylinders. If a pump of this description is connected to the lower point of the main return from a heating system, it can be made to maintain what is now called a dry return. This is in some cases valuable, as it obviates the necessity of considering the water line, as before mentioned, in placing radiators in basements. Vacuum pumps used in this way are especially valuable in cases where return water is to be brought back from a heating plant removed at some distance from the source of steam supply.

(To be continued.)

New York University announces that its school of civil engineering has been reorganized and merged into a school of applied science, which will commence by offering four courses, namely, civil, mechanical, and chemical engineering, and industrial chemistry. The work will go forward for the present in temporary wooden pavilions and such new buildings as have been erected at the university's new site, north of the Berkeley Oval in New York.

The City Engineer of Alexandria, Va., has recently had to discharge the duties of police superintendent as well, a combination of official obligations which is probably unique. The office of city engineer was created about four years ago, when the city contemplated a number of public improvements. As a basis for these works it was decided to have an official map, and the engineer began to collect data for its preparation. His labors as a police officer interfered with the engineering work, however, and the map is still unfinished.

AN OPEN-AIR SWIMMING BATHHOUSE.

A free public swimming bath recently built on Hedge Street, Frankford, by the City of Philadelphia, has been constructed to provide shelter and ample bathing and swimming facilities for a large number of people in the hot weather, when such opportunities are most necessary and popular, and is also arranged so that a portion of it can be readily operated during the winter, and hot and cold shower baths be always made available when the large pool is not. As the requirements did not involve roofing or heating a large building, nor the warming of the water in the swimming pool, the essentials were substantially comprised in the construction and enclosure of the pool and of the little dressing rooms, and in equipping a toilet room and a number of shower baths. To this end a concrete tank was built in a pit and surrounded by a masonry wall parallel to its sides and a few feet beyond them. The space between this wall and the pool was covered by a shed roof and divided into small rooms or closets, and an office, toilet room and vestibule in front completed the structure, which is large enough for about 100 bathers per hour.

The plan of the bath house is shown in Figure 1; the space between the outer lines of the masonry and the sides of the swimming pool are roofed and the pool itself is unroofed and entirely open above like an interior court. Longitudinal and transverse sections of the bath house are given in Figures 2 and 3, respectively, the latter being a view looking towards the rear. The exterior wall is made perfectly plain and without windows, except in front, where it is relieved by a pair of low square flanking towers and is somewhat embellished by decorative treatment in brick and terra-cotta. The entire ground surface inside the outer walls was leveled, rammed and covered with 5 inches of concrete finished with granolithic pavement 1 inch thick throughout. The outer walls are about 10 feet high above grade and support the lower ends of the rafters, which are also carried by wooden posts midway between the wall and the pool, except at the front, where both ends are supported on the walls. The towers are 15 feet square and 18 feet high, with hipped, pyramidal roofs. All the roofs are sheathed with 1-inch hemlock boards 10 inches wide, lined below with tongued and grooved yellow pine, 2½ inches wide, beaded. The hemlock is covered with water-proof felt, on which is laid tin in narrow sheets, with standing locked joints and painted both sides with red lead. The front roof and towers are slated. Around the sides and rear of the building there are 50 dressing closets 3 feet 6 inches by 3 feet 10 inches, made with partitions of ⅞-inch tongued and grooved boards beaded, which are set free of the floor and about 8 inches above it, so as to leave clear ventilation and cleaning space below. Each closet is furnished with a board seat and a number of clothing hooks. Six similar closets and two larger ones in the rear corners are provided with showers and there is a row of six open showers near the entrance.

The details of roofs and closets are shown in Figure 5, which is a cross-section through one of the side walls near the corner and a portion of the end of the building in elevation, thus giving both views of the interior construction and presenting typical details of the whole. It will be noticed that the upper part of the roof cantilevers beyond the vertical posts and is supported by knee braces in both directions, and the eaves overhang as far as the edges of the buttresses. The wall plates are made in two pieces, breaking joints, and are secured by long bolts and anchor plates built into the wall about 6 feet apart. Special foundation is provided for the wooden posts and their bases are extended by large angles bolted on and anchored to the foundation piers under the concrete. All of the floor is laid with a slight pitch towards the swimming pool, except in the shower bath rooms, one of which is shown in Figure 5, where it is depressed and separately drained to the sewer. In constructing the bath house, trenches were dug for the wall footings and an excavation made of the exact size and depth of the outside dimensions of the swimming pool. The ground was rammed and soft places or cavities filled with broken stone; then a course of large flat stones was laid in the bottom of the trenches and the concrete rammed in above it, using form boards where necessary. A 12-inch bed of concrete was thoroughly rammed all over the bottom of the swimming pool, and before it was set a second layer of 6 inches thickness was rammed down on it and leveled. This concrete platform extended 6 inches beyond the outer edges of the walls on all sides and was grooved to receive them by embedding a 6x4-inch timber in the surface when it was laid and afterwards removing it when the concrete was set. The walls were built in forms and are 2½ feet thick at the bottom and 1½ feet at the top. They were built up simultaneously on both sides and their tops finished off even with the concrete floor. For all concrete one barrel of Dyckerhoff cement was mixed dry with two barrels of bar sand and turned twice on a tight platform, then three barrels of wet 1½-inch broken stone and two barrels of wet ¾-inch stone was added, and the whole mass wet and turned three times. The bottom and sides of the pool were finished with 1 inch of a plaster made of 1 part cement and 2 parts white sand. The main walls are of common hard red brick selected for the face and not sheathed or covered inside. The cornice cove on the front and side elevations of the towers is paneled with ornamental designs of carton-pierre work.

The swimming pool is supplied with cold wa-

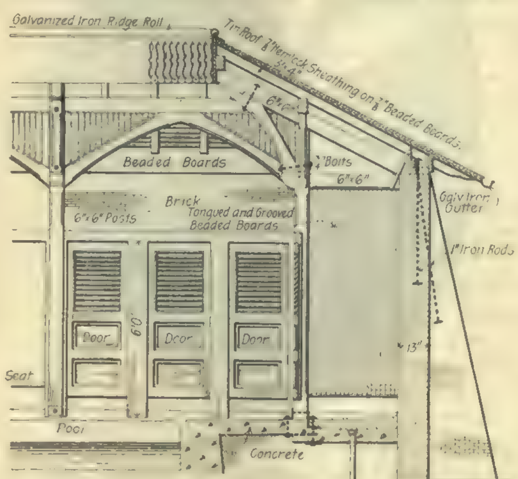


FIG. 5

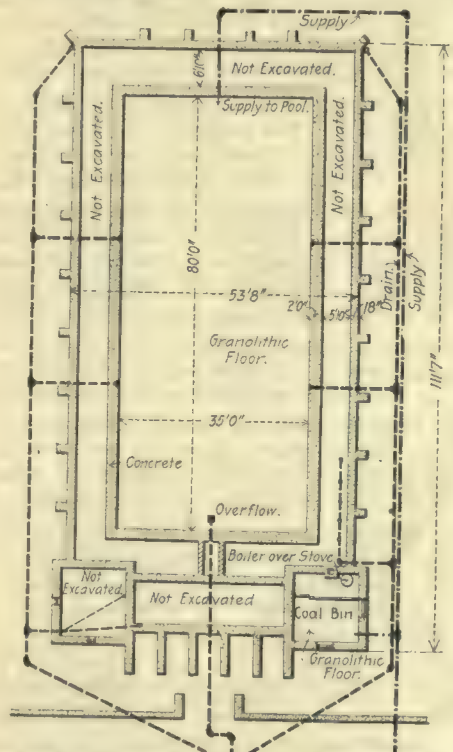


FIG. 6 Foundation Plan.

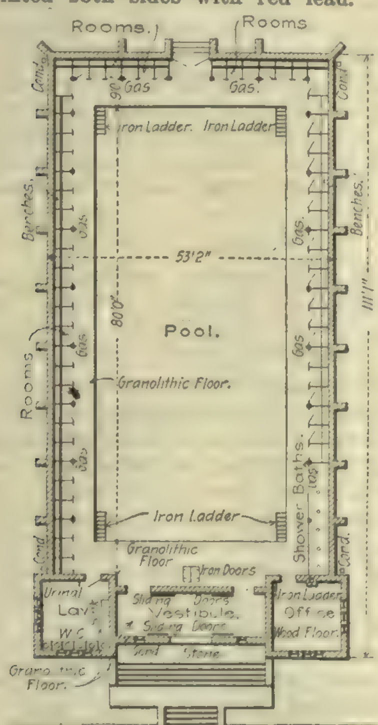


FIG. 1 First Floor Plan

FIG. 2 Longitudinal Section.

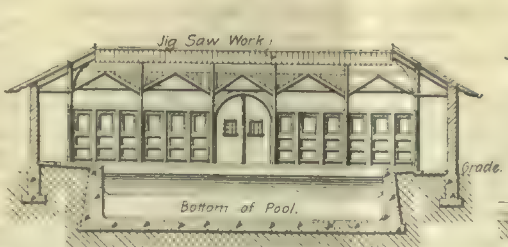


FIG. 3 Cross-Section.

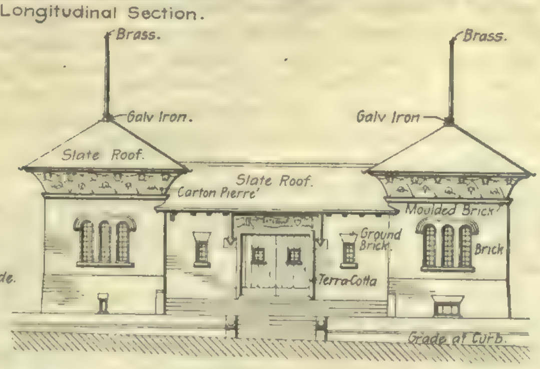


FIG. 4 Front Elevation.

AN OPEN-AIR SWIMMING BATHHOUSE, PHILADELPHIA.

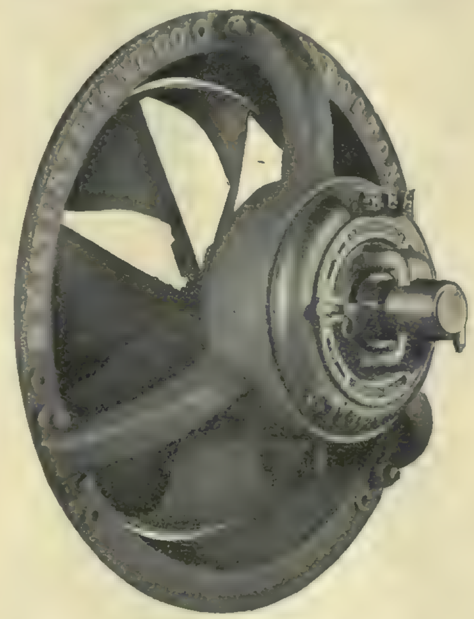
MESSRS. HAZLEHURST & HUCKEL, ARCHITECTS; MR. ALFRED S. EISENHOWER, CHIEF OF BUREAU OF CITY PROPERTY.

ter through a 4-inch pipe from the city main, as shown in Figure 6, which is a horizontal section just below the floor level. The main supply is valved at the curb and the branch to the pool has another valve (not shown in the figure) which is controlled from the office and is usually kept closed, atlhough in order to allow a constant flow into the pool this valve is by-passed by a 1½-inch pipe, which is also commanded by a valve to regulate the flow as closely as may be wished. The inlet to the pool is through a brass grating in the end wall about 6 inches below the water level. There are four overflow outlets in the long sides of the pool. Each of them is provided with a brass strainer plate 6 inches square, set flush with the face of the wall and screwed to a square brass box built into the concrete and having a shoulder screwed to the 4-inch waste pipe. In the bottom of the pool, at the opposite end from the supply inlet, is the emptying outlet. This is a brass strainer plate 12 inches square, with openings aggregating about 50 square inches in area, set flush with the floor of the pool and forming the top of a square brass box bedded in concrete and having a bottom nipple calked into the end of the 8-inch iron waste pipe. The waste pipe is commanded by a gate valve set in a vault close to the pool. Beyond the valve two horizontal 90-degree short bends are introduced into the waste pipe expressly to check the force of discharge. The waste pipe empties into a brick city sewer through a vented running trap, and between this trap and the horizontal bends it receives two 5-inch lines of extra strong glazed terracotta sewers, one of which extends along each outer wall. The branches from these lines to the showers, overflows and rain-water leaders, are of 4-inch extra heavy cast-iron pipe, with accessible deep-seal traps and hand holes at their outlets. From the 4-inch main water supply a 1½-inch branch is carried to the shower baths, and a 1-inch branch to the toilet room and to the hot water apparatus. The water is warmed in a Hitchings heater connected to an adjacent 60-gallon kitchen boiler, and is delivered to a mixing apparatus in the office from which supplies to all the shower baths are run. The six shower supply branches are operated by the bather, but are controlled in the office, where they are each arranged to be independently furnished with cold water or with hot water from the mixing apparatus at the bather's choice. The mixing apparatus can furnish water at any temperature up to a maximum of 120 degrees. All the baths must, of course, be supplied with water of the same temperature at the same time. The showers and their exposed pipes are of polished brass. There is a 6-seat row of water-closets, a slate urinal 7 feet long, and an iron sink serving as a wash tub and as a wash basin in the toilet room. There is a fire valve on the main water pipe, with two lengths of hose and a nozzle.

One attendant does the janitor work and is in charge of the bath house. Ordinarily, admission is through the front door only, and bathers pass the office as they enter and are there supplied with soap and towel, if they wish for it, and are directed to use the shower baths before going to the swimming pool. The bathers are permitted to remain in the swimming bath a period of thirty minutes, and can have either hot or cold shower baths. One day in the week (Thursdays) the bath house is open to women only. It is expected that the swimming bath will be used from May until October, and if the demand justifies it, the shower baths will be enclosed so as to be available for use throughout the cold weather. This bath house was opened for public use in June, 1898, and had been built and equipped for a total cost of about $8,500. Messrs. Hazlehurst & Huckel were the architects and the work was for the Bureau of City Property, Mr. Alfred S. Eisenhower, Chief. The principal contractor was Mr. George Stewart.

THE STURTEVANT ELECTRIC PROPELLER FAN.

Since the B. F. Sturtevant Company of Boston, Mass., entered extensively upon the manufacture of electric motors and generating sets, it has been carefully studying the problem of the manufacture of a compact, efficient and convenient type of electric ventilating fan. Exhaustive tests were made with different types of fan wheels. The result is shown in the accompanying engraving. The fan wheel has eight blades, rigidly attached to a spider at the center, and held in place by a hoop at the periphery, at an angle of approximately 30 degrees. The angle is increased in such a manner that as the center is approached the theoretical velocity of the air remains practically constant. The delivery edge is helical, and the air is picked up on the inlet edge of the blades at low velocity. When well under the influence of the blades it is accelerated to its maximum velocity with the least amount of slip. The result is an extremely efficient wheel. The motor likewise has been the result of very careful study in the attempt to provide a light machine, entirely enclosed, and at the same time to avoid the excessive temperature which is incident to the operation of most enclosed motors. The result is a machine capable of continuous operation for 10 hours, with a maximum temperature rise not exceeding 30 degrees Fahrenheit. A



practical efficiency of over 80 per cent. is obtained even with the small-size motors, and an excess load of 75 per cent. above the rated capacity may be carried without sparking or change of brushes. This feature, combined with the small temperature rise, allows carrying temporary overloads with impunity. The bearings are self-oiling and self-aligning, and are fitted with phosphor bronze sleeves, which are removable from the outer ends of the boxes. The wheel is partially enclosed within a conoidal inlet ring, which decreases the frictional resistance to the entering air, and furnishes at the same time a rigid support for the motor, to which it is attached by the tripod hanger. These fans are built in sizes from 18 to 120 inches, with motors designed for either medium or maximum speed, and to run at any ordinary direct-current voltage. A speed controller is provided, by means of which the fan can be efficiently operated at different speeds.

TRADE PUBLICATIONS.

The Goshen Manufacturing Company, Canton, Ohio, is distributing a pamphlet containing a number of illustrations of bridges and buildings on which its paints have been used.

The Reeves Pulley Company, Columbus, Ind., has issued a finely illustrated descriptive catalogue of the variable-speed countershaft, which it has recently placed on the market. The purposes and construction of the apparatus are explained in detail in this pamphlet.

The Union Hydraulic Works, Van Horn and Sophia Streets, Philadelphia, Pa., have prepared a pamphlet describing the line of valves, pressure regulators, hydrants and specialties made at their plant, which has been in operation at the present location since 1837. The pamphlet describes a number of specialties in addition to the usual line of supplies, and will be of use to all engineers who have to design water-works and similar plants.

The Ingersoll-Sergeant Drill Company, New York, has added still another booklet to its series of trade publications. This it designates by the large but indefinite title of Number 25,000, which signifies that the company has completed 25,000 rock drills. The contents of the brochure give some idea of what such an output signifies. For instance, it represents some 22½ million pounds of metal and a drilling capacity of a mile of hole in about 1 2/3 minutes.

The Michigan Brass & Iron Works, Detroit, Mich., have published a new catalogue in which is shown a full line of gate valves for steam, designed for the lightest pressures up to 250 pounds. The works of the company have been recently equipped with new machinery and plant, which enable them to make valves up to 76 inches in size, in addition to those formerly turned out. The new catalogue gives detailed information concerning these new goods and also the hydrants, boxes and other supplies which are made at the works.

The Watson-Stillman Company, 204-210 East Forty-third Street, New York, is one of the firms which issues its catalogue in the form of loose sheets, one for each tool. In order that the wide range of machinery and tools made by the company may be understood, it also publishes what it calls an illustrated index, a cloth-bound book of about 50 pages, showing briefly the types of machines which are described more completely in the loose sheets. The index is useful to engineers engaged in both civil and mechanical work, for the company's products include apparatus used for a great variety of purposes.

The manual of surveying instruments and their use and adjustment, which was issued from time to time by the firm of Buff & Berger, Boston, has been revised by its successor, Messrs. C. L. Berger & Sons. The latest edition contains new sections on mining transits and new leveling instruments, which have already been mentioned in these columns. The book retains all those features which made it such a favorite with engineers in the past, and the additions make it still more valuable both in the class room and in the library of the practicing surveyor. It is sold at 60 cents, and may be obtained by addressing the firm at 9 Province Court, Boston.

The Report of the Pittsburg Filtration Commission, which was reviewed at length in these columns on February 11, has been printed in a book of 400 pages by the city. The report is accompanied by the full text of the report of Prof. W. T. Sedgwick on the sources of typhoid fever in Pittsburg, that of Mr. Allen Hazen, that of Mr. Emil Kuichling on the gravity water supply from Indian Creek, that of Mr. Morris Knowles on the operation of the experimental laboratory of the commission, that of Dr. Walther Riddle on the chemical work of the laboratory, that of Dr. Eugene Wasdin on a bacteriological investigation of 15 samples of Pittsburg city water, that of Mr. W. R. Copeland on bacteriological investigations and that of Mr. A. B. Shepherd on a driven well supply for the city. The volume is illustrated by 21 plates, and is one of the most important contributions to the literature of water supply printed in recent years.

PERSONAL AND OBITUARY NOTES.

Mr. Chas. J. Laux has been elected city clerk of Guthrie, Okla.

Mr. George Killian has been elected city clerk of Florence, Col.

Mr. John F. Hahn has been elected city clerk of Evanston, Ill.

Mr. John W. Miller has been appointed city engineer of Sandusky, O.

Mr. W. H. Barnes has been re-appointed city engineer of Topeka, Kan.

Mr. C. W. Nutter has been re-elected city engineer of Wausau, Wis.

Mr. Henry E. Norris has been elected city clerk for New Haven, Conn.

Mr. Howard H. Burgess has been re-elected city clerk of Cleveland, O.

Mr. F. L. Niederheiser has been appointed city engineer of Ashland, O.

Mr. D. J. Aber has been appointed city engineer of Las Vegas, New Mexico.

Mr. C. B. Myles has been appointed street commissioner of Colorado City, Col.

Mr. John Brown has been appointed street commissioner of Jamestown, N. Y.

Mr. William Jones has been elected president of the Toledo, O., water works board.

Mr. Edward Cowley has been appointed superintendent of streets for Cleveland, Ohio.

Mr. Harvey Cockell has been appointed superintendent of water works, Columbus, O.

Mr. Walter A. Doane, M. Am. Soc. C. E., has been re-elected city engineer of Meadville Pa.

Mr. H. C. Thompson of Sault Ste. Marie, Mich., has been elected city engineer of Lansing, Mich.

Mr. Frank E. Davidson has resigned the office of superintendent of the bureau of sewers, Chicago, Ill.

Major William H. Bixby, Corps of Engineers, U. S. A., has been relieved at the Cincinnati office by Captain Harry F. Hodges.

Mr. A. M. Welles of Denver, Col., designer of the Castlewood dam, recently described in these columns, has returned from a trip to Honolulu.

Mr. James I. Beatty has been appointed city clerk of Marion, O., for a term of two years, and Mr. J. W. Scott city engineer for a term of one year.

Mr. Frank Monahan has been appointed president of the board of public works, and Mr. George Randall has been elected city surveyor, Oshkosh, Wis.

Mr. George Pike has been elected city engineer of Kalamazoo, Mich; Mr. William Fry, street commissioner, and Mr. W. F. Reed, superintendent of water-works.

Mr. Joan B. C. Zeile, who for a number of years has been a prominent Colorado engineer in Denver, died April 11 of quick consumption. He was born in Holland in 1863.

The following appointments have been made in La Junta, Col.: Mr. G. S. Thompson, clerk; Mr. James King, street commissioner, and Mr. L. C. Gillen, water commissioner.

Mr. Charles J. Poetsch, M. Am. Soc. C. E., has been appointed city engineer of Milwaukee, succeeding Mr. George H. Benzenberg, to whom he had served as assistant for many years.

Mr. Singleton King has been appointed assistant city engineer of Youngstown, O. He has been employed as a member of the engineering corps of the Erie Railroad Co. for the past four years.

Mr. Charles H. Wright, M. Am. Soc. C. E., has resigned his position with the Edge Moor Bridge Company to become chief engineer of the Brown Hoisting & Conveying Machine Company, Cleveland, O.

Mr. W. V. Ingham has been re-elected city engineer of Wilkes-Barre, Pa. About 22 years ago he was appointed street commissioner of the city and two years later became city engineer, holding the office ever since.

Mr. George B. Preston, M. Am. Soc. M. E., has been appointed inspector of boilers in New York State. For a number of years past Mr. Preston has been an instructor in the department of experimental engineering, Sibley College, Cornell University.

Mr. C. H. Swan, M. Am. Soc. C. E., died at his home in Roxbury, Mass., April 17. Mr. Swan was born in Boston in 1842, was educated in the Boston schools and graduated from the Lawrence Scientific School at Cambridge. He was assistant to the city engineer of Providence for many years, and accompanied him to Europe in 1884 to investigate European sewerage works, writing a large part of the report thereon. He was associated with Mr. Rudolph Hering on the Chicago sewerage. In recent years his work has been chiefly in and around Boston, his last work being under the Metropolitan Sewerage Commission.

Mr. Edmund B. Weston, M. Am. Soc. C. E., assistant engineer in charge of the Providence, R. I., water-works, has tendered his resignation, to take effect May 1. He has been with the engineering department of the city since 1878, and, in addition to the management of the water department, has had charge of the meteorological bureau. His work in these lines has been frequently described in these columns, and his papers on the flow of water and kindred subjects have had a cordial reception abroad as well as in the United States. He is a member of the Institute of Civil Engineers and a Fellow of the Imperial Institute of the United Kingdom, the Colonies and India.

Captain Alfred E. Hunt, Battery B, National Guard of Pennsylvania, died in Philadelphia, April 26, on his way to Atlantic City, where he was going at the advice of his physicians. He was first taken ill while his battery was encamped at Chickamauga Park, and though he never fully recovered, he remained with his command until it was mustered out, going with it to Porto Rico when he was far from well He was born 44 years ago at Douglas, Mass., and was graduated from the Massachusetts Institute of Technology in 1876. He served on surveys of the boundary line between the United States and British Columbia, and afterward engaged in mining. He then returned to the East and was largely interested in the development of the open-hearth steel process. Subsequently he went to Park Brothers in Pittsburg, where he was closely allied to the steel business. At the time of his death he was vice-chairman of the Pittsburg Testing Laboratory, which he organized in 1882; president of the Pittsburg Reduction Company, president of the Georgia Bauxite & Mining Company, and prominently connected with many others. From his early manhood he was associated with various military organizations. He rose by promotions to the captaincy of the Ninth Massachusetts Volunteer Infantry, later became captain in a regiment of the New Hampshire National Guard and in 1884 joined Battery B, National Guard of Pennsylvania.

The Pneumatic Dome, illustrated in the preceding issue of "The Engineering Record" as a device for preventing the bursting of pipes by water hammer, is primarily intended to keep them from breaking when the water in them freezes. The Pneumatic Dome Manufacturing Company, 502 E Street, Washington, D. C., says that the air in the domes is compressed when the water changes to the solid state, allowing the expansion of the fluid to occur without injury to the pipes. An automatic air-inspirator is permanently placed in the basement of a protected building, which supplies air to the domes every time a spigot is opened or closed, the air being carried along the pipe by the flowing water, and caught wherever there is a dome.

CONTRACTING NEWS

OF SPECIAL INTEREST TO

CONTRACTORS, BUILDERS, ENGINEERS, AND MANUFACTURERS

OF ENGINEERING AND BUILDING SUPPLIES.

For Proposals see pages xi, xii and 512.

WATER.

Arnprior, Ont.—It is stated that a by-law to raise $70,000 for water-works and sewerage will shortly be submitted to the people.

Houghton, Mich.—The House has passed a bill authorizing the issue of $60,000 bonds for water-works and street improvements.

Takoma Park, D. C.—A special committee on water-works is investigating as to the most feasible source of supply.

Murphysboro, Ill.—It is stated that the Murphysboro Water-Works and Electric Co. will rebuild the stand pipe destroyed in January.

Danbury, Ia.—It is stated that it has been voted to issue water bonds.

Milwaukee, Wis.—Local press reports state that the contract for furnishing and laying water mains during 1899 has been awarded to Charles Forrestal of Milwaukee at 17 7/10 cts. per lin. ft. for 6-in., 24 cts. for 8-in. and 35 cts. for 12-in. pipe.

Havre de Grace, Md.—The Point Concord Water Co. of Harford County has been incorporated with a capital of $12,000. The directors are: Lawrence B. McCabe of Baltimore County, Dr. D. W. Hopkins of Havre de Grace, James P. Gorter and H. Arthur Stump of Baltimore city.

Spearfish, S. D.—Press reports state that it has been voted to issue $10,000 water bonds.

Deadwood, S. D.—It is stated that it has been voted to issue $50,000 water-works bonds.

Thompson, Ia.—The town has voted to establish water-works at a cost of $3,500.

Howard, S. D.—It is stated that a new water-works system is to be built.

Toledo, O.—Superintendent Cook of the Water-Works has been authorized to prepare plans and estimates for 3,000 ft. of pipe line from Pontiac St. to Bay View Park.

Grayville, Ill.—At the recent election it was voted to purchase the water and electric light plant for a sum not to exceed $26,500.

Heber City, Utah.—Articles of incorporation have been filed by the North Field Irrigation Co., reorganized. The capital stock is $40,000. John Carlile, Pres.; Robert Duke, Vice-Pres.; James H. Moulton, Treas. and Sec.

Philadelphia, Pa.—The Common Council has concurred in the resolution passed by the Select Council authorizing the Mayor to appoint three experts to make recommendations regarding the improvement and extension of the water supply.

Ludington, Mich.—A bill has passed the Senate authorizing the issue of $115,000 bonds for water-works.

Tinleypark, Ill.—Wm. Funk, Village Clk., writes that the contract for constructing a system of water-works has been awarded to the Chicago Bridge & Iron Co. of Chicago for $3,041.

Summit, N. J.—The Essex-Union Water and Light Co. has filed articles of incorporation with a capital of $500,000. The incorporators are: Carroll P. Bassett of Summit, Fred R. Drake of Easton, Pa., Frederick Green of Summit.

Newport, Ky.—The contract for a new set of boilers at the pumping station has been awarded to Sterling Co. of Chicago for $3,750.

Traverse City, Mich.—The City Council has voted to establish a system of water-wroks.

Des Moines, Ia.—The Des Moines Water Co. is stated to be considering improvements to its system, to cost $15,000.

Starbuck, Minn.—It is stated that plans will be prepared at once for the water system to be installed.

St. Charles, Mo.—H. C. Sandforth, City Clk., writes that the proposition to grant the local water company a new contract for a term of 20 years was defeated at the election held April 15. A new proposition will probably be submitted in the near future.

Nyack, N. Y.—G. N. Houston, Engr. of Water Commrs., writes that an election will be held May 1 to vote on the issue of $35.000 bonds for completing the filter beds and the High Service Reservoir.

Milford, Ind.—The contract for the new water and electric light plant has been awarded to the Olds Construction Co. of Ft. Wayne, for $17,500.

Glouster, O.—Bids are wanted May 6 for a system of water-works, including 20,925 ft. of 3 to 8-in. cast-iron pipe, hydrants, etc. D. Antle, Village Clk.

Saint James, Minn.—Bids are wanted May 8 for constructing a deep well, as advertised in "The Engineering Record."

Washington, D. C.—Bids are wanted May 27 for furnishing water valves, 2 cast-iron intake towers and 27 cast-iron specials, as advertised in "The Engineering Record."

Cullman, Ala.—Bids are wanted May 22 (change of oate) for the construction of water-works and an electric light plant, as advertised in "The Engineering Record."

Cape Vincent, N. Y.—An appropriation of $3,000 has been voted for an additional boiler and pump for the water-works.

Willimantic, Conn.—Bids are wanted May 8 for power pumping machinery for the water-works, as advertised in "The Engineering Record."

Mt. Clemens, Mich.—Press reports state that plans are being prepared for the new water supply, which it is proposed to obtain from Lake St. Clair. It is stated that 2½ miles of mains will be laid and a pumping station built.

White Plains, N. Y.—Bids are wanted May 12 for a masonry dam and gate house, vertical wall, spillway, filtering well, etc. John M. Digney, Pres. Bd. Water Commrs.

Belgrade, Minn.—Bids are wanted May 5 for a system of water-works and electric lights. F. W. Lenz, Village Recorder.

Ute, Ia.—Bids are wanted May 1 for a system of water-works. O. E. Lathrop, Clk. City Council.

Pine Island, Minn.—It is stated that A. M. Patiz of Milwaukee is preparing plans for a water system.

Boston, Mass.—Bids are wanted May 11 for constructing filter beds near Marlborough Junction, as advertised in "The Engineering Record."

Boston, Mass.—Bids are wanted May 17 for excavating soil from a part of Section 5 of the Wachusett Reservoir, and for excavating and refilling at the westerly portion of the North Dike, at Clinton. The main contract for excavating soil from the Wachusett Reservoir will be let on June 5, or soon afterward, as advertised in "The Engineering Record."

Yonkers, N. Y.—Bids are wanted May 13 for rebuilding boiler settings, etc., at the low service pumping station. John C. Shotts, Pres. Bd. Water Commrs.

Chicago, Ill.—Bids are wanted May 16 for 6 boilers and coal conveying plant for Chicago Ave. pumping station. L. E. McGann, Commr. Pub. Wks.

Washington, D. C.—Bids are wanted May 17 for a water system at the Oteo sub-agency. W. A. Jones, Commr. Indian Affairs, Dept. of the Interior.

Princeton, Minn.—Bids are wanted May 13 for $6,000 water and electric light bonds. J. W. Hartman, Village Recorder.

Peekskill, N. Y.—The Governor has signed the bill authorizing the issue of $10,000 bonds for improving the water system.

Santa Rosa, Cal.—It is stated that $80,000 water and light bonds have been sold.

Auburn, N. Y.—According to local press reports the Water Board has decided to lay 3½ miles of water mains during the coming year.

Winnipeg, Man.—It has been recommended to the Council that 5 130 h. p. boilers be ordered in place of 4 of the 160 h. p. boilers; cost, $18,691.

Union, Me.—Fred A. Allen, Secy. Warren Water Co., writes that it has ben voted to contract with R. D. Wood & Co., of Philadelphia, Pa., for pipe, pig lead and hydrants.

Perris, Cal.—The Val Verde Water Co. has been organized by the residents in the north end of Perris Valley for the purpose of pumping water for irrigation. Capital stock, $50,000.

Duquoin, Ill.—Articles of incorporation have been filed by the Duquoin Water Works Co., with a capital of $58,500. The incorporators are: Henry A. Keith, Jas. H. Thompson and Henry J. Bauich.

Milwaukee, Wis.—Bids are wanted May 2 for 75 fire hydrants. John R. Wolf, Compt.

New Whatcom, Wash.—Albert Clark, Supt. of Water Works, writes that nothing definite has been done, except to make a survey and locate pipe line, for the water works extension; estimated cost $43,000. A. R. Campbell of New Whatcom is the Engineer in charge.

Sterling, Neb.—Press reports state that plans and estimates are wanted for the construction of a system of water works and a lighting plant.

Dexter, N. Y.—A. R. Shannon of Watertown is reported to have estimated the cost of the proposed system of water works at about $15,000.

Lakeport, Cal.—Water works bonds to the amount of $15,400 have been sold.

Cincinnati, O.—Bids are wanted May 26 for the grading, masonry, drains, macadamizing and revetment of slopes, of a part of the Columbia and New Richmond turnpike, of the Little Miami River bank and of the railroad branch, on the water works grounds, near California. Aug. Herrmann, Pres. Bd. Trustees Commrs. of Water Wks.

Titusville, Pa.—Local press reports state that the following bids were received for a pumping engine: Holly Manufacturing Co., Lockport, N. Y., $19,400; $900.10 additional for condenser. Barr Pumping Engine Co., Germantown Junction, Philadelphia, Pa., $17,772; $475.01 additional for condenser. Henry R. Worthington, New York City, $24,750 and $14,750. Geo. F. Blake Manufacturing Co., Boston, Mass., $19,440, or $18,400 with independent condenser. Snow Steam Pump Wks., Buffalo, N. Y., $21,848 with $702 additional for surface condenser; and $14,300.

SEWERAGE AND SEWAGE DISPOSAL

Denver, Colo.—Plans and estimates for storm sewers in sub-districts Nos. 18, 21 and 22 of the Capitol Hill Storm Sewer district No. 1 have been adopted, and ordinances authorizing the work have been asked for.

The O'Rourke Construction Co. will begin work at once under its contract for the construction of 12¼ miles of storm sewer mains for the Capitol Hill Storm Sewer District No. 1, contract price $310,000.

Arnprior, Ont.—See "Water."

Cedar Rapids, Ia.—City Engineer G. H. Merridith has been ordered to prepare plans and specifications for sanitary sewers on the west side, between C and D Aves.

Evansville, Ind.—Bids are wanted May 13 for a sewer in Pennsylvania St. Geo. W. Swearingen, Clk. Bd. Pub. Wks.

St. Paul, Minn.—Bids are wanted May 1 for sewers in several streets. C. H. Bronson, Clk. Bd. Pub. Wks.

Jersey City, N. J.—Bids are wanted May 2 for an 18-in. vitrified pipe sewer in Stevens Ave. Geo. T. Bouton, Clk. Bd. St. & Water Commrs.

Philadelphia, Pa.—Bids are wanted May 3 for branch sewers, reconstructing and improving old sewers; also Pennsylvania Ave. subway and tunnel. Wm. C. Haddock, Dir. Dept. Pub. Wks.

Dayton, O.—Bids are wanted May 8 for sanitary lateral sewers on Grafton and Rockwood Aves. P. E. Gilbert, Pres. Bd. City Affairs.

Lebanon, Pa.—The Select Council has passed a bill providing that an engineer be employed to prepare plans for sewerage.

Fargo, N. D.—Press reports state that the Council has ordered bids advertised for a 36-in. brick sewer about 1 mile in length.

New Orleans, La.—It is stated that bids are wanted July 5 for additional work on pumping stations and drainage canals; estimated cost, about $50,000. F. G. Freret, Secy. Drainage Com.

Sheridan, Pa.—Ordinances are being enacted and plans prepared for the construction of a complete sewer system.

Worcester, Mass.—Bids are wanted May 15 for furnishing the following supplies for the Sewer Department for one year: 50,000 ft. vitrified pipe with fittings, 35,000 ft. cement pipe with fittings, 10,000 bbls. Portland cement, 4,000 bbls. Rosendale cement, 2,250,000 bricks, sand, catch basin stone, etc. Harrison P. Eddy, Supt. of Sewers.

Cincinnati, O.—Local press reports state that the contract for constructing Bates and Stock Aves. sewer has been transferred from P. N. Jonte to Strack & Co., the price being the same, $72,459.

Indianapolis, Ind.—Bids are wanted May 3 for a sewer in Hillside Ave., also for improving Market Place. M. A. Downing, Chmn. Bd. Pub. Wks.

South Bend, Ind.—Bids are wanted May 8 for a 15-in. vitrified salt glazed sewer and a 10-in. pipe sewer. L. A. Hull, City Clk.

Cambridge, O.—Bids are wanted May 19 for extending the sanitary and storm sewerage systems, as advertised in "The Engineering Record."

Cedar Rapids, Ia.—Bids are wanted May 5 for a vitrified brick and concrete sewer in "E" St. R. N. Buck, Chmn. Pub. Improvement Com.

Milwaukee, Wis.—Bids are wanted May 2 for sewer work in the West and Bay View Sewerage Districts. Charles J. Poetsch, Chmn. Commrs. Pub. Wks.

Lead, S. D.—Bids are wanted May 15 for a main sewer, including a tunnel of about 600 ft. Mason Tyler, City Aud.

Cooperstown, N. Y.—Bids are wanted May 1 for a sewer in Leatherstocking St. Geo. N. Smith, Clk. Bd. Trustees.

Buffalo, N. Y.—Bids are wanted May 5 for 10 to 18-in. tile sewers, also for paving Macinaw St. R. G. Parsons, Secy. Bd. Pub. Wks.

Salisbury, N. C.—The North Inniss Sewer Co. has been incorporated with the following incorporators: I. M. McCulloch, P. M. Brown, A. H. Boyden and others. The capital stock is $1,980.

Elizabeth, N. J.—It is stated that bids are wanted May 15 for 1,600 ft. of 6 to 12-in. pipe sewers, manholes, etc.; also for 1,080 sq. yds. Telford and block paving. N. K. Thompson, St. Commr.

Chattanooga, Tenn.—City Engineer Hooke estimates the cost of Washington St. sewer at $8,000.

Greensburg, Ind.—The Committee on Sewerage, composed of Mayor Andrew Willoughby, City Attorney Horace C. Skillman and City Engineer J. W. Craig, recommends that a competent engineer be employed to make plat plan and specification of the town for a sewerage system.

Charlottetown, P. E. I.—It is stated that bids are wanted May 6 for a sewerage system. Henry Smith, Chmn. Commrs.

Topeka, Kan.—City Engineer Barnes has completed plans for the North Topeka sewer to be known as "District 13."

Saratoga Springs, N. Y.—The Governor has signed the bill providing for the disposal of sewage.

Rochester, N. Y.—Assistant City Engineer Raymond is making a survey of the territory at the outlet of the East Side sewer for the purpose of aiding the authorities in settling the question of the disposal of sewage from territory drained by this trunk sewer.

East Cleveland, O.—Press reports state that the Council has contracted with the City Wastes Disposal Co., of New York City, for a sewage disposal system.

Quincy, Ill.—The Council has passed an ordinance for the sewering and paving of Third, York and Kentucky Sts. Estimated cost, $30,000.

Camden, N. J.—Articles of incorporation have been filed in the Camden County Clerk's office by the Sherman Sewerage Co., with a capital stock of $475,000. The objects of the corporation are to construct and contract for sewer systems. The incorporators are S. Percy Edmund, Charles F. Walker and Richard F. Loper.

Syracuse, N. Y.—Bids are wanted May 1 for 12, 15 and 24-in. pipe sewers in 3 streets. M. Z. Haven, City Clk.

Norristown, Pa.—Bids are wanted May 18 for 8-in. salt glazed fire clay pipe sewer in Stanbridge St. John Shanks, Chmn. Sewer Com.

Massillon, O.—Local press reports state that plans have been completed for 4,500 ft. of sanitary sewer in West Tremont St.

Niagara Falls, N. Y.—Bonds to the amount of $15,000 have been authorized for the construction of 6 sewers.

St. Paul, Minn.—C. H. Bronson, Clk. of the Bd. of Pub. Wks., writes that the following bids were received for a sewer on Cherokee and Smith Aves.: Anderson & Johnson, *$13,683; Patrick Doherty, St. Paul, $15,652; P. J. Ryan, $17,000; John Lind, $17,000.

*Contract awarded.

Dayton, O.—The County Commissioners have adopted the plans of Surveyor Kline for a sewerage and filtering system at the County Infirmary. The estimated cost of the improvement is $5,500. Bids will at once be invited.

Bayonne, N. J.—Local press reports state that the following bids were received for the construction of a trunk sewer through the Centreville section of Bayonne: Timothy Burke *$51,788; James Forquer, $63,755; Martin Murray, $65,676; M. T. Connolly, $65,708.50; James J. Cogan, $67,562.50; Patrick Costello, $49,394.
*Contract awarded.

Birmingham, Ala.—Julian Kendrick, City Engr., writes that contracts have been awarded to C. M. Burkhalter & Co. of Birmingham as follows: For storm sewer, amount, $3,892.75; and for sanitary sewer, amount, $4,350.75. The work includes 18,000 ft. of 8 to 18-in. pipe sewer, 34 manholes, 38 inlets and 2 flush tanks; also 260 ft. of 36-in. and 660 ft. of 30-in. brick sewers.

Taunton, Mass.—George A. King, City Engr., writes that the contract for constructing 6,600 ft. of sewers with 26 manholes, has been awarded to Dean & Magee, of Taunton, at the following prices: *a*, indicates the 8 to 10-inch sewers; *b*, indicates the 24-in. sewers: Excavating to a depth of 8 ft., *a*, 60 cts.; *b*, $1.35; excavating from 8 to 14 ft., *a*, $1.20; *b*, $2.70; excavating 14 to 20 ft., *a*, $1.50; *b*, $3.25; rock excavation, *a* and *b*. both $5.50 and $6.00; brick masonry, brick and cement furnished, *a* and *b*. both $6.50; concrete masonry, cement furnished, *a* and *b*, both $4.75; undredrain, laying and gravel, *a*, 40 cts.; *b*, $1; laying sewer pipe, *a*, 15 cts.; *b*, 25 cts.

BRIDGES.

Cohoes, N. Y.—Press reports state that a bill has passed the Assembly appropriating $5,000 for the construction of a bridge at Ontario St.

Pawtucket, R. I.—The Groton Manufacturing Co., Groton, N. Y., is stated to have received the contract for building an addition to Main St. bridge for $11,630.

Atlanta, Ga.—The Council has adopted a resolution requiring the Southern Railway to build a bridge over its tracks, near the Whitehall crossing, to replace present structure.

Cleveland, O.—Local press reports state that the following bids for the superstructure of Center St. bridge were opened April 7: King Bridge Co., Cleveland, $45,977.50; J. H. Webster, $46,960; Youngstown Bridge Co., Youngstown, O., $49,190.10; Wm. J. Carter, $50,794.

Painesville, O.—Press reports state that the proposition to issue bridge bonds has carried.

McConnelsville, O.—Press reports state that $10,000 bonds have been voted to build a bridge across the Muskingum River. Geo. Birch, Clk.

Preston, Minn.—Press reports state that the County Board will build 2 iron bridges in Amherst township.

Schwenkville, Pa.—Press reports state that the construction of a bridge over the Perkiomen Creek, connecting Skippack and Perkiomen townships, to cost about $6,500, is under consideration.

Phoenixville, Pa.—Local press reports state that the construction of a bridge across Pigeon Creek is contemplated.

Troy, N. Y.—A bill has passed the Assembly giving the Albany Railway permission to build a bridge across the Hudson River between Troy and Watervliet.

Washington, D. C.—Plans are being prepared for the construction of the Memorial bridge across the Potomac from the Naval Observatory to the Arlington reservation. Appropriation, $5,000.

Kansas City, Mo.—Local press reports state that plans have been prepared by the Brooklyn Avenue Street Car Co. for a steel bridge across Agnes Ave., to replace the present wooden structure.

Flushing, L. I., N. Y.—Plans have been drawn for a bridge over the creek at Ireland Mills.

Charlottetown, P. E. I.—Press reports state that it is contemplated to construct a bridge for railway and vehicles across the Hillsboro River.

Walla Walla, Wash.—Press reports state that the Street Committee recommends the construction of a steel structure at 4th St., to replace the wood bridge.

St. Joseph, Mo.—It is stated that bids are wanted May 12 for 5 bridges and for repairing a bridge. Theo. Steinacker, Co. Surveyor.

Greig, N. Y.—A bill passed the Assembly appropriating $16,000 for the construction of a bridge over Black River, at Pratt's Landing, between Greig and Turin.

Marietta, O.—E. Frank Gates, City Engr., writes that $70,000 bonds have been voted to build a bridge across the Muskingum River. Plans have not yet been prepared for the bridge.

St. Paul, Minn.—Separate bids are wanted May 2 for the superstructure and substructure of Raymond Ave. bridge, for the substructure of Wabasha St. bridge and for constructing wooden piers and trestle approach and moving and taking down old iron spans of Wabasha St. bridge. Matt Jensen, City Clk.

Forman, N. D.—Bids are wanted May 17 for 3 combination bridges. W. S. Baker, Co. Aud.

Cleveland, O.—Bids are wanted May 10 for furnishing materials and constructing a masonry arch under St. Clair St. for the main drive of the Brookway Division of Rockefeller Park (span 65 ft., length 107 ft.), as advertised in "The Engineering Record."

Toronto, Ont.—Bids are wanted May 22 for a steel highway bridge over Humber River, on the Lake Shore Road; also for a steel highway bridge over the River Don at Queen St., and for taking down and erecting at the Eastern Ave. crossing of the Don River the present Queen St. bridge, as advertised in "The Engineering Record."

Washington, D. C.—Bids are wanted May 27 for a bridge across Piney Branch, in Rock Creek Park, as advertised in "The Engineering Record."

Nashville, Tenn.—Viaduct bonds to the amount of $100,000 have been sold.

Eugene, Ore.—It is stated that bids are wanted May 3 by the County Clerk for a bridge across Long Tom River.

Boston, Mass.—The Cambridge Bridge Commission opened the following bids April 25 at Mayor Quincy's office, for building draws and piers for a temporary pile bridge across Charles River, near the present West Boston bridge: William H. Ellis & Co., of East Boston, $24,500; William L. Miller, of South Boston, $27,945; Benjamin Young, of Boston, $23,202; William J. Lawler, of Charlestown, $20,199.

Wessington Springs, S. D.—Bids are wanted May 15 for a bridge. Wm. Zink, Co. Aud.

Aberdeen, S. D.—Bids are wanted May 24 for 5 steel bridges. Chas. Eygabroad, Co. Aud.

Denison, Ia.—Bids are wanted May 2 for 2 iron bridges. J. T. Carey, Co. Aud.

Brooklyn, N. Y.—A bill has passed the Senate authorizing the Board of Estimate and Apportionment to appropriate $12,000 for the construction of a bridge over Mill Pond in the 31st and 32d Wards.

Providence, R. I.—The following bids for bridge work were received April 7: *a*, for abutment walls and pier from Exchange Bridge, northerly; *b*, for constructing abutments and wing walls at Mill St. and river wall, south of Stevens St.: Ross and Fowler, Ipswich, Mass., *a*, $20,811.05, b, $11,935.50; Norcross Bros., Providence, R. I., a, $22,019.55, *b*, $13,987.06; John T. Tank & Co., Providence, R. I., *a*, $23,680.50; James McKinnon, Providence, R. I., *a*, $24,951.65; T. H. Riddle, New Brunswick, N. J., *a*, $26,142.00, *b* $17,988; Frederick E. Shaw, Providence, R. I., *a*, $27,206.70, *b*, $16,885; Nehemiah Kimball, Bridgeton, R. I., *b*, $10,406.

Bids were received April 12, as follows, for the steel superstructure of Mill St. Bridge over the Moshassuck River, as advertised in "The Engineering Record":
Boston Bridge Wks., Boston, Mass., $11,443; Groton Bridge & Mfg. Co., Groton, N. Y., $11,611; New England Structural Co., Boston, Mass., $11,624.20; Youngstown Bridge Co., Youngstown, O., $11,635.28; Massillon Bridge Co., Massillon, O., $11,702.50; Toledo Bridge Co., Toledo, O., $11,813.50; Mace Moulton, Springfield, Mass., $11,830.05; Canton Bridge Co., Canton, O., $11,849.55; The R. F. Hawkins Iron Wks., Springfield, Mass., $11,858; James H. Tower, Providence, R. I., $11,881.45; King Bridge Co., Cleveland, O., $11,912.40; Wrought Iron Bridge Co., Canton, O., $11,962.25; Variety Iron Wks. Co., Cleveland, O., $12,288; Springfield Construction Co., Springfield, Mass., $12,394.25.

PAVING AND ROADMAKING.

Portland, Ind.—A. J. Frost, City Engr., writes that Philip Hipskind of Wabash, Ind., has secured the contract for 25,000 sq. yds. of Metropolitan block pavement at $1.54 per sq. yd., including sandstone curbing, a 24-in. sewer and 59 manholes.

Liberty, Ind.—It is stated that John Clark, Elwood Johnson and Sam Hull have been appointed by the Council as a committee to purchase a stone crusher.

Houghton, Mich.—See "Water."

Denver, Colo.—Plans and estimates for paving on Race St. 14,014 sq. yds., and on 8th Ave. 17,999 sq. yds., with sheet asphalt, have been adopted, and ordinances authorizing the work have been asked for.

Marysville, O.—The City Clerk writes that the question of paving is being agitated. Although no definite plans have as yet been made, it is probable that some paving will be done in the near future.

Winchester, Mass.—Bids are wanted May 1 for building the Mystic Valley parkway from Main St. to Middlesex Fells reservation. Wm. T. Pierce, Engr. Metropolitan Park Commrs., Boston, Mass.

Union City, Pa.—A correspondent writes that bids are wanted until May 3 for paving to cost about $8,000. E. J. Morton of Erie, Pa., Engr. in charge. J. E. Gillett, Borough Secy.

Louisville, Ky.—Bids are wanted May 1 for vitrified brick pavement on Greenwood Ave. Thos. P. Craig, Secy. Bd. of Pub. Wks.

Glens Falls, N. Y.—Bids are wanted May 22 (change of date) for constructing about 18,000 sq. yds. of brick pavement on concrete foundation, as advertised in "The Engineering Record."

Petersburg, Va.—Bids are wanted May 15 for laying from 11,888 to 29,221 sq. yds. of macadam pavement, as advertised in "The Engineering Record."

Jamestown, N. Y.—Bids are wanted May 6 for about 5,800 sq. yds. of brick paving, about 2,920 lin. ft. of curbing and 200 ft. of curved curbing, as advertised in "The Engineering Record."

Watertown, Wis.—Bids are wanted May 23 for paving certain streets with brick or blocks, as advertised in "The Engineering Record."

Revere, Mass.—An appropriation of $16,000 has been voted for highway improvements.

Elmira, N. Y.—The City Engineer has reported the approximate estimate of paving and curbing State St. from 2d St to 5th St. as $21,334.98.

Rhinebeck, N. Y.—An appropriation has been voted for a stone crusher.

Houston, Tex.—Bids are wanted May 8 for macadam, gravel, brick or asphalt pavement on 3 streets. I. Austin Miller, City Engr.

Cincinnati, O.—Bids are wanted May 22 for macadamizing Delta Ave. Samuel Nieman, Pres. Bd. City Affairs.

Montgomery, Ala.—Bids are wanted May 1 for vitrified brick pavement on 4 streets. R. H. Sommerville, Treas.

Buffalo, N. Y.—Bids are wanted May 10 for paving and repaving several streets. R. G. Parsons, Secy. Bd. Pub. Wks.

Indianapolis, Ind.—See "Sewerage and Sewage Disposal."

Plainfield, N. J.—Bids are wanted May 15 for macadamizing West 3d and 4th Sts. James T. MacMurray, City Clk.

Buffalo, N. Y.—See "Sewerage and Sewage Disposal."

Waterbury, Conn.—The City Engineer has estimated the cost of paving Bank St. to be $2,500 for cobble stones and $12,000 for brick.

Quincy, Ill.—See "Sewerage and Sewage Disposal."

Zanesville, O.—The estimated cost of paving West Main St. is $9,105.

Rochester, N. Y.—The Governor has signed the bill authorizing the levying of an assessment of $52,773 for improving Mount Hope Ave., and $13,700 for improving Court St.

Mayfield, Ky.—N. J. Cruchfield, City Engr., writes that contracts for one to three miles of brick or stone pavement will be let by Mayor A. J. Watts. Bids may be filed with the City Engineer. A. B. Cordin, City Clk., will furnish specifications.

Binghamton, N. Y.—The City Engineer has been directed to prepare plans and specifications for both brick and asphalt pavements in several streets.

Pittsburg, Pa.—Bids are wanted May 5 for paving, repaving, grading and curbing. Local press reports state that the work will cost about $400,000. Edw. M. Bigelow, Dir. Dept. Pub. Wks.

Middletown, Conn.—It has been voted to appropriate $3,000 for macadamizing the Durham road.

Woodbury, N. J.—J. R. Shanley of Philadelphia is stated to have received the contract at $1.75 per sq. yd. to lay vitrified brick gutters on Broad St. Total cost, $9,000.

Baltimore, Md.—An ordinance has been passed providing for the paving of a portion of Fulton Ave. with sheet asphalt and brick.

Findlay, O.—A petition is about to be presented to the Council for brick paving on West Lima St.

St. Paul, Minn.—The Board of Public Works has reconsidered the vote by which it ordered East Seventh St. macadamized and passed an order to have the street paved with brick.

Marion, Ind.—It is stated that bids are wanted May 2 for improving 3d St. and until May 9 for asphalt and brick paving on Washington St., and for brick paving on Delphi Ave. Cyrus G. Robbins, City Clk.

Sewickley, Pa.—Bids are wanted May 2 for fire brick pavement on Bank St. H. T. Hirst, Boro Engr.

Haverhill, Mass.—Bids are wanted May 15 for furnishing 50,000 granite paving blocks, 2,000 ft. granite flagstones, etc. B. W. Davis, Clk. Com. on Sts., Sidewalks and Bridges.

Union, N. J.—Bids are wanted May 11 for asphalt paving, reflagging, recurbing, etc., on Blum St. and place. Chas. Singer, Jr., Town Clk.

Meadville, Pa.—D. T. McKay, Jr., City Clk., writes that contracts for brick paving in three streets, including storm sewers, were awarded as follows: Pine St., 13,465 sq. yds., to Jas. McAfee & Co., Allegheny, Pa., $26,938.85; North St., 10,680 sq. yds., to Fredk. Robinson, Meadville, Pa., $7,533.35; Northern Market St., 13,755 sq. yds., to Thos. McGuigan, Meadville, Pa., for $20,425.25.

Boston, Mass.—The following bids were opened April 23 by the Metropolitan Park Commission, Wm. T. Pierce, Engr., for surfacing, etc., for Revere Beach Parkway: J. J. Welch & Co., Salem, $18,525.80; McCusker Bros., Waltham, $17,181.90; Mirick & Wentworth, Malden, $16,562.50; T. Stuart & Son, Boston, $16,414.40; T. H. Gill, Somerville, $16,352.60; Chas. G. Craib, Boston, $15,184.50; Coleman Bros., Charlestown, *$15,104 with trap rock surfacing and $14,316.50 broken stone.

*Contract awarded.

Rochester, N. Y.—Local press reports state that the following paving bids were recently received: *a*. for block stone pavement on Caledonia Ave.; *b*. for macadam on Hudson Ave.: Lauer & Hagaman, *a*, $28,608; *b*. $40,033.50; Brayer & Albaugh, *a*, $30,060.60; *b*. 43,801.90; Whitmore, Rauber & Vicinus, *a*. $29,183; *b*, $40,784.70; William H. Jones & Sons, *a*, $29,497.20; *b*. $38,314.50; Rock Asphalt Pavement Company, *a*, $29,911.90; H. B. Hooker, *a*, $29,926; *b*, $38,131.50; H. N. Cowles, *a*. $29,805; *b* $34,652; William Fuller, *a*. $29,966; *b*, $39,875; George Chambers, *a*, $31,840.80; *b*, 41,343.50; F. A. Brotsch, *a*, $29,312.

Address of all bidders, Rochester.

POWER PLANTS GAS AND ELECTRICITY.

White Cloud, Mich.—L. A. Macy, Village Clk., writes that an election will be held May 3 to vote on the issue of bonds for an electric light plant to cost about $4,500. It is stated that bids will be received May 15 for the construction of same.

Carthage, Mo.—The Guido Jaeger Electric Co., Richhill, Mo., is stated to have received the contract for constructing the electric light plant, at $25,125.

Milford, Ind.—See "Water."

Columbus, O.—The County Infirmary Directors are said to be considering the matter of constructing an electric light plant.

The Council is stated to have approved the ordinance granting a franchise to the Federal Natural Gas & Fuel Co.

The Pennsylvania Tube Co. is stated to have received the contract for about 40 miles of 10-in. tubes for the Columbus Gas Co.

Pittsburg, Pa.—The officials of the Pittsburg & Lake Erie R. R. Co. are said to be considering the matter of constructing a power plant for lighting and heating the station on the south side. J. M. Schoonmaker, Pres.

Florence, Ala.—D. L. Foster of Huntsville, with others, is stated to have purchased on April 18 certain water privileges on Cypress Creek and will at once erect an electric light and power plant.

Warren, Ill.—A. S. Tinker is said to be interested in the construction of an electric light plant.

Cullman, Ala.—See "Water."

Charlotte, N. Y.—It is stated that an election will be held May 2 to vote on issuing $6,000 bonds to purchase an incandescent dynamo.

Columbus, Miss.—A correspondent writes that the Electric Light Co. is in the market for a Corliss engine.

Yonkers, N. Y.—The Consumers' Electric Co. is stated to have received a franchise for an electric lighting system.

Colfax, Ia.—The Electric Light & Power Co. is said to be considering the question of improving its plant.

Berea, O.—D. T. Gould, Pres. Bd. Water Wks. Trus., writes that at the April election it was voted to issue $12,000 bonds for the construction of an electric light plant, to be operated in conjunction with the water-works.

Cannellton, Ind.—The Cannellton Electric Light, Heat & Power Co. is stated to have been incorporated. Capital, $5,000. Incorporators: C. H. Walls and L. Adair of Fordsville, Ky.

Brazil, Ind.—J. N. Halstead is stated to have applied to the Council for a franchise for a steam or hot water heating plant.

Cincinnati, O.—The Cincinnati Natural Gas & Illuminating Co. has been incorporated; capital, $100,000. Incorporators: Robt. Laidlaw, Pres. Laidlaw-Dunn-Gordon Pump Co.; John Omwake, Treas. U. S. Playing Card Co.; John B. Morris, Foundryman, and others.

Danville, Ill.—John L. Fate, Plaza Hotel, Danville, is said to be interested in the construction of gas works.

Summit, N. J.—See "Water."

Kanawha City, W. Va.—A charter is stated to have been granted to the Kanawha Power Co., with a capital of $25,000, to furnish steam and electrical power. Incorporators: Henry A. Gardner, Chicago, Ill.; A. S. Crow, Pittsburg, Pa., and others.

Waupun, Wis.—Fred Ford is said to be considering the question of establishing an electric light plant.

Belgrade, Minn.—See "Water."

Kent, O.—Bids are wanted May 6 for lighting the streets with electricity and furnishing the citizens with electric light, heat and power. Fred. Bechtel, Village Clk.

Sterling, Neb.—See "Water."

Harrodsburg, Ky.—It is stated that bids are wanted for an electric light plant with a capacity of 25 2,000-c. p. arc and 25 50-c. p. incandescent lights. C. Geffinger, City Clk.

Evansville, Ind.—F. B. Rae of Chicago, in his report to the Board of Public Works, estimates the cost of constructing an electric light plant at $106,000.

Gainesville, Ga.—It is stated that capitalists of this place are interested in the construction of an electric plant on the Chattahoochee River 4 miles from here.

Baltimore, Md.—The Board of Awards on April 26 opened bids for electric lights for 4 years from Nov. 1, 1899. Two bids were received from the Brush Electric Co., the only bidders, as follows:

First: To install and maintain 3,500 arc lamps or their equivalent in incandescent lamps for $400,000 a year.

Second: To furnish 1,369 arc lights for 35 cts. a night for each lamp.

Nanticoke, Pa.—Bids are wanted May 2 for arc and incandescent electric lights, gas, naphtha or other modern street lighting system, as advertised in "The Engineering Record."

Santa Rosa, Cal.—See "Water."

Cleveland, O.—The Federal Gas & Fuel Co., with a capital of $2,000,000, petitioned the City Council April 24 for permission to lay pipe lines to supply the city with natural gas.

Ft. Wayne, Ind.—The City Clerk writes that a contract has been made with the Jenney Electric Light & Power Co. to light the city for a period of five years beginning July 1, 1899.

Williamsport, Md.—The Town Council is stated to have authorized the Electric Light Supervisors to employ an engineer to select site, etc., for proposed electric light plant.

Asotin, Wash.—E. H. Libby, Pres. Lewiston Water & Power Co., Lewiston, Idaho, is said to be considering the matter of constructing a power plant here, to cost about $200,000.

Wilkesbarre, Pa.—A charter has been granted to the Peoples' Electric Light & Power Co., and it is stated that the company will apply to the Council for permission to construct an electric light plant at once at an estimated cost of $200,000. T. F. Ryman, Pres. Jacob Roberts, Jr., Treas.

Livermore Falls, Me.—John H. Maxwell, Secy. of the Livermore Falls Light & Power Co., writes that a $10,000 power plant is to be built. Fred Riley, Engr. in Charge, Livermore Falls.

Painesville, O.—The Yaryan Hot Water Construction Co., of Toledo, has received a franchise for a hot water heating plant.

Victor, Colo.—The Woods Investment Co. is said to be considering the matter of constructing an electric plant.

Harrisburg, Pa.—Bids are wanted May 8 for lighting the city with electricity. Morris H. Craiglow, Pres. Select Council.

ELECTRIC RAILWAYS.

Yeadon, Pa.—The Midland St. Ry. Co. is stated to have received a franchise for a trolley line from Angora to the western boundary of this borough.

New York, N. Y.—The Municipal St. Ry. Co. of New York City has been incorporated with a capital of $250,000 to construct a street surface railroad about 9 miles long. Directors: D. W. Cutting, Jas. W. Gerard, Jr., Robt. McM. Gillespie, Arthur C. Hume, and others, all of New York City.

Home City, O.—The Cincinnati, Lawrenceburg & Homer City St. Ry. Co. is stated to have received a franchise.

Benton Harbor, Mich.—The Benton Harbor burg & Home City Ry. Co. is stated to have received a franchise.

Wheeling, W. Va.—A charter has been granted to the People's Ry. Co. to construct and operate a railroad from Wheeling to and through Benwood; capital, $500,000. Incorporators: Frank P. McNeil, C. L. Hill, Gilmore Brown, and others, all of Wheeling.

Adrian, Mich.—Henry P. Glover is stated to have petitioned for a franchise.

Grand Rapids, Mich.—The Hess Holland Co. is stated to have received a franchise.

Batavia, N. Y.—Chas. A. Kibbe of Batavia is said to be interested in the construction of an electric railway from Batavia to Lakeside.

Perkasie, Pa.—John H. Pascoe and Hugh E. Crilly are stated to have received a franchise for a trolley line from Perkasie to Lansdale.

Wilkinsburg, Pa.—Booth & Flinn, 422 Forbes Ave., Pittsburg, are stated to have received the contract from the Monongahela St. Ry. Co. for constructing the Wilkinsburg & East Pittsburg railway; contract price said to be $150,000.

Seattle, Wash.—It is reported that the Seattle & Renton Electric Ry. Co. will probably construct a 7 mile extension this summer. F. H. Osgood, Pres.

Kaukauna, Wis.—W. H. Holcomb, Mgr. Fox River Interurban Electric Ry. Co. is stated to have petitioned for a franchise.

Phoenix, Ariz.—A correspondent writes that the Phoenix City Railway Co. proposes to build a trolley road from Phoenix to Indian School, a distance of 3 miles. B. N. Pratt, Mgr.

Saratoga Springs, N. Y.—The Saratoga Northern Ry. Co. is stated to have applied for a franchise.

Cleveland, O.—B. Schatzinder, L. G. Kassulker, Chas. A. Klump and others have applied to the City Council for a franchise to construct and maintain an electric railway running easterly with a double track to the city limits.

Northbend, O.—The Cincinnati, Lawrenceburg & Aurora Electric Ry. Co. is stated to have received a franchise.

Brockton, Mass.—The Brockton St. Ry. Co. is stated to have received a franchise on Centre St.

Mt. Vernon, N. Y.—The New York, Westchester & Connecticut Traction Co. is stated to have received a franchise.

Indianapolis, Ind.—It is stated that a company has been formed here to build an electric railway from this city to Plainfield; capital, $100,000. Directors: D. P. Erwin, D. M. Parry and others of Indianapolis, and Taylor Reagan and Oscar Hadley of Plainfield.

Far Rockaway, N. Y.—P. H. Flynn, 189 Montague St., Brooklyn, is said to be receiving bids for the construction of a trolley road across Jamaica Bay to Rockaway Beach.

RAILROADS.

Pasadena, Cal.—The Pasadena & Mt. Lowe R. R. Co. is reported to have been incorporated, to construct a railroad from Pasadena to the summit of Mt. Lowe, about 10 miles long. Directors: Valentine Peyton, Danville, Ill.; J. S. Torrance, Pasadena, and others.

Welch, W. Va.—A charter is stated to have been granted the Tug River & Elk Fork R. R. Co. to build a railroad in McDowell County; capital, $30,000. Incorporators: C. L. Ritter of Welch, E. M. Watts, Henry S. Cato of Huntington, and others.

Wayland, N. Y.—The Central New York & Northern R. R. Co. has been incorporated with a capital of $1,500,000, to construct a steam road 55 miles long. Directors: Wm. W. Clark and Martin Kimmel of Wayland, Fredk. H. Mollenhuer and Simeon M. Ayres of New York City, Ward J. Spafford of Brooklyn, and others.

Moline, Ill.—The Rock Island & Eastern Illinois R. R. Co. has been granted a right of way through the city. It is stated that they will erect a depot here.

Lumberton, S. C.—Bids are wanted May 1 for grading 12 miles of road. J. H. McRee. Ch. Engr. Carolina Northern R. R.

Denver, Colo.—The Denver & Northwestern Ry. Co. has been incorporated to construct a railroad between Denver and Boulder. Incorporators: A. Herman, Louis Grover and others.

St. Louis, Mo.—The Brentwood, Clayton & St. Louis Ry. Co., of St. Louis, has been incorporated; capital, $70,000. Incorporators: Thos. C. Kimber, Hunt Turner, C. L. Caldwell and others.

PUBLIC BUILDINGS.

(See also Schools and Government Work.)

Manson, Ia.—Bids are wanted May 1 for a church. W. C. Moody, Secy. Bldg. Com. Bd. Trus. 1st Congregational Church.

Steilacoom, Wash.—Plans are being prepared for a $35,000 addition to the Washington Hospital for Insane. J. G. Proctor, Archt., Steilacoom.

Richmond, Va.—Noland & Baskerville have prepared plans for a hospital to be erected by Dr. Hunter McGuire on Grace and Harrison Sts., at a cost of $25,000.

Wm. C. West, 1,103 Main St., has prepared plans for a $10,000 building to be erected for the M. E. Church. Rev. J. T. Routten, Chmn. Com.

Dannemora, N. Y.—The Senate is stated to have passed a bill appropriating $72,910 for repairs and improvements to the Dannemora State Hospital for Insane.

Rochester, N. Y.—The Cornhill M. E. Society is stated to have decided to erect a $22,000 church. Rev. Thos. Cardus, Pastor. J. B. Loomis, Chmn, Bldg. Com.

Allegheny, Pa.—It is stated that the Eighth United Presbyterian Society will build a $24,000 church. John C. Park, Secy.

Tionesta, Pa.—Jas. A. Nixon of Titusville is stated to have received the contract for erecting the Forest County Poor House, at $20,000.

Ames, Ia.—Bids are wanted May 5 for a church. Address Dr. H. M. Templeton.

Orange City, Ia.—It is stated that an election will be held in Sioux County May 31 to vote on erecting a court house.

Oshkosh, Wis.—The plans of the Canton Bridge & Iron Works, Canton, O., are stated to have been accepted for the jail and sheriff's residence, to cost about $25,000.

Newark, N. Y.—The Senate is stated to have passed the bill appropriating $35,300 for repairs to the State Custodial Asylum for Feeble-minded at this place.

Adel, Ia.—Proudfoot & Bird of Des Moines are said to be preparing plans for a $15,000 asylum for insane.

Evansville, Ind.—Bids are wanted May 8 for a new wing at the Southern Indiana Hospital for Insane. G. C. Mason, Supt.

New York City.—Flemer & Koehler, 1 Bway., are stated to have prepared plans for a hospital for the Beth-Israel Hospital Association, to be erected on Cherry and Jefferson Sts., to cost about $100,000. Harry Fischell, Chmn. Bldg. Com.

Bids are wanted May 8 for a building to be known as "Pavilion F," on Randall's Island. John W. Keller, Pres. Dept. Pub. Charities.

Wayne, Neb.—It is stated that bids are wanted May 2 (change of date) for a $30,000 court house.

Chicago, Ill.—The Governor is stated to have signed a bill appropriating $100,000 for erecting an armory and parade grounds on the lake front.

Pittsburg, Pa.—The Trusteees of the Third United Presbyterian Society are stated to have decided to erect a $40,000 church. Perry F. Smith, Chmn.

It is stated that the Bethel A. M. E. Society will build a $25,000 church at Wylie Ave. and Elm St. Rev. A. W. Gazaway, Pastor.

Danville, Ill.—Bids are wanted May 3 for two buildings at the Danville branch of the National Home for D. V. Soldiers. W. B. Franklin, Pres. Bd. Mgrs.

St. Paul, Minn.—Edw. J. Donahue has prepared plans for a $25,000 chapel for St. Joseph's Academy at Western and Nelson Aves.

Utica, Ia.—Bids are wanted June 1 for a town hall for Harrisburg Township. Robt. Ely, Twp. Clk.

Leavenworth, Kan.—A correspondent writes that the city has voted to issue $20,000 bonds for the erection of a public library.

Yates Center, Kan.—J. H. Brewister of Independence is stated to have received the contract for building the court house, at $23,147.

Auburn, Cal.—It is stated that bids are wanted June 6 for the first six sections of the proposed county hospital buildings. J. B. Landis, Clk. Superv.

Halifax, N. S.—It is stated that bids are wanted May 5 for a building for the Halifax Infants' Home. Address J. C. Mackintosh.

Madison, Minn.—John Swanson, 17 So. 6th St., Minneapolis, is stated to have received the contract for erecting the court house, at $29,000.

Somerset, Pa.—It is stated that bids are wanted May 1 for a hospital at the County Home. L. C. Colborn.

New Albany, Ind.—Bids are wanted June 12 for a steam heating plant in the Asylum for the Poor on the poor farm. Wm. Morton, Chmn. Bd. Commrs.

Marion, Ind.—It is stated that bids are wanted May 2 for a chapel. H. O. Heichert, Treas. National Military Home.

Jamestown, N. D.—Bids are wanted May 3d for $50,000 bonds to be used for additional buildings at the hospital for the insane. Anton Fried, Secy. Trust. N. D. Hospital for Insane.

Indianapolis, Ind.—Plans are wanted for a receiving vault and chapel for Evergreen Cemetery. Address E. C. Windt, Secy., Newport, Ky.

Audubon, Ia.—Bids are wanted May 5 for a church. J. F. Hinkhouse, Chmn. Bldg. Com.

Connellsville, Pa.—It is stated that a $50,000 library will be erected.

Louisville, Ky.—The Second English Lutheran Congregation is about to build a $25,000 Church on Jefferson St.

Starkville, Miss.—Bids are wanted May 1 by the Board of Supervisors for repairing the court house. C. E. Gay, Chancery Clk.

St. Louis, Mo.—The following bids were opened April 25 by the Board of Public Improvements for constructing a storage coal shed, lavatory and supply house for the Water Department: John Low, $30,540; Moritz, Barwick Const. Co., $33,000; Hill & O'Meara Const. Co., $29,519; Lenz-Helm Building Co., $31,940; C. Stafford, $31,490; Geisel Const. Co., $32,375; Kerr & Allen, $29,425; R. W. Morrison Const. Co., $37,500. Address of all bidders, St. Louis.

Blackwood, N. J.—The following bids were opened April 25 for an addition to the Camden County Insane Asylum: Wells & Son Co., Philadelphia, $44,401; B. F. Sweeten & Son, Camden, N. J., $40,457; H. L. Foulks, Trenton, N. J., $43,544; Jos. B. Best, Camden, N. J., $41,174; Burd P. Evans, Philadelphia, $43,638; Philip Anns Co., Philadelphia, $40,596; Wm. Sevrons, Camden, N. J., $40,374.

The bids received for heating were as follows: C. F. West, Gloucester, N. J., $5,797; Robt. Scott & Co., Philadelphia, $6,848; David R. Burns, Philadelphia, $7,398; Anderson & Adams, Philadelphia, $6,343; E. Keeler & Co., Philadelphia $7,893.

BUSINESS BUILDINGS.

Little Rock, Ark.—Lasker Bros. propose to erect on 6th and Main Sts. a 3-story brick and granite store building, with hydraulic elevators and steam heat: cost, $30,000. Rome Harding, 12 Kahn Bldg., Archt.

Birmingham, Ala.—A correspondent writes that the Southern Railway will build a new passenger station.

Richmond, Va.—It is reported that alterations to cost $25,000 are to be made to the Academy of Music. J. B. McElfatrick & Son of N. Y. City, Archts.

Reading, Pa.—C. Whitner & Co. propose to erect a 3-story brick building on 5th and Penn Sts. Cost, $13,000. Smith Bros., Archts.

Wm. A. Fink, 426 Franklin St., has prepared plans for a $12,000 brick building to be erected by J. Grant on 6th and Washington Sts.

Massena, N. Y.—Williams & Johnston of Ogdensburg have prepared plans for a creamery to be erected by Simpson, McIntyre & Co.

Richmond, Va.—F. C. Christian of 1,113 E. Main St., has secured the contract from the Kanawha Construction Co. for the erection of the James River Falls Paper and Pulp Mills; cost, $100,000. Archt., Ashley B. Tower of N. Y. City.

Boston, Mass.—A correspondent writes that a 10-story structure, containing a theatre and offices, on the five upper floors, will replace the old public library building on Boylston St. Clarence H. Blake of Boston, Archt.

The Massachusetts Horticultural Society has decided to erect a new building on Huntington and Massachusetts Aves. Estimated cost, $250,000.

Architects Winslow, Witherell & Bigelow, No. 3 Hamilton Place, have filed plans for an 8-story brick and iron mercantile building, to be erected on Chauncy and Essex Sts., estimated cost $150,000. The Webb Granite & Construction Co., Builders, Worcester, Mass.

Chippewa Falls, Wis.—It is stated that Judge Marshall will erect an opera house here, to cost about $20,000.

Kansas City, Mo.—Rudolph Markgraf, 818 Wyandotte St., is stated to have prepared plans for a $75,000 flour mill to be erected for John Kelly.

Philadelphia, Pa.—Chas. McCaul, 10 N. 11th St., has received the conrtact for a 9-story granite and brick ware house and office building at 17th and Filbert Sts., for the Bell Telephone Co. Cost, $250,000.

Moline, Ill.—See "Railroads."

Memphis, Tenn.—A 10-story office building is about to be erected by the Commercial Building Co., at a cost of $350,000. Austin Miller, Secy., 44 Madison St.

Youngstown, O.—It is stated that plans are about completed for the new depot to be erected here by the Erie R. R. Co.; probable cost, $100,000.

Albany, N. Y.—Marcus F. Reynolds, 59 N. Pearl St., is stated to have prepared plans for a $50,000 office building for the Albany Ry. Co.

St. Paul, Minn.—Herman Kretz & Co., Life Insurance Bldg., are stated to have prepared plans for a $40,000 building, to be erected by the Wm. Lindike Land Co., at 382 Robert St.

Alterations and repairs are to be made to the market house on 7th and Wabasha Sts. Cost, $35,000. Archt., J. W. Stevens, Drake Blk.

NEW YORK CITY.

Permits for the following buildings have been issued; o, signifies owner; a, architect; b, builder, and c, contractor.

95 Sheriff st, br stores & flat, cost, $28,500; o, L & J Pizer; a, G F Pelham.

3d st & Ave D, 2 br stores & flats, cost, $60,000 all; o, Wielandt & Roth; a, Horenburger & Straub.

60 E 10th st, br stores & lofts, cost, $23,000; o, A J C Anderson; a, R N Anderson.

Grand & Suffolk sts, 2 br stores & tenem'ts, cost, $85,000 all; o, Henry Fischel; a, Saml. Sass.

34 to 38 W 14th st, 33 to 37 W 13th st, br store, cost, $200,000; o, Bernard J Ludwig; a, Louis Korn.

Ave B & 2d st, br stores & tenem'ts, cost, $29,000; o, Henry Dinkelspiel; a, Kurtzer & Rohl.

149 & 151 Broome st, br stores & flat, cost, $26,000; o, Nathan Lieber; a, M J Smallheiser.

Ave B & 6th st, br store & flat, cost, $40,000; o, S R Horowitz; a, Samuel Sass; b, A Horowitz.

180 Rivington st, br stores & flat, cost, $30,000; o, Horowitz & Parnas; a, Horenburger & Straub.

30 Chrystie st, br stores & tenem't, cost, $28,000; o, Bernard Klingenstein; a, Geo F Pelham.

252 E Houston st, br stores & tenem't, cost, $28,000; o, L & J Pizer; a, Geo F Pelham.

32d st & 7th ave, br stores & loft, cost, $22,000; o, Fred'k Brandt; a, John Brandt.

7 E 17th st, br warehouse, cost, $210,000; o, John Walker; a, Franklin Baylies.

229 5th ave, br store, cost, $30,000; o, J G Wallace, a, Oswald Wirz.

10th ave & 42d st, br stores & flat, cost, $75,000; o, N Y Fire Proof Tenement House Assoc; a, Ernest Flagg.

606 8th ave, br store & flat, cost, $20,000; o, Mandelbaum & Lewine; a, Israels & Harder.

7th ave & 22d st, 5 br stores & flats, cost, $140,000 all; o, Leopold Kaufman; a, Schneider & Herter.

208 & 210 E 106th st, 2 br stores & flats, cost, $56,000 all; o, Peter J Herter; a, Peter Herter & Son.

Broadway, 78th and 79th sts, 2 br stores & flats, cost, $10,000 all; o, Estate of Sarah Sandford; a, P F Brogan.

8th ave & 112th st, 2 br stores & flats, cost, $51,000 all; o, William J Brown; a, G A Schellenger.

8th ave, 120th st & St Nicholas ave, br store and loft, cost, $75,000; o, Arthur Gorsch; a, W O Tait.

133d st & Lenox ave, br store & flat, cost, $25,000; o, Louis Lese; a, John Hauser.

BROOKLYN, N. Y.

Surf ave & 5th st, frame depot & restaurant, cost, $30,000; o, Pabst Brewing Co; a, Otto Strack; b, Louis Limm.

DWELLINGS.

Richmond, Va.—J. Skelton Williams is about to erect a $40,000 residence on West Franklin St. Plans prepared by Noland & Baskerville.

Worcester, Mass.—Lewis Black, Jr., has prepared plans for a $20,000 brick apartment house to be erected by Geo. W. Houck on Sumner St.

Worcester, Mass.—It is stated that it is proposed to erect a new home for the Sisters of Notre Dame, to cost about $40,000.

NEW YORK CITY.

Permits for the following buildings have been issued; o, signifies owner; a, architect; b, builder, and c, contractor.

174 Thompson st, br tenem't, cost, $25,000; o, D H & J Solomon; a, M Bernstein.

Monroe & Pike sts, br tenem't, cost, $20,000; o, L Rattner; a, M Bernstein.

198 E 7th st, br tenem't, cost, $22,000; o, Chas Weinstein; a, Schneider & Herter.

221 E 10th st, br tenem't, cost, $25,000; o, Leopold Kaufmann; a, Schneider & Herter.

246 W 22d st, br tenem't, cost, $28,000; o, Julius Dreyfus; a, Geo F Pelham.

110th st & Madison ave, br flat, cost, $30,000; o, Henry Muhlker; a, R R Davis.

95th st & Madison ave, 4 br dwell'gs, cost, $100,000; o, Wm W Graham; a, Thos Graham.

225 E 105th st, br tenem't, cost, $28,000; o & a, Peter J Herter.

124th st & Amsterdam ave, 7 br flats, cost, $140,000 all; o, Sussman Goldreyer; a, G F Pelham.

108th st & Amsterdam ave, 2 br flats, cost, $40,000 all; o, Henry N Benson; a, M V B Ferdon.

Riverside Drive & 79th st, 4 br dwell'gs, cost, $105,000 all; the Riverside Bldg Co; a, Clarence True.

Central Park West & 89th st, br flat, cost, $100,000; o, Matthews & Eppenstein; a, Clarence True.

Amsterdam ave, 138th & 139th st, 4 br flats, cost, $300,000 all; o, Harry Chaffel; a, Henri Fouchaux.

Amsterdam ave & 138th st, 2 br tenem'ts, cost, $60,000 all; o, John Davis; a, Henri Fouchaux.

St Ann's ave & 159th st, br flat, cost, $20,000; o, Mrs Mary T Upington; a, Chas Rentz.

Brook ave & 159th st, br flat, cost, $20,000; o, Mrs. Mary T Upington; a, Chas. Rentz.

NEW INDUSTRIAL PLANTS.

The Cincinnati Milling Machine Co., Cincinnati, O., has under consideration the construction of a 3-story, 40x120-ft. extension to its plant.

The Selma Oil & Fertilizer Works of Selma, N. C., have been organized and want machinery for an oil mill and fertilizer factory. M. C. Winston is president.

Messrs. Hench, Dromgold & Shull of Plaine, W. Va., are erecting a new saw mill and factory at Mill Creek, W. Va.

G. W. Ford of Louisburg, N. C., is to erect a cotton seed oil mill and wants machinery for the same.

The Parker Mills of Fall River, Mass., are to erect a new mill with a power capacity of 600 to 800 H. P.

Geo. R. Hosford of Hudson, Wis., is to build a grain elevator requiring a gasoline engine of 12 to 15 H. P.

P. & F. Corbin of New Britain, Conn. are to erect a 6-story 42x112-ft. addition to their plant and will want shafting and pulleys.

The Husted Milling & Elevator Co. of Buffalo, N. Y., is building a 50x90-ft. addition to its feed warehouse and is to add a 200 H. P. boiler to its boiler plant.

The Cedar Valley Mfg. Co. of Waterloo, Ia., will erect a 2-story 80x80-ft. lumber mill and a 32x70-ft. engine house, with a capacity of about 70 H. P. They will want a tubular boiler and pulleys, shafting, etc.

W. P. Hodnett and associates of Danville, Va., are to erect a plant for making cotton ginghams, etc., starting with 100 looms, and wish to correspond with manufacturers of machinery for such a plant.

The Textile Starch & Gum Co. of Stevens Point, Wis., is erecting a 2-story 20x100-ft. building for a starch drying kiln.

BUSINESS NOTES.

The Eastern Solar Gas Machine Co. has removed its office to 120 Liberty Street, New York City, and has added to its line of improved acetylene gas generators a recently developed machine called the Simplex.

The Ball Engine Co., Erie, Pa., has lately furnished a 150-H. P. engine for the L. Wolff Mfg. Co. of Chicago; a 300-H. P. tandem compound engine to the Jones Bros. Electric Co., Cincinnati, which is a duplicate of an earlier order; and has received orders for two engines for the Parlin & Orendorf Bldg., Kansas City, Mo., and one for the Ayers & Son store building in Philadelphia, Pa.

The Chicago Pneumatic Tool Co. announces that it has secured the services of Mr. W. P. Pressinger and J. M. Towle. The former, who is well known on account of his numerous articles on the uses of compressed air, will be connected with the company's New York office, while the latter, who has been engaged for ten or twelve years in the manufacture of pneumatic tools, will open a Boston office for the company.

The Nitro Powder Co., Kingston, N. Y., has received an order from Belden & Seeley for all the dynamite to be used on their contract for 200,000 yds. of rock excavation at Great Bend, N. Y.

PROPOSALS OPEN.

Bids Close		See Eng. Record
	WATER-WORKS.	
May 1.	Martinez. Cal.	Apr. 22
May 1.	College Hill, O	Apr. 22
May 1.	Ute, Iowa	Apr. 29
May 2.	Mayville, N. D	Apr. 22
May 2	Fire hydrants, Milwaukee, Wis.	Apr. 29
May 3.	Winchester, Ind.	Apr. 22
	Adv., Eng. RECORD, Apr. 22, 29.	
May 3.	Laurel, Del	Apr. 22
	Adv., Eng. RECORD, Apr. 22.	
May 4.	Lining reservoir, Morristown, N. J.	Apr. 22
	Adv., Eng. RECORD, Apr. 22.	
May 5.	Belgrade, Minn	Apr. 29
May 6.	Glouster, O.	Apr. 29
May 8.	Pima, A. T	Apr. 15
May 8.	Orange, Cal.	Apr. 15
May 8.	San Carlos, A. T	Apr. 22
May 8.	St. James, Minn	Apr. 29
	Adv., Eng. RECORD, Apr. 29	
May 8.	Pumping machinery, Willimantic, Conn	Apr. 29
	Adv., Eng. RECORD, Apr. 29.	
May 11.	Boston, Mass	Apr. 29
	Adv., Eng. RECORD, Apr. 29.	
May 12.	Dam, etc., White Plains, N. Y	Apr. 29
May 13.	Yonkers, N Y	Apr. 29
May 15.	Gallatin, Tenn	Apr. 22
May 15.	Wellsville, O	Apr. 22
	Adv., Eng. RECORD, Apr. 29.	
May 16.	Ottawa, Ont	Apr. 22
May 16.	Boilers, Chicago, Ill	Apr. 29
May 17.	Washington, D. C	Apr. 29
May 17.	Boston, Mass	Apr. 29
	Adv., Eng. RECORD, Apr. 29.	
May 22.	Cullman, Ala	Apr. 29
	Adv., Eng. RECORD, Apr. 29.	
May 26.	Cincinnati, O	Apr. 29
May 27.	Washington, D. C	Apr. 29
	Adv., Eng. RECORD, Apr. 29.	
——	Grand Forks, N. D.	Apr. 22
——	Peekskill, N Y	Apr. 15
	Adv., Eng. RECORD, Apr. 15, 22.	
——	Napoleonville, La	Mar. 25
——	Corinth, Miss	Mar. 25
	SEWERAGE AND SEWAGE DISPOSAL.	
May 1.	Logansport, Ind	Apr. 15
May 1.	Williamsport, Pa	Apr. 22
May 1.	Toledo, O	Apr. 22
May 1.	Albany, N. Y	Apr. 22
May 1.	Braddock, Pa	Apr. 22
May 1.	Syracuse, N. Y	Apr. 29
May 1.	Cooperstown, N. Y	Apr. 29
May 1.	St. Paul, Minn	Apr. 29
May 2.	Olean, N. Y	Apr. 22
May 2.	Milwaukee, Wis	Apr. 29
May 2.	Jersey City, N J	Apr. 29
May 3.	Indianapolis, Ind	Apr. 29
May 3.	Philadelphia, Pa	Apr. 29
May 3.	Laurel, Del	Apr. 22
	Adv., Eng. RECORD, Apr. 22.	
May 3.	Sauk Centre, Minn	Apr. 1
May 5.	Bridgeport, Conn.	Apr. 15
May 5.	Buffalo, N. Y	Apr. 29
May 5.	Cedar Rapids, Ia	Apr. 29
May 6.	Charlottetown, P. E. I	Apr. 29
May 8.	San Carlos, A. T	Apr 22
May 8.	Elyria, O	Apr. 8
May 8.	South Bend, Ind	Apr. 29
May 8.	Dayton, O.	Apr. 29
May 13.	Evansville, Ind	Apr. 29
May 15.	Elizabeth, N J	Apr. 29
May 15.	Lead, S. D	Apr. 29
May 15.	Supplies, Worcester, Mass	Apr. 29
May 15.	Medford, Ore	Apr. 1
May 17.	Auburn, Ind	Apr. 22
	Adv., Eng. RECORD, Apr. 22.	
May 18.	Norristown, Pa	Apr. 29
May 19.	Cambridge, O	Apr. 29
	Adv., Eng. RECORD, Apr. 29.	
May 20.	Auburn, Ind	Apr. 8
July 5.	New Orleans, La	Apr. 29
	BRIDGES.	
May 1.	Doylestown, Pa.	Apr. 22
May 2.	Denison, Ia	Apr. 29
May 2.	St. Paul, Minn	Apr. 29
May 3.	Eugene, Ore	Apr. 29
May 3.	Grafton, N. D	Apr. 22
May 6.	Washington, D. C	Apr. 22
	Adv. Eng. RECORD, Apr. 22.	
May 8.	Birmingham, O	Apr. 22
May 9.	Birmingham, O	Apr. 22
May 9.	Binghamton, N. Y	Apr. 22
May 10.	Chicago, Ill	Mar. 18
	Adv., Eng. RECORD, Mar. 25.	
May 10.	Cleveland, O	Apr. 29
	Adv., Eng. RECORD, Apr. 29.	
May 11.	London, O	Apr. 22
May 12.	St. Joseph, Mo	Apr. 29
May 15.	Wessington Springs, S. D	Apr. 29
May 15.	Honolulu, H. I	Apr. 22
May 17.	Norristown, Pa	Apr. 22
May 17.	Forman, N. D	Apr. 29
May 22.	Toronto, Ont	Apr. 29
	Adv., Eng. RECORD, Apr. 29.	
May 24.	Aberdeen, S. D	Apr. 29
May 27.	Washington, D. C	Apr. 29
	Adv., Eng. RECORD, Apr. 29.	
May 31.	Chicago, Ill.	Apr. 8
	Adv., Eng. RECORD, Apr. 15.	
——	Quincy, Ill	Feb. 25
	Adv., Eng. RECORD, Feb. 25.	
——	Bradford, Pa.	Apr. 15
——	Randolph, Utah	Apr. 15
	PAVING AND ROADMAKING.	
May 1.	Williamsport, Pa	Apr. 22
May 1.	Albany, N. Y.	Apr. 22
May 1.	Benwood, W. Va	Apr. 8
May 1.	Bradford, Pa	Apr. 15
	Adv., Eng. RECORD, Apr. 15 to 29.	
May 1.	Montgomery, Ala.	Apr. 29
May 1.	Park work, Winchester, Mass	Apr. 29
May 1.	Louisville, Ky	Apr. 29
May 2.	Sewickley, Pa	Apr. 29
May 2.	Marion, Ind	Apr. 29
May 3.	Indianapolis, Ind	Apr. 29
May 3.	Union City, Pa	Apr. 29
May 3.	Cincinnati, O	Apr. 15
May 4.	Fort Wayne, Ind	Apr. 8
May 4.	Hackensack, N. J.	Apr. 22
May 5.	Pittsburg, Pa	Apr. 29
May 5,	Buffalo, N. Y	Apr. 29
May 6.	Jamestown, N. Y	Apr. 29
	Adv., Eng. RECORD, Apr. 29.	
May 6.	Indianapolis, Ind.	Apr. 22
May 6.	Westshoals, Ind	Apr. 22
May 8.	Lafayette, Ind	Apr. 22
May 8.	Houston, Tex.	Apr. 29
May 9.	Marion, Ind	Apr. 29
May 10.	Buffalo, N. Y.	Apr. 29
May 11.	Union, N. J.	Apr. 29
May 15.	Plainfield, N. J.	Apr. 29
May 15.	Petersburg, Va	Apr. 29
	Adv., Eng. RECORD, Apr. 29.	
May 15.	Haverhill, Mass	Apr. 29
May 15.	Road roller, Nanaimo, B. C	Apr. 22
May 20.	Washington, D. C	Apr. 22
	(2 advts.) Adv., Eng. RECORD, Apr. 22.	
May 22.	Cincinnati, O	Apr. 29
May 22.	Glens Falls, N. Y	Apr. 22
	Adv., Eng. RECORD, Apr. 22, 29.	
May 23.	Watertown, Wis	Apr. 29
	Adv., Eng. RECORD, Apr. 29.	
	POWER, GAS AND ELECTRICITY.	
May 1.	Franchise, Santa Ana, Cal	Apr. 1
May 1.	Franchise, Fairfield, Cal.	Mar. 25
May 1.	Barrie, Ont	Apr. 22
May 2.	Florence, Ala	Apr. 15
May 2.	Mayville, N. D	Apr. 22
May 2.	Nanticoke, Pa	Apr. 29
	Adv., Eng. RECORD, Apr. 29.	
May 2.	Kansas City, Mo	Apr. 22
May 3.	Winchester, Ind	Apr. 22
	Adv., Eng. RECORD, Apr. 22.	
May 5.	Belgrade, Minn.	Apr. 29
May 6.	Kent, O	Apr. 29
May 8.	Harrisburg, Pa	Apr. 29
May 8.	San Carlos, A. T	Apr. 22
May 9.	Franchise, Midway, Ky	Apr. 22
May 10.	Galt, Ont	Apr. 15
May 10.	Cleveland, O	Apr. 15
May 13.	Charleston, S. C	Apr. 15
May 13.	Washington, D. C	Apr. 22
	Adv., Eng. RECORD, Apr. 22.	
May 15.	Lebanon, Pa	Apr. 22
May 22.	Vincennes, Ind	Apr. 8
	Adv., Eng. RECORD, Apr. 8, 22.	
May 22.	Cullman, Ala.	Apr. 29
	Adv., Eng. RECORD, Apr. 29.	
June 1.	Prineville, Ore	Apr. 15
——	Pleasantville, O	Dec. 24

GOVERNMENT WORK.

May 1. Duluth, Minn.........................Apr. 1
Adv. Eng. RECORD, Apr. 1 to 22.
May 1. Fort Hancock, N. J....................Apr. 8
May 1. St. Paul, Minn.........................Apr. 8
Adv., Eng. RECORD, Apr. 8, 15.
May 2. Dredging, New York City...............Apr. 8
Adv., Eng. RECORD, Apr 8 to 29.
May 2. Power plant, Kansas City, Mo. ....Apr. 22
May 3. Dredging, New York City...............Apr. 8
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May 8. New York City.........................Apr. 15
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May 8. Brockton, Mass.......................Apr. 15
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May 15. Cleveland, O.........................Apr. 22
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May 19. Pier, St. Joseph, Mich..............Apr. 22
May 20. Buffalo, N. Y.........................Apr. 22
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May 31. Rock Island, Ill......................Apr. 29
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May 1. School, McConnellsville, O..........Apr. 15
May 1. School, Glencoe, Minn...............Apr. 8
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May 1. Plans, etc., vault, Conroe, Tex......Apr. 22
May 1. School, New York, N. Y...............Apr. 22
May 1. School, Spring Garden, Pa............Apr. 29
May 1. Vent. & htg. school, Ironwood, Mich. Apr. 29
May 1. Hospital, Somerset, Pa...............Apr. 29
May 1. School, Fairmont, N. D...............Apr. 29
May 1. School, Charleston, W. Va...........Apr. 29
May 1. Repairing court-house, Starkville, Miss.......................................Apr. 29
May 1. Vent. & htg. school, Superior, Wis. Apr. 29
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May 2. Plans, etc., Bus. Bldg., Fargo, N. D. Apr. 8
May 2. School, Devils Lake, N. D............Apr. 15
May 2. Chapel, Marion, Ind...................Apr. 29
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May 3. Danville, Ill...........................Apr. 29
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May 3. Hospital, Jamestown, N. D...........Apr. 22
May 4. School, Monroe, La.....................Apr. 15
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May 15. School, Colfax, N. D.................Apr. 29
May 15. School, Watkins, Minn...............Apr. 29
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May 20. School, Huntington, W. Va..........Apr. 29
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May 1. Grading R. R., Lumberton, S. C....Apr. 29
May 2. Steel dumping carts, New York, N. Y...Apr. 22
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May 4. Subway, Morristown, N. J............Apr. 22
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May 4. Park work, New York, N. Y..........Apr. 29
May 6. Washington, D. C......................Apr. 22
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May 6. Levee work, West Memphis, Ark.. Apr. 15
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May 13. Park work, Toledo, O................Apr. 29
May 15. Railroads, Santiago, Chile...........Apr. 15
May 16. R. R. work, Richmond, Va ....Apr. 29
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June 30. El. Ry., Shanghai, China............Mar. 4
Oct. 1. Railroad, Moscow, Russia...........Feb. 25
—— Garbage plant, Savannah, Ga.......Apr. 29
Adv., Eng. RECORD, Apr. 29.

SCHOOLS.

Des Moines, Ia.—Bids are wanted May 24 for an addition to Oak Park school. M. T. Scanlan, Secy. Bd. Educ.

Centerville, Ia.—Bids are wanted May 20 for a school in District No. 8 Vermilion township. Jacob Harter, Secy. Bd. Educ.

West Burlington, Ia.—Bids are wanted May 17 for a ventilating and heating plant in a school. V. A. Johnson, Secy. Bd. Dirs., Independent School Dist. No. 4.

Frostburg, Md.—Bids are wanted May 5 for State Normal School No. 2, at Beall Park. Separate bids are wanted for a ventilating, heating and plumbing apparatus for the same. E. B. Pretyman, Secy. State Bd. Educ., State Normal School, Baltimore.

Osage, Ia.—Bids are wanted May 6 for a school in sub-district No. 3, Burr Oak township. Frank Lonergan, Chmn. Bd.

Superior, Wis.—Bids are wanted May for ventilating and heating the Blaine building and addition. H. H. Smith, Secy. Bd. Educ.

Adel, Ia.—Bids are wanted May 5 for a school in Grant township. D. H. Stoner, Secy.

Springfield, Mass.—H. C. Brocklesby of Hartford is stated to have prepared plans for a gymnasium for Mt. Holyoke College, to cost about $30,000.

Blooming Prairie, Minn.—It is stated that a $15,000 school will be erected.

Rochester, N. Y.—The Governor is stated to have signed a bill directing the Common Council to raise $100,000 for school purposes.

Ephrata, Pa.—Wm. A. Fink of Reading has prepared plans for a 4-room school, to cost $10,000.

Madison, Wis.—It is stated that the Board of Regents of the State University will receive plans until June 15 for an engineering building.

Denver, Colo.—The Governor is stated to have signed a bill appropriating $25,000 for new heating apparatus and improvements at the State Normal School; also the bill for $15,000 for improvements at the State Agricultural College.

Glendale, O.—It is stated that the citizens will soon be asked to vote on erecting a $25,000 school.

Leadville, Colo.—The citizens are stated to have decided to erect a school, to cost about $45,000.

Portland, Ore.—The plans of R. H. Miller are stated to have been accepted for a $40,000 school.

Salt Lake City, Utah.—The Board of Education is stated to have decided to erect an $18,000 addition to the Emerson School.

Denison, Ia.—The citizens are stated to have voted to erect a $15,000 high school.

Tilton, N. H.—The citizens are stated to have voted $20,000 bonds for a school.

Washington, Ia.—Weary & Halm of Freeport, Ill., are said to have prepared plans for a high school.

Colfax, N. D.—Bids are wanted May 15 for a school. H. E. Crandall, Jr., Clk. School Bd.

Washington, D. C.—Bids are wanted May 23 for a dormitory at the Chilocco Indian school, O. T. W. A. Jones, Commr. Indian Affairs, Dept. of the Interior.

Hinton, Ia.—Bids are wanted May 27 for a school in Perry Township. P. Flynn, Treas.

Geneva, O.—Bids are wanted May 15 for a school. Henry Means, Clk. Bd. Educ.

Stevens Point, Miss.—Bids are wanted May 8 for rebuilding a school in the 1st ward. A. R. Week, Chmn. Com.

Fairmount, N. D.—Bids are wanted May 1 for a school in Le Mars District. A. S. Hoffman, Clk.

Blacksbury, Va.—Bids are wanted May 5 for a building at the Virginia Polytechnic Institute; cost, $15,000. Wm. C. West, Archt., Richmond.

Spearfish, S. D.—The plans of Architect Gibbs of Lead, S. D., are stated to have been accepted for a dormitory for the Spearfish Normal School; probable cost, $25,000.

Huntington, W. Va.—Bids are wanted May 20 by the State Board of Regents for an annex to Marshall College to cost $15,000. Harrison Albright, Archt., Charleston.

Superior, Wis.—The plans of Haxby & Chisholm are stated to have been accepted for a $20,000 addition to the Blaine school.

Spring Garden, Pa.—It is stated that bids are wanted May 1 for a school in Spring Garden township. H. S. Paules, Treas., School Dist.

Oshkosh, Wis.—The State Board of Normal School Regents is stated to have authorized an expenditure of $25,000 for an addition to the school here.

Watkins, Minn.—Bids are wanted May 15 for a school in District No. 41. Michael Lies, Clk.

Indianola, Ia.—Bids are wanted May 6 for a school in sub-district No. 4, Whiteoak Township. W. A. Eberman, Secy.

Sandy, Utah.—Bids are wanted May 11 for a school. N. H. Hallstrom, Trustee.

Oskaloosa, Ia.—Bids are wanted May 11 for a school in sub-district No. 2, Monroe township. E. Brewer, Secy.

Waterbury, Conn.—Bids for school on Woodlawn Terrace have been rejected because cost exceeded appropriation. Probability of increasing size of building from 6 to 14 rooms, with consequent increase of appropriation to $40,000.

Des Moines, Ia.—Bids are wanted May 18 for a school in Grant Park district. J. L. Livingston, Secy.

Boston, Mass.—The following Boston architects have been selected by the School Board to prepare plans for schools as designated: Whitman & Hood, primary, Brighton; Greenleaf & Cobb, grammar, East Boston; Cabot, Everett & Mead, grammar, Dorchester; Wilson & Webber, primary, Roxbury; Chas. J. Bateman, grammar, South Boston.

Lynch & Woodward, Boston, have received the contract for the ventilating and heating plant in the high school, East Boston, at $19,700.

Charleston, W. Va.—Bids are wanted May 1 for an addition to a building at the West Virginia Colored Institute. J. M. Hazelwood, Chmn. Bldg. Com., Bd. Regents.

New York City.—The following bids were opened April 17 for an addition to school No. 84, Borough of Brooklyn; Thos. B. Rutan, 5 Court Sq., Brooklyn, $100,978; John Thatcher, 54 Park Ave., Brooklyn, $108,000; K. A. Murphy, 96 Linwood St., Brooklyn, $100,100; Mapes-Reeve Construction Co., 150 Nassau St., N. Y. City, $88,000.

Bids are wanted May 8 for additions to school No. 63 and alterations and additions to school No. 70, Brooklyn Borough; also for an addition to school No. 12, Richmond Borough. Richard H. Adams, Chmn. Com. on Bldgs.

The following permits have been issued for schools: 4-story brick convent to be erected by the Sisters of Mercy on 152d St. and Broadway, N. Y. City, to cost $40,000. Neville & Bagge, Archts., 217 W. 125th St.

5-story brick addition to be erected by the city on Watkins St. and Glenmore Ave., Brooklyn, to cost $80,000. C. B. F. Snyder, Archt., 585 B'way, N. Y.

4-story brick school to be erected by the city on Butler St. and 4th Ave., Brooklyn, to cost $108,000. C. B. F. Snyder, Archt.

3-story school to be erected by Rev. B. Frey, 225 Jerome St., on Liberty Ave. and Warwick St., Brooklyn, to cost $20,000. Schickel & Ditmars, Archts., 111 5th Ave., N. Y.

STREET CLEANING AND GARBAGE DISPOSAL.

Utica, N. Y.—All bids received April 21 for cleaning the paved streets have been rejected. The Clerk has been directed to advertise for new bids, also for bids for the collection of ashes, rubbish, etc.

Savannah, Ga.—Bids are wanted for the erection of a 100-ton garbage plant, as advertised in "The Engineering Record."

GOVERNMENT WORK.

Rock Island, Ill.—Bids are wanted May 31, at the U. S. Engineer Office, for the construction of dams and shore protections, also for the construction of levees and for dredging, as advertised in "The Engineering Record."

Chicago, Ill.—Bids are wanted May 25, at the U. S. Engineer Office, for dredging in Calumet River, as advertised in "The Engineering Record."

San Francisco, Cal.—Bids are wanted May 27, by the Superv. Archt., Treas. Dept., Washington, D. C., for all masonry work, roof covering, etc., for the U. S. Post Office and Court House, as advertised in "The Engineering Record."

Mobile, Ala.—Bids are wanted May 25, at the U. S. Engineer Office, for dredging in Ship Island Pass, at mouth of Pearl River, Miss., in Pascagoula River and Horn Island Harbor, Miss., as advertised in "The Engineering Record."

Milwaukee, Wis.—Bids are wanted May 25, at the U. S. Engineer Office, for Harbor of Refuge, Milwaukee Bay, breakwater construction; Racine Harbor, crib pier, breakwater, removal of old pier, and dredging; Kenoasha Harbor, pile and crib piers, crib breakwater, removal of old piers and dredging, as advertised in "The Engineering Record."

Louisville, Ky.—Bids are wanted May 22, at the U. S. Engineer Office, for furnishing and delivering Portland cement at Lock No. 5, Green River, Ky., as advertised in "The Engineering Record."

Oswego, N. Y.—Bids are wanted May 22, at the U. S. Engineer Office, for excavating rock in St. Lawrence River, N. Y., as advertised in "The Engineering Record."

Ellis Island, N. Y.—Bids are wanted May 22, by the Superv. Archt., Treas. Dept., Washington, D. C., for plumbing, marble and slate work for the main buildings at the U. S. Immigrant Station, Ellis Island, N. Y. Harbor, as advertised in "The Engineering Record."

Cleveland, O.—Bids are wanted May 15, at the U. S. Engineer Office, for dredging channels and constructing jetty and bar protection of brush and stone at Sandusky Harbor, O., as advertised in "The Engineering Record."

Baltimore, Md.—Bids are wanted May 25 for a storehouse at North Point. Col. Peter C. Hains, Corps Engrs., U. S. A.

Washington, D. C.—Bids are wanted May 6 for removing an old roof and building a new steel roof for copper rolling mill, at the Navy Yard at Washington. Mordecai T. Endicott, Ch. Bureau Yards & Docks, Navy Dept.

Fort Trumbull, Conn.—Bids are wanted May 18, at the Quartermaster's Office, for the construction and heating of a hospital; also for steward's quarters, at Plum Island, as advertised in "The Engineering Record."

New York, N. Y.—Major Henry Adams, Corps of Engrs., U. S. A., received only one bid for dredging the east channel of the entrance to N. Y. Harbor; it was from Andrew Onederdonk, No. 1 B'way, at 9 cts. a cu. yd. The contract calls for the dredging of the channel to a width of 2,000 ft. and a depth of 40 ft. at mean low water throughout its entire length, between the main channel and the sea. The amount of excavation necessary to complete the work is not expected to exceed 39,020,000 cu. yds., measured in place.

Manila, Philippine Islands. — Bids are wanted May 3 (readvertisement) for furnishing and erecting a complete refrigerating and ice-making plant at Manila. Col. J. G. C. Lee, Ch. Q. M., 415 Pullman Bldg., Chicago Ill.

Duluth, Minn.—The following bids were opened April 17 by Major Clinton B. Sears, Corps of Engrs., U. S. A., for furnishing cement to be used in constructing the concrete superstructure for breakwater at Marquette, Mich., amount to be expended for materials about $12,000: *a*, price per bbl. for 3,700 bbls. of natural cement; *b*, price per bbl. for 800 bbls. of Portland cement: William T. Berthelet, Milwaukee, Wis., *a*, $1.04 Keystone; Fowler & Pay, Mankato, Minn., *a*, $1.43 Austin; F. B. Spear & Sons, Marquette, Mich., *b*, $2.40 Atlas; The Kelley Island Lime and Transport Co., Cleveland, O., *b*, $2.35 Lehigh.

Chicago, Ill.—The following bids were opened April 18 by Major W. L. Marshall, Corps of Engrs., U. S. A., for constructing the foundations for 7 arch and 10 pipe culverts under the Feeder, Illinois and Mississippi Canal, as advertised in "The Engineering Record:" *a*, total for first group, miles 1 to 18, inclusive; *b*, total for second group, miles 19 to 28, inclusive; *c*, grand total: A. T. Young & Co., Chicago, Ill., *a*, $41,400.07; *b*, $41,180.10; *c* $82,580.17. Monroe & Bryant, Portsmouth, O., *a*, $35,243.32; *b*, $29,904.63; *c*, $65.147.95. T. W. Kinser & Sons, Terre Haute, Ind., *a* $48,527.71; *b*, $34,908.13; *c*, $83,430.84. Callahan Construction Co., Omaha, Neb., *a*, $31,128.42; *b* $26,525.40; *c*, $57,653.82. Jackson & Hogan, Chicago, Ill., *a*, $50,329.32; *b*, $37,842.36; *c*, $88,171.68. H. A. Boedker & Co., Chicago, Ill., *a*, $31,658.18; *b*, $29,196.88; *c*, $60,855.06.

MISCELLANEOUS.

New York, N. Y.—Bids are wanted May 4 for the construction and improvement of a portion of Claremont Park. Geo. C. Clausen, Chmn. Park Commrs.

Jersey City, N. J.—Articles of incorporation have been filed by the American Plumbing Supply Co., with $35,000,000 capital. The incorporators are: John Summerfield, Henry Haviland, Robert Barry, Jr., A. Matthews and James Hunt.

Toledo, O.—Bids are wanted May 13 for the proposed revetment and dock and for the necessary dredging and filling at Bay View Park. W. J. Sherman, Engr. Toledo Centennial Com.

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THE ENGINEERING RECORD.
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TABLE OF LEADING ARTICLES.

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THE AUSTRIAN SOCIETY OF ENGINEERS AND ARCHITECTS.

The fifty-first birthday of one of the great national technical associations, the Austrian Society of Engineers and Architects, occurred on Tuesday of this week. For half a century it has been actively engaged in advancing engineering knowledge and in struggling for the recognition of its members as representatives of a profession as important and learned as the law or medicine. For various reasons the Austrian society has not received the recognition in this country which its important work merits, although the report of its committee on arches has recently attracted considerable attention and favorable comment. In its own country, however, it has exercised much influence. The committee on arches was but one of many which have been appointed to study technincal subjects, some of them to supply definite information for the benefit of the members or to conduct investigations at the request of city or national authorities, or even the citizens of other countries, as in the case of the study of the effect of frost on green masonry, made at the request of Swiss contractors and reported at some length in these columns on March 17, 1894. Its "Zeitschrift," which appears every week, contains many important contributions and an excellent index to current technical literature.

The society was in a certain sense an offshoot of a still older organization, the Lower Austrian Industrial Society, which was founded in 1840, and numbered among its members many engineers and architects. At this time Austria was being rejuvenated by the railway. Late in 1837 an English locomotive, the first to be operated in Austria, was run over the Emperor Ferdinand Northern Railway. In the next ten years over 800 miles of railway was laid in the empire, and industries sprang up and grew rapidly, which had previously been languishing or practically dead because of defective ways of communication. The engineer became an important man. He was no longer to be patronized by the legal profession. The latter could refer to its centuries of steady growth; to the university traditions which, in the land of the last ruler of the Holy Roman Empire, were very strong; to the precedents and customs which had gradually placed the control of all bureaus of the Government in the hands of the lawyer. The engineer was practically self-educated, no university backed him with with its great influence, and there was no esprit de corps for the very good reason that the corps did not exist. But the engineer was sorely needed by the country in its rapid development, the lawyer unbent and came to him for assistance, and there was an opportunity to establish his standing in the community as a professional man. The Industrial Society tried to retain its engineers and architects by creating in 1842 a special section for the arts of construction. This was not a sufficent recognition of either profession, however, for their far-seeing members recognized that the time had come for independent existence. On April 20, 1848, the architects formed a new association and twelve days later the engineers followed suit.

Like all young engineering societies of the day, that of Austria had its little troubles. Thirty-three engineers petitioned for the charter, but only fourteen attended the meeting which was called to perfect the organization; still there were only eight members present at the meeting of January 5, 1853, at which the work of the American Society of Civil Engineers was inaugurated, so our society did not start under any more favorable auspices than that of Friedrich Schnirch and his associates. The government seems to have taken them under its wing by furnishing rooms free of charge for the meetings and inviting the society to be represented at all official building ceremonies. It was repaid, however, by the investigations made at its request by the youthful organization, such as those to determine the practicability of an adhesion line for the Semmering Railway, the curriculum for technical schools and the regulation of the Danube. At the beginning of the next year there were seventy-seven active and two corresponding members, and the first number of the "Zeitschrift" had appeared.

It would be out of place to follow the history of the society through all the fifty years of its active and useful career, but it is interesting to notice the manner in which it became an organization of architects as well as engineers. It may be recalled by those familiar with the early history of the American Society of Civil Engineers that it was the original purpose of the founders of that organization to include among its members not only civil engineers, but geologists, mining engineers, mechanical engineers, architects and other persons who were professionally interested in the advancement of science, and for this reason its early name was the American Society of Civil Engineers and Architects. In Austria the architects endeavored to found an association before the engineers, as already mentioned, but it died before it had a good grasp on life, and there was no architectural association in the country for many years after the engineers' society had become a flourishing body. In 1862 the German Society of Architects and Engineers, at its Hanover convention, decided to hold its next meeting two years later in Vienna, and notified its three members dwelling in that city of its intention. The local arrangements for the reception of the members of the German society fell largely on these three distinguished Vienna architects. They invited all the officers of the engineers' society to assist them in receiving the guests, and requested the unorganized Vienna architects to select an equal number of representatives.

This led the architects to recognize the importance of a permanent organization and their delegates to the reception committee were requested at the same time to consider the advisability of forming a national architectural society, or, if possible, of uniting with the engineers in an organization representing both professions. The latter project was received with enthusiasm by all concerned, the constitution and charter of the engineers' society was changed and in February, 1864, the old body became the Austrian Society of Engineers and Architects, which has remained the title of the association to the present time. The architects form a section of the society, which meets every second Wednesday, alternating with the section of mining and metallurgical engineers. The result of this consolidation was marked. The society gained rapidly in numbers and the famous structures which the Austrian architects were then designing or constructing gave additional credit to the association to which they belonged. The joint meeting with the German Society of Architects and Engineers was a brilliant affair, in which nearly 1,500 professional men participated and the sessions did much to bring the two professions into a prominent position before the Austrian public.

To-day the society has nearly 2,400 members, of whom about six-tenths live in Vienna. Its annual income is nearly 40,000 florins and the library has some 8,000 volumes. In the "Festschrift," which records the half century's work, there are accounts of many discussions and committee reports to which any association may look back with pride. Unlike similar bodies in some other countries, the Austrian Society of Engineers and Architects has never hesitated to place on record its belief or disbelief in municipal and national engineering undertakings proposed or in progress. It is believed that its decision has frequently had marked weight in influencing public opinion, and there is no question but its "Zeitschrift" has often reflected the opinion of the society on subjects of a wider scope than the mere technicalities, however important, of engineering and architectural problems. No one who reads the history of its past half century's work can fail to hope that its strong individuality and freedom of discussion will continue for many years to come, and that the good work it is doing for the engineering profession will result in still greater benefits than in the past, however important the latter may have been.

SOME EXAMPLES OF BRIDGE ENGINEERING.

In a recent issue of "The Transit," the engineering periodical of the University of Iowa, there are exhibited some most remarkable features of current highway bridge design in the State of Iowa. The unique details of a number of these designs, together with the descriptive comments on them in the publication mentioned, will be found after this introductory note. In a portion of the paper, not reprinted, there is an explanation why the original intention to call those instances of criminal bridge design "Engineering Crimes" was changed so as to denominate them "Examples of Bridge Engineering." This change shows too much leniency towards a class of dangerous offenses which have resulted many times already in appalling loss of life and no little loss of property. As a simple matter of fact the failure of ill-designed highway bridges occurs with uncomfortable frequency even though such disasters do not take place every month.

There are times when it is well to call a spade a spade, and when the principles of good structural design are so well set forth and familiarly known as at present, and so cheaply attainable in the shop, all parties on whom rests the responsibility of authoritatively considering such matters, should now use very plain English. Designs like those shown in detail by the Transit are instances of such gross technical imprudence on the part of the authors, and involve such open disregard of responsibility, with imminent fatal danger to the users of the structures, that it is at least no extravagance of language to call them morally criminal.

There was a time during the infancy of bridge building twenty-five or thirty years ago when even the computation of the main stresses in many forms of trusses was none too well understood, and the proper design of many simple details as well as all of the more complicated ones completely failed of recognition. As meager as was the knowledge of those days, however, the wretched designs of the Iowa highway spans under consideration would then have been inexcusable. More than twenty years

ago, the correct determination of the greatest moving load stresses in the ordinary truss with chords parallel, or nearly so, was regularly practiced, as it was also abundantly set forth in engineering literature. Yet in this day of excellent structural design a public corporation in Iowa is so ill administered that a so-called bridge designer, ignorant of so simple and fundamental a fact, can impose upon it a dangerously weak bridge for constant daily use. It is of course possible that the designer may have perfectly understood the proper system of computation, but intentionally used the erroneous procedure to reduce the sections of web members, trusting that the operation was plausible enough to escape criticism, at least from the public officials with whom he was dealing. Probably, however, all these miserable bridge designs result from what has been aptly termed crass ignorance, although it certainly is remarkable that the variations from good designs are always on the side of reduced sections and weak details, resulting in great danger and many failures. The second case cited in the following excerpts is a fair illustration of this point. Aside from the thoroughly scandalous character of the details, the rivet-bearing on one-half inch rivets runs up to 38,000 pounds per square inch, while the shearing reaches the amount of 24,000 pounds per square inch. Perhaps the most remarkable proposition among those that have lately come to light in connection with highway bridge building is that for the "rivetless steel bridge" composed of "iron timbers as shone" the timbers having "rivets spaced from 3 to 4 inches to sute the work."

It seems to be the opinion of "The Transit," as it is of many others, that if all who practice the profession of engineering had to submit to an examination before some authorized State board, the incompetent or ignorant practitioners might be weeded out. It is practically certain that this alone would not cure the trouble. There must not only be well qualified civil engineers, known to be such, but they must be brought in touch with public officials, and the latter must feel that the performance of their duties in connection with public works must be guided by the engineer's advice. As long as public officials resort to unrestricted competition for public works, without professional guidance, the public will have sham bridges to prop up, fall through and rebuild. "The Transit" has rendered a public service in calling attention to these matters, and it is to be hoped that it will continue its good work.

"The examples to be presented in this issue are the following: Figure 1 is a stress sheet of a bridge of two hundred and fourteen feet span, which was designed to carry a load of 1,000 pounds per lineal foot, exclusive of its own weight, which is given as 660 pounds per lineal foot. The web stresses on the left side

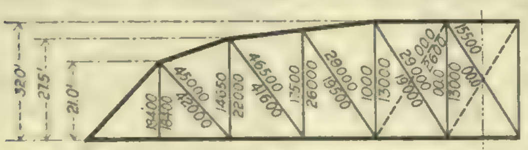


FIG 1

of the pieces are those given by the designer, who evidently assumed that dead and live loads produced the same effects on the stresses. On the right side are seen the corrected stresses, which, for the sake of comparison, were calculated on the same erroneous assumption. But disregarding such a comparatively small matter as the difference in effect of live and dead loads—which Cooper places at about 100 per cent., and Waddell at about 56 per cent., for a bridge of this length of span—it can easily be understood from the enormous errors in the stresses which the members were designed to resist, why many of them are so dangerously light. Four of the columns, for instance, are 32 feet high, made of two 5-inch 6½-pound laced channels, having a thickness of web of 0.17 inch. Thus all rules of practice concerning minimum thickness of web and maximum ratio of height to width have been disregarded in these members.

"The webs are but two-thirds as heavy as the minimum allowable, while the columns, being 74 times their width in height, are 1 2/3 times as long as the allowable maximum. It will be observed that in these pieces the designer calculated on only 1,000 pounds of stress in one pair and nothing in the other, whereas, without allowing for the impact or increased effect of moving load on the stresses, each of these columns must sustain a stress of 13,000 pounds. All who are familiar with bridge stresses will see at a glance that the computer made these serious errors by calculating the web stresses for the load entirely over the bridge. . . . Such structures are often excused by the statement that bridges in the country never have on them the loads for which they are supposed to be designed. If so, the fact should be provided for in lighter loading. But it is important to note that in sections of the country where large numbers of cattle are raised this is not in accord with fact, for a drove of cattle taken over a bridge will load it to approximately the loading prescribed for this bridge, i. e., 66 pounds per square foot; and furthermore, from the characteristics they possess of jamming in the front rank, they create maximum web stresses, and by stampeding when the first few are across they produce surprising vibrations, thus making heavy chord stresses. For the ordinary uses to which this bridge will likely be put it will doubtless hold up for some years, but we learn from data in use by the government that a structural steel surface in air will corrode from 0.25 to 0.3 inch deep in a century. If these data are correct, then in 25 or 30 years the 0.17 inch webs in the columns referred to will have passed entirely away. How long before that time failure will occur is a matter of conjecture, depending on the loads which may happen to come on it after it has seen a few years of service, and the attention, or lack of attention, it receives by way of painting, with coatings other than red lead.

"Another example of light sections of bridge members is shown in Figure 2, in which the maximum thickness used is the minimum allowed by standard specifications for light highway bridges. All sections, even of the bottom chord, are ¼ inch or under. The span is 100 feet and width of roadway 16 feet. There is hardly a joint or member which will stand analysis. For instance, since the bridge is unquestionably a light one, assume its whole weight, including the floor system, to be 400 pounds per lineal foot, and take the live load as 1,000 pounds per foot. Then the equivalent static stress in the center bottom-chord piece is about 57,000 pounds. The center fastening seems to be made with six ⅝-inch rivets in each piece in single shear, and bearing on a ¼-inch plate, hence the bearing pressure is about 30,000 pounds, while the shear is about 15,500 pounds per square inch. But at the other end of this same bar the fastening seems to be made to a ¼-inch plate by six ½-inch rivets. Manifestly the same stress must be withstood by these smaller rivets, and we find the bearing pressure to be 38,000 pounds and the shear 24,000 pounds per square inch. The net area of these strap chord pieces themselves contains but 2.37 square inches, giving a unit stress of 23,000 pounds, or 50 per cent. above what it should be. The fastening of the hip vertical and first diagonal is particularly weak also, but it would be difficult to tell which point would give away first. This bridge is evidently waiting the load for which it is supposed to be designed—when it will doubtless fail. It is new now, but in ten years, on our previous mentioned rate of corrosion, many pieces will not be over ⅛ inch thick, and the users of it will have become confident of its strength. But the water it spans is but 4 to 5 feet deep and the bridge is but 6 to 8 feet above the ordinary water mark. The results of its failure may not, therefore, be expected to be very terrible.

"Not so, however, with the most startling details forming part of the construction of the bridge shown in Figure 3, which is over 70 feet above the water. As shown on the full detail sheet it is an aggregation of weak points, similar to the last bridge mentioned, but one important detail is so very weak and its failure would be attended by such horrible consequences that it only will be mentioned here; it is shown in Figure 4, which was made from a tracing of the original design without the slightest change except blocking out the title and inserting the large reference arrows. [This illustration has been redrawn for 'The Engineering Record,' as the cut in 'The Transit' could not be reproduced.] This cut represents a half cross-section of the bridge and shows the details of the bracket attachments for the sidewalk. Engineers all know that rivets, being driven hot, are put in such a state of tension on cooling that this initial stress many times causes rupture, which usually occurs by their heads flying off. It is therefore never admissible to supply an important tensile resistance by rivets. Now assuming that this bracket with its floor and joists will weigh but 20 pounds per square foot; that the live load will never exceed 70 pounds per square foot, and the iron hand railing will weigh 25 pounds per lineal foot. Then the horizontal pull in the top of the brace fastenings will, without impact, be 17,000 pounds. By observing the fastenings at the arrow B, we see that this stress must be resisted by rivets in tension, and further that practically the whole stress must pass through one pair of rivets. If these are ¾-inch rivets, we see that they would have a stress of quite 20,000 pounds per square inch under full load; but they would likely break with 1/10 to 1/3 of this stress, or such as would be caused by the dead weight alone. The exact arrangement of this joint is a little difficult of comprehension at first, but by reference to B' on the upper part of Figure 4, it will be seen the hanger is not slit to admit of a plate passing through it, hence the attachment must be by tension rivets.

"The upper attachment at the arrow A needs no comment. The angles forming the column are 3×2½ inches with no thickness given. The distribution of the shear needs no analysis here. Neither does the stress in the wind brace fastening. Had a deck bridge been used at this site the center pier would have been reduced in height by 1/3 and the spans materially shortened, and in fact there seems no good reason for using a center pier at all.

"Should such a structure be so unfortunate as not to fall of its own weight during construction, it might likely hold until heavily loaded. as with people gathered to watch a freshet in the stream 70 feet below, when the horrible consequences can readily be imagined. But the bridge has been built and no such accident has occurred. This can only be explained by the statement that the contractor must have adopted a different detail, which it can well be supposed he would, to relieve himself from risk.

"In Figure 5 is presented, without analysis, the drawing and verbatim specifications of a rivetless steel truss which is being sold to the laymen. The stresses as computed, as well as the details and general plan, will be found to be of interest as well as to serve the purpose of this article.—[The specifications are not reproduced in the accompanying illustration, but they read as follows: 'Iron Tubes as shone by exivite A Tubes rivets spaced from 3 to 4 inches

to sute the work Cap stone on top of each Tube 6 inch thick 10 inch acrost round as the Tube 12 inches concrete under each Tube as fowls bronen Rock or pebleston not to excead over 2 inches dimeter clean from earth and dirt 4 parts Rock to one part cement mortar composed of one part Best Louisville Cement two ½ parts clean sand mix dry before weating after mortar weat and mixed with Rock then throw in place and ram done solid before it seats tubes filed with the same. if the gravle is not clean must be washed with water till clean before used.' The legend of this drawing also deserves to be put on record, for it runs as follows: 'Live load—1600. lbs ger linel foot. Safety factor of 5 included on plan. Wind presur—28 lbs. per squar foot. Snow load stresses, 12 lbs. per foot, Also dead load.']

"The last example of engineering to be mentioned is shown in Figure 6, which has more vital weaknesses in it than would appear at first glance. [On the drawing as printed in 'The Transit' there was a note to the effect that the floor system is composed of 15-inch 42-pound beams, eight 7-inch roadway joists, two 7-inch sidewalk joists, 3-inch plank for both sidewalk and roadway, 3x6-inch wheel guards and 3x7-inch nailers. The substructure is asserted to be two bents, each having six steel tubes 6½ inches in diameter and 20 feet long and two steel beams 5 inches deep and 25 feet long. The composition of the truss is: Rafters, each two 5-inch lap-welded steel tubes; spreaders, one 7-inch lap-welded steel tube; bottom chords, each two 2½x13/16-inch steel bars; verticals, each two 2x⅛-inch steel bars; counters, each a single 1 3/16-inch steel bar; pin, 2½ inches diameter; live load, trusses, 1,800 pounds per foot; dead load, 500 pounds per lineal foot; floor system, 100 pounds per square foot.] For instance, with but 5-inch I beams used as caps on top of the gas pipe, used as piles, it is evident the piles in the center cannot help to support the trusses till those at the ends and immediately under the bed plate have settled. This settling would occur under full load and when the bridge was again empty it would rock over the center piles. But there are two dangerous points which cause unwarranted risk of life and property. The first is the 1¼-inch cock-eye bolt fastening under the hip. The strength of a cock-eye cannot be determined with any degree of assurance, but one acquainted with the strength and nature of metals would at once pronounce this dangerous under nearly 35,000 pounds stress. The second point is the

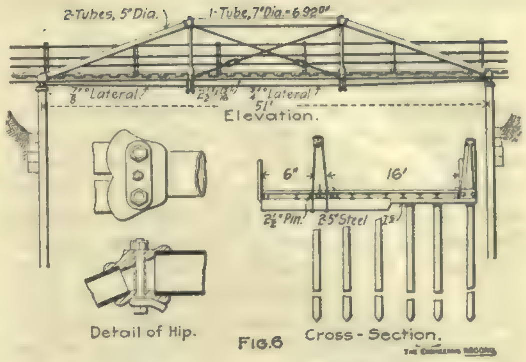


FIG.6

pin in the bottom chord. Using the designer's own loading, this pin would have in it a stress of about 75,000 pounds per square inch, which would insure its failure and the collapse of the bridge, should it ever have on it the load which it is supposed to have been designed to carry.

"The foregoing illustrates the quality of work being perpetrated on the people. It will be noticed no example of faulty design or construction of railway bridges is given. This is because we know of no cases to be put in the above class and it is safe to say few, if any, could be found in the State which should be put in the same category. The reason for this is that railways employ engineers who are competent to protect them against such practices. All of the cases cited are examples of structures sold to county officials, whom there is no more reason to suppose able to analyze bridges than that a lawyer could pass judgment on a physician's prescription. And there is hardly a limit to the number of cases that could be given were it necessary. Aside from the great wrong done the people this condition must react against the profession. Engineers have recognized this fact and endeavored to have laws passed to better their condition. State legislatures have refused to pass such laws, and maybe wisely. The law, when enacted, should have as its first object the protection of the public. Let all who wish, practice civil engineering, but let the law declare it a punishable offense for anyone to design or construct bridges for the public unless he possesses a certificate of competency from a State board of examiners. And it is more important, as affecting the death rates of our towns and cities, that a similar law should be in force concerning the engineer in responsible charge of sanitary work. But such a law in itself would not insure protection to the people. It must further be within the power of the examining board, and it must also be its duty, to annul the certificate or license of an engineer for dishonesty, manifest incompetency or unwarranted risk of life or property."

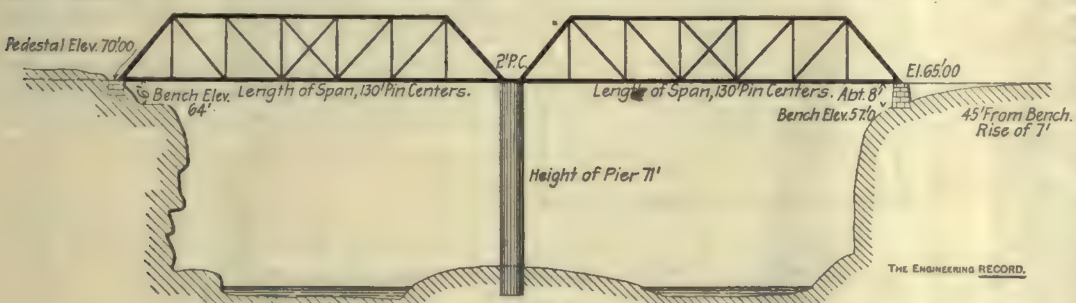


FIG.3

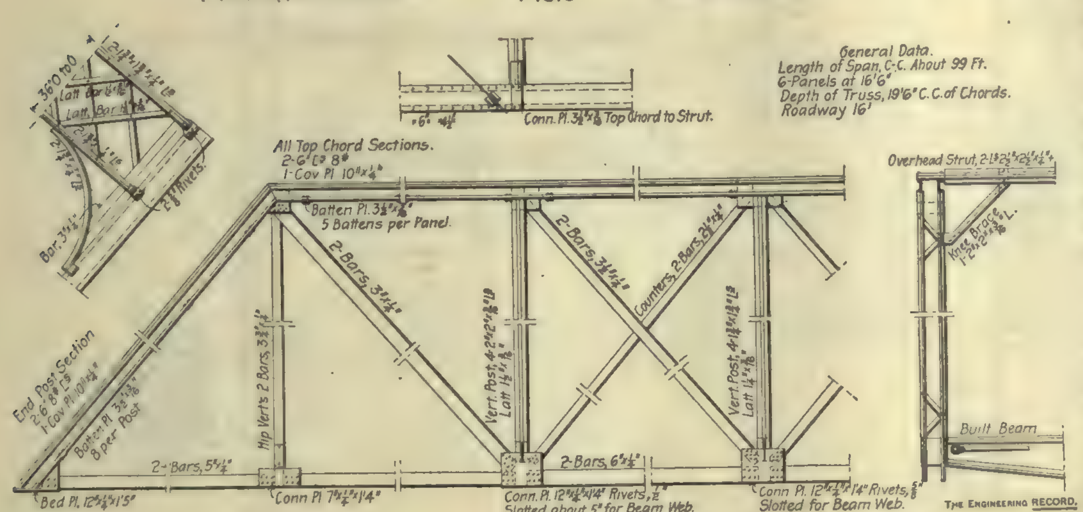


FIG.2

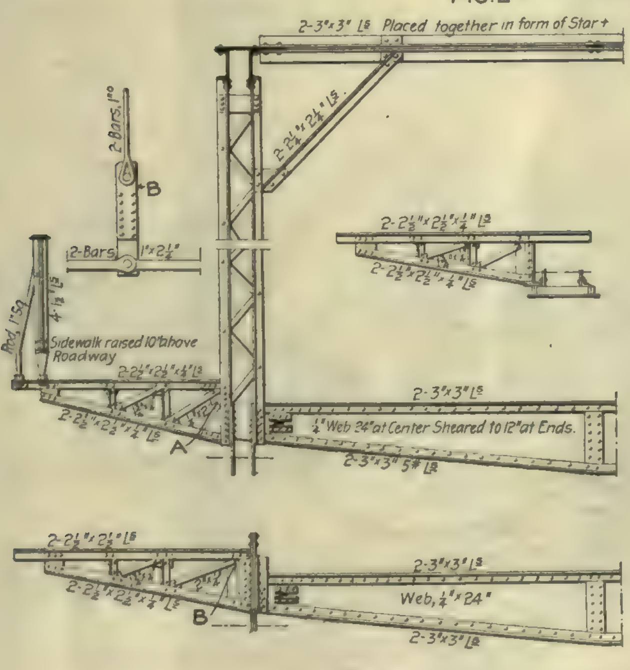


FIG.4

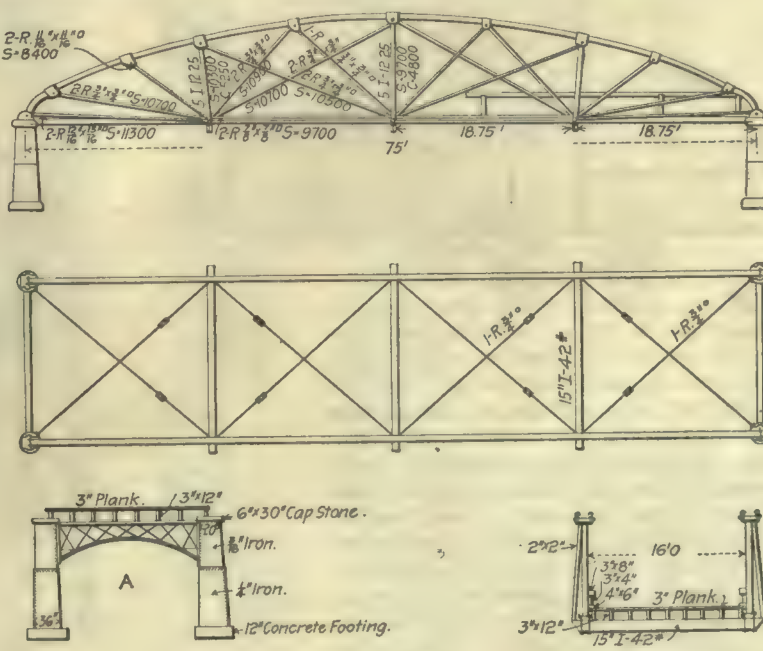


FIG.5

THE DETAILS OF BRIDGES FOR SERVICE IN THE STATE OF IOWA.

THE VULCANITE PORTLAND CEMENT COMPANY'S WORKS.

[By Frederick H. Lewis, M. Am. Soc. C. E.]

The Vulcanite Portland Cement Company of Philadelphia is intimately associated in ownership and in its directorate with a much older corporation, known as the Vulcanite Paving Company, which has been identified for many years with the asphalt and cement pavement business in Philadelphia. Indeed the plant at Vulcanite, N. J., originated some five years ago in the desire of the Vulcanite Paving Company to be able to command an assured supply of Portland cement of the quality required for its paving business.

At the outset three 40-foot kilns were installed. Two additional kilns were added to this plant, and as further additions were impracticable owing to the location of the buildings, an entirely new plant of six kilns was constructed last year and put in operation the past winter. Hence the works at this time comprise two complete and independent cement plants, one of them containing five kilns, which have been in operation some years, and the other six kilns which have just recently been put in operation. Both plants are complete in all their details, even to separate quarry outfits and cable tramways. The office and laboratory are the only features which are common to both.

In the general plan, Figure 1, the old plant is to the left, adjacent to the railroad, and the new plant is to the right and back from the railroad. In their general features and arrangement the old and new plants are much alike, but they are not equally interesting, because, while the older one has been a gradual growth, the new one represents the views of the Vulcanite managers in a modern plant as solidly and substantially built and equipped as any construction in the way of cement plant which has yet been attempted in this country or in Europe. The cost per unit of output is undoubtedly high, but it is believed by the management that this will be fully compensated by economy of operation. The duty required of machinery and power in a Portland cement plant is heavy and continuous, and it is found that liberal expenditure to install ample power and machines of large capacity is economy in the broader and more intelligent sense of the word. Prior to building the new plant at Vulcanite the company had a diamond drill survey made of the rock deposits, under the direction of Mr. E. V. d'Invilliers, geologist of Philadelphia, and in this way located the position of the rock strata and the quantity of available rock for cement purposes, indicating a very large reserve supply sufficient for many years, and warranting a large expenditure on the new plant.

In general features of machinery and equipment the old plant is similar to the new one, hence the latter only will be described. There are four principal features in this plant; 1, the power plant; 2, the stone house and mill building; 3, the kiln building; 4, the stock house. In this order they will be described.

The Power Plant.—Two compound condensing Corliss engines of 500 horse-power each constitute the main power installation. They were built by the Pennsylvania Iron Works of Philadelphia. A view of the interior of the engine room is shown on Figure 8. The two engines drive different shafts spaced about 12 feet centers and leading across the mill building. See Figure 3. One drives the stone house and raw material mills with their accessories, conveyors, elevators, etc. The other drives the cement mill, clinker crackers, stock house con-

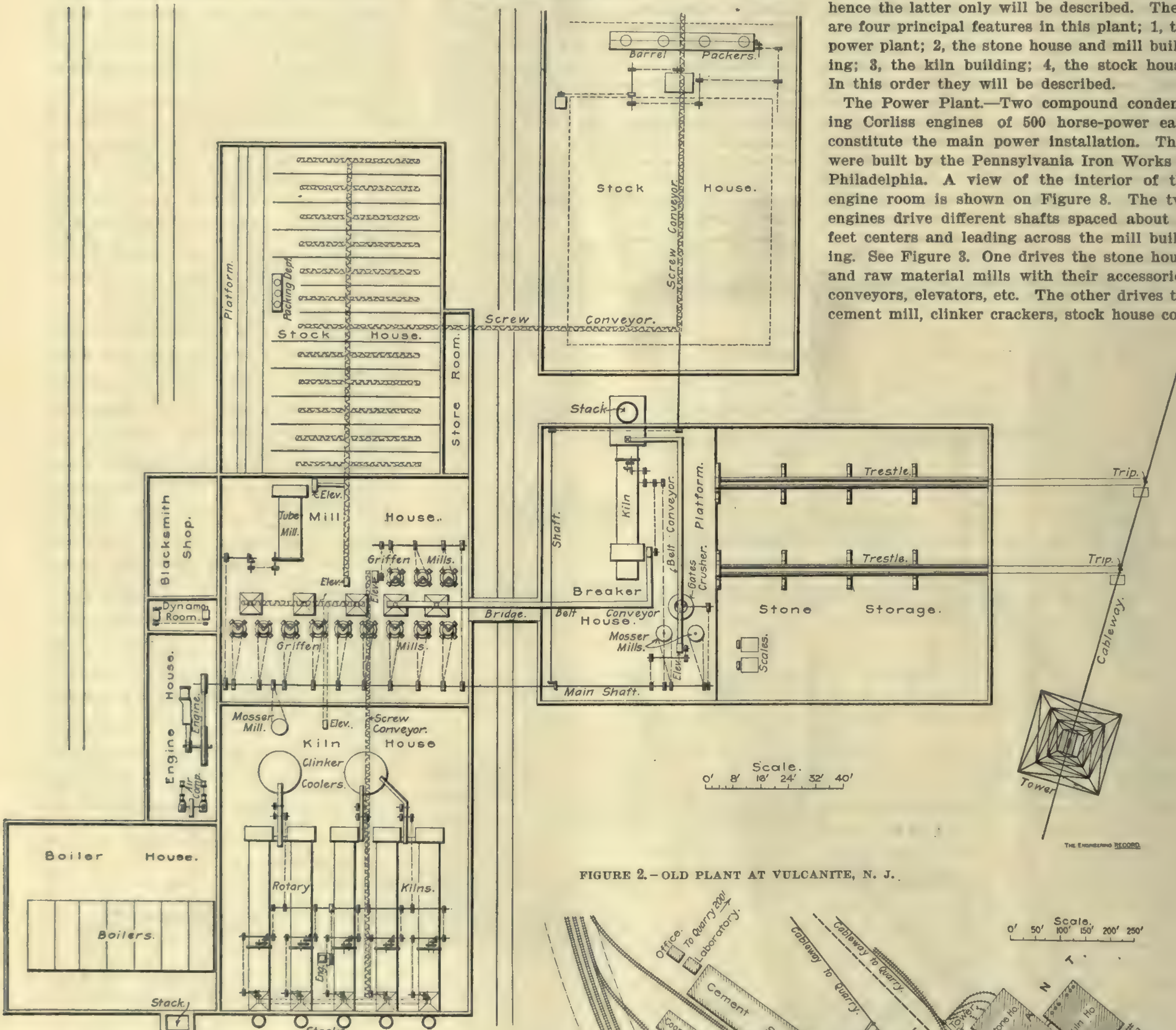


FIGURE 2.—OLD PLANT AT VULCANITE, N. J.

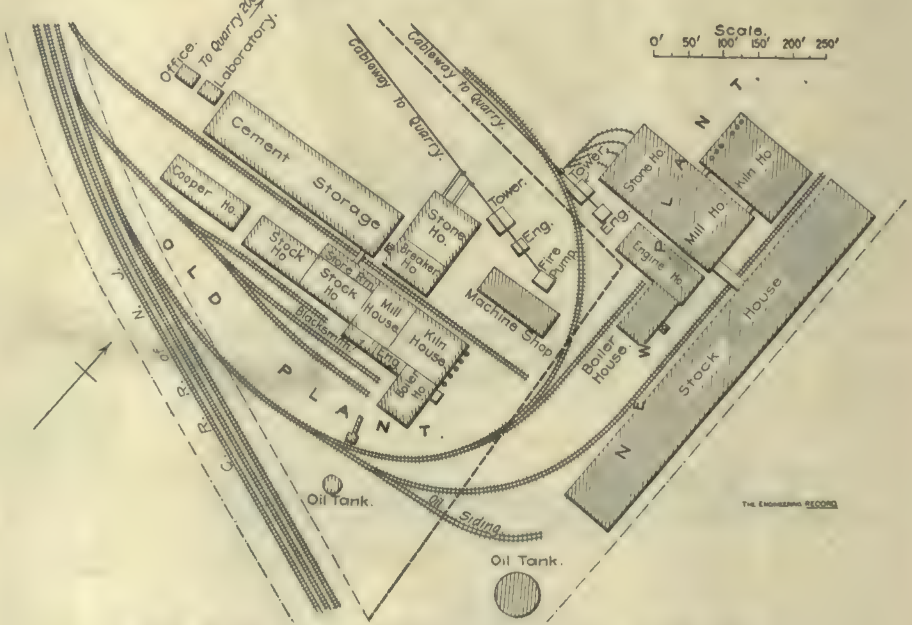


FIGURE 1.—THE OLD AND NEW CEMENT PLANTS AT VULCANITE, N. J.

veyor, etc. The one thus handles all machinery required for raw material from the stone house to the bins at the back of the kilns; the other all machinery required to handle cement from the clinker crackers to the stock house bins.

Each side of the mill is thus entirely independent of the other in the matter of power. The kilns and their accessories and the stock house and its accessories are run by auxiliary engines set up in the respective buildings. The kilns are thus run regardless of whether the mills are in operation or not, and the stock house machinery is operated or stopped irrespective of work going on elsewhere. This general scheme of distribution of power is undoubtedly correct, and has been admirably carried out at Vulcanite, as will be seen by examination of Figures 3, 4 and 5. A small auxiliary engine will also be seen in the boiler house operating the Wilkinson stoker with its elevator, conveyors and coal pockets.

Besides power engines there is an Ingersoll-Sergeant air compressor, an electric generating set and the pumping engines. The boiler plant consists of seven return tubular boilers of 150 horse-power each, built by Henry Goldner & Son of Philadelphia. As indicated above, they are equipped with the complete Wilkinson stoker for handling and feeding coal and discharging ashes. Each boiler has independent blow-off pipes set in the passage under the smoke flue. The high standard of excellence in this power installation will be apparent.

The Mill Building.—At Vulcanite the cement rock is brought from the quarry, see Figure 1, in skips, on a rope tramway, furnished by S. Flory of Bangor, Pa. It is discharged from the skips at a tipple dropping into service cars. The limestone required for perfecting the cement mixture is received by rail. Both grades of stone are dumped on the floor under the trestles shown in the stone house, Figure 4, and a sufficient stock is maintained at all times on the floor to permit of making the necessary analyses and computation for proportioning mixtures. These mixtures are made by weight, as the stone is charged into a crusher and begins the process of reduction. It is practicable to make the mixture at the outset in this way because the two grades of stones are practically the same in hardness, gravity, etc. There are two Gates crushers set to different gauge, each discharging into the foot of the elevator shown between them. The stone is thrown into the one at the right, and on passing through is elevated to revolving plate screens made by the Gates Company. These screens are carried overhead on a trestle and are perforated with ¾-inch holes. All material which passes through the screens falls into a hopper below, and thence passes by a chute into a dryer. Material which is too large for the screens passes out of them at the lower end and thence falls by a chute into a second Gates crusher.

The rock dryer is a revolving sheet iron drum carried on trunnions. There is a coal fire at the lower end and a chimney at the upper, with the heated gases passing through the drum from the fire place to the chimney.

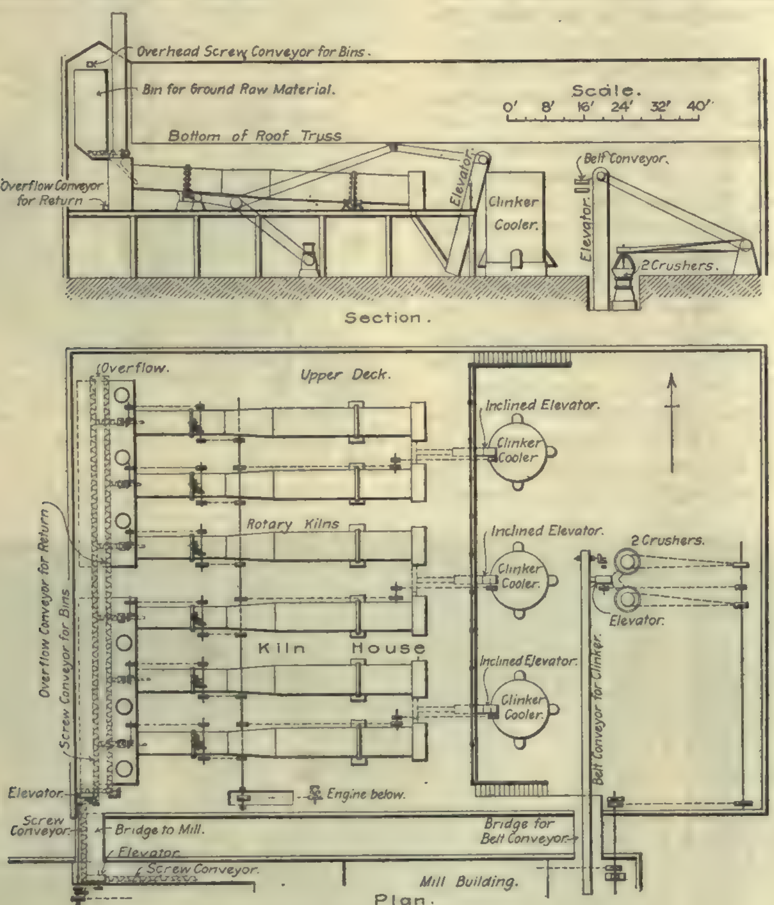


FIGURE 5.—THE KILN BUILDING.

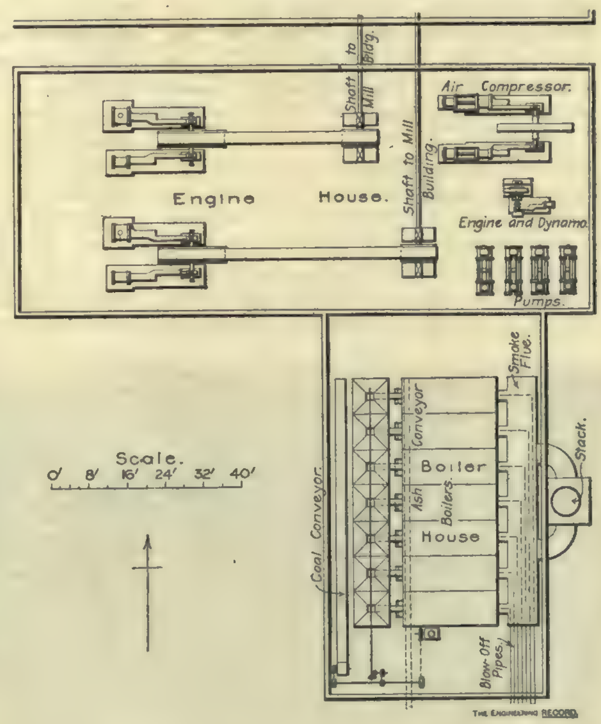


FIGURE 3.—NEW POWER PLANT.

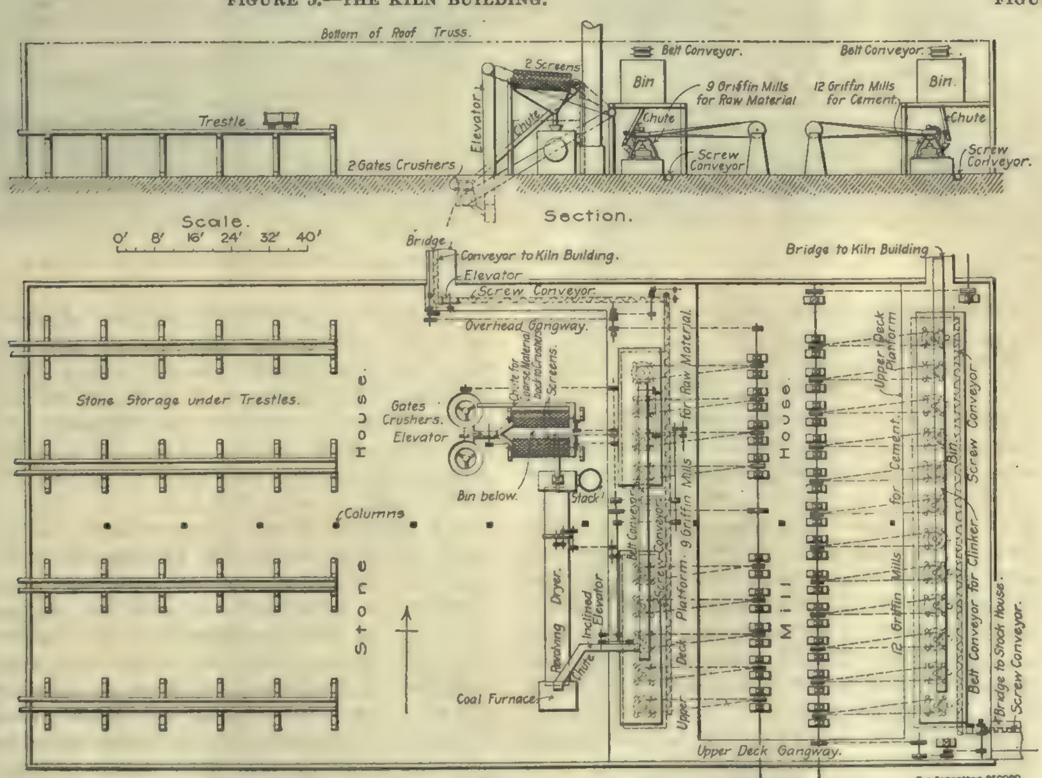


FIGURE 4.—THE STONE HOUSE AND MILL BUILDING.

From the dryer the stone is elevated to bins which are set on a staging of steel work over the raw material mills. Of these there are nine, all 30-inch Griffin mills. In them the reduction of the raw material is completed. It passes from them directly by conveying and elevating machinery, see Figures 4 and 5, to the bins at the rear of the kilns. Some 50 feet in the rear of this line of mills is another group of 12 Griffin mills, which are run on clinker, and are shown in Figure 7. Their setting, with bins on staging above and with conveyors below, leading to elevators, is similar to that of the other group of mills. Between the two groups of mills are the two shafts leading from the main engines, with the belt drives to each group. The driving belt of each mill has its own friction clutch on the line pulley, and any mill can be cut out by releasing the clutch. The overhead conveyors, carrying stone and clinker, are rubber belts. The conveyor to the stock house is shown in Figure 4, and there is a link belt drive leading over the bridge to the stock house for the purpose of driving the overhead conveyor distributing cement to the stock house bins. Whenever the cement mill is in operation these conveyors to and through the stock house are operated by the mill engine.

The Kiln Building.—This building is for the most part two stories high and has the kilns

FIGURE 9.—VIEW OF THE STOCK HOUSE FROM THE RAILWAY.

on the upper floor, some 16 feet from the ground. There are six kilns, 60 feet long and 6 feet in diameter, narrowing to 5 feet 6 inches at the upper end. They were built by W. F. Mosser & Son of Allentown, Pa., and are mounted and turned in the usual manner. All six kilns are driven by one 25-horse-power engine, set up on the ground floor below, and belted to a main shaft running under the kilns. From this line shaft there are link belts leading to counter shafts which drive the train of gears ending in the pinion which engages the rack on the body of the kiln. The same counter shaft drives the feed screw from the raw material bins. There is a change of speed provided for the counter shafts by throwing in friction clutches on different drives. Any change of the speed of revolution affects also the feed of the raw material, so that the bed of raw material on the kiln lining is constant. The fuel

FIGURE 7.—THE CEMENT MILLS.

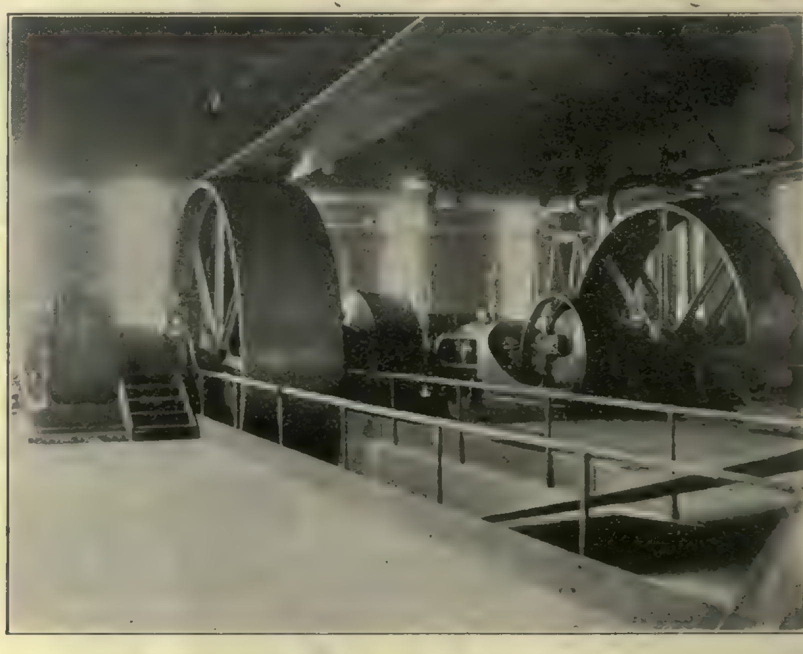


FIGURE 8.—INTERIOR OF THE NEW ENGINE HOUSE.

used in these kilns has been oil, but this is soon to be replaced by coal. The end housing of the kilns is shown in Figure 6.

The six kilns discharge in pairs by chutes dropping the clinker into three elevator boots. It is elevated into three cooling tanks, as shown in Figure 5, which have an artificial circulation of air and discharge nearly cold clinker from chutes at the bottom. This clinker is cracked in two Mosser crackers and passes thence by elevator and belt conveyor to the cement mill.

The Stock House.—In size, capacity and cost this building is believed to be unique in cement manufacturing. It is a substantial brick and iron building, with slate roof, about 80 feet wide by 590 feet long, and will store 70,000 barrels of cement. It sets on ground which has a natural slope to the east, and seen from that side, as in Figure 9, its great size is accentuated. It has 6-foot alleys on either side, with conveyor troughs set in the floor. Excepting a few transverse gangways, one of which contains barrel packing machinery, the entire building between the side alleys is given up to cement bins.

All the buildings described above are of substantial brick and iron construction, with the exception of the stone house, which is a steel skeleton building sheathed with galvanized iron. The power building, boiler house, stone house and kiln platform have substantial concrete floors. Taken as a whole, it may fairly be said that the plant is as genuine and substantial in construction as anything which has been built for Portland cement manufacture.

The writer is much indebted to Mr. J. B. Lober, vice-president of the company, and to Messrs. Stradley and Dunn, secretary and superintendent, respectively, for the opportunity to describe this plant for the readers of "The Engineering Record."

MUNICIPAL NOTES.

The experience of the city of Fitchburg, Mass., as a contractor for state roads has not been a success, according to the annual report of Mr. David A. Hartwell, city engineer. He states that under one contract the city lost about $1,000 and under a second the loss was about $4,000. "There is no reason to think that these roads would not have been built," he reports, "if the city had not taken the contracts, and, for all practical purposes, as good as they have been built by the city, and the city would have been $5,000 richer. . . . If any more sections of state road are laid out within our limits we would better not have anything to do with their construction." Two streets have been macadamized by the local street railway company; in both cases the track is in the center of the street and paving brick have been laid on a concrete foundation between the rails. From the rails to the curbs the work consists of a foundation of small field stone covered with a layer of broken granite and finished with about 3 inches of trap rock.

Service pipes are referred to in the annual report of Mr. F. F. Forbes, superintendent of the Brookline, Mass., water-works, and it is interesting to notice that his experience has been entirely opposite to that of Mr. Chase at Taunton, mentioned in these columns on March 4. The few leaks that have occurred recently in Brookline have been on old lead pipes and have

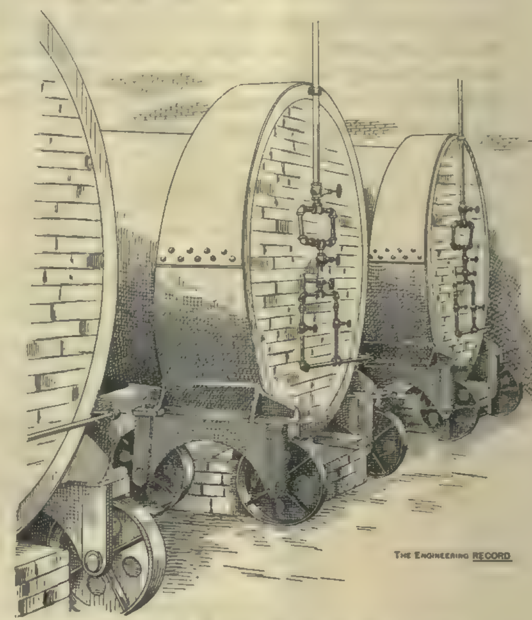


FIGURE 6.—END HOUSING OF KILNS.

been remedied at a small expense. Cement-lined iron pipe is still used, and in nearly 25 years' experience there has not been a single instance of diminution of flow due to the formation of rust in the services. Several which were removed on account of changes in grade or for other reasons, were found as smooth and perfect inside as when first laid.

The portions of the report relating to the check of water waste read as follows: "The usual amount of time has been given to the inspection of water fixtures, and the leakage traceable to defective plumbing has formed about the same percentage of the total consumption. A water meter is the best inspector, and those who have studied this subject most thoroughly are convinced that water should be sold only by the meter. With houses properly piped and provided with good fixtures, meters

would prove a hardship to no one and in most cases would be an advantage. From a careful reading of the reports of nearly two hundred cities and towns, it is very evident that the use of water meters is rapidly growing and that the prejudice against them is fast disappearing."

The storage of the supplies of a water department is a matter of considerable importance, particularly to a small city, which, if it has ample room, can take advantage of low prices and lay in material for some time to come at rates which will mean a considerable ultimate saving. The superintendent of the Binghamton, N. Y., water-works, Mr. Darwin Felter, reports that his department has lately built an addition to its storage shed and now has a building 297 feet long and 17 and 20½ feet wide. The portion of the ground floor used for heavy material other than pipe is concreted and paved with brick, and the total floor room is over 11,000 square feet. In one portion of the shed a machine shop has been fitted up with an 18-inch by 6-foot lathe, a shaping machine, an upright drill and a full outfit of tools. Such a shop, in the hands of a competent superintendent, pays for itself in a short time and it is surprising that so few departments have one.

The water supply of the Boroughs of Manhattan and the Bronx is becoming a matter of serious concern to the officials in charge of that department of the affairs of Greater New York, and the first annual report of Mr. William Dalton, Commissioner of Water, makes some very plain statements on this subject which are worth quoting.

"During the year 1898 the quantity of water daily distributed and consumed in the two boroughs was increased from 231,000,000 gallons to 238,000,000 gallons in June, 251,000,000 gallons in August, and 256,000,000 gallons in September, after which it gradually diminished to 244,000,000 gallons in December. The average for the whole year was 243,000,000 gallons per day, which is 121 gallons per capita for a population of 2,000,000. It shows the enormous increase of 17,000,000 gallons in the total, and 9 gallons per capita over the daily consumption of water in 1897, and 98,000,000 gallons, 31 gallons per capita, over the consumption in 1890, when the new aqueduct was first brought into use. Making the most liberal allowances for increase in population and buildings and new demands on the water service by new contrivances and methods for domestic, industrial and sanitary uses of water, the conclusion is yet irresistible that enormous quantities are carelessly or wantonly wasted without any possible benefit in any direction. If such rate of increase should continue, all previous calculations and estimates as to the future necessities of the city and means of meeting them will be set at nought; the magnificent resources of the combined watersheds of the Croton, Bronx and Bryam Rivers will be exhausted or exceeded in a few years, and many more millions of dollars of public funds will, in a few years hence, have to be invested in obtaining water from new, more distant, more expensive and practically inexhaustible sources. The lesson to be drawn from this experience is the absolute necessity of effective measures to restrain waste, even at times when there is a superabundant supply, because prolonged and unchecked indulgence in waste creates a fixed habit which cannot be overcome so long as the material for waste is at hand.

"The water meter and the enforced payment for water at meter rates, have, so far, been the only practicable and effective means of detecting and checking waste. There are now 35,442 meters in use in Manhattan and the Bronx, covering, I am informed, every place where water is used to any considerable extent for other than domestic purposes. The presentation of meter bills for water consumed or wasted is such a forcible monitor that it is not reasonable to assume that any considerable portion of the people who receive and pay these bills will persist in wanton or careless waste of water. The bulk of the waste, must, therefore, be in the dwellings, which are exempt from the use of meter and meter charges. The consideration forces itself seriously on the municipal government and the public mind, whether the meter rates should not be enforced on dwellings as well as on business establishments.

"The results of waste are most seriously felt in the high-service district and in the Borough of the Bronx, where the present means of supply are now used to their maximum capacity, and waste diminishes the pressures in the mains and the elevation at which the water can be delivered in the houses to the extent of depriving the higher ground of an adequate supply. Waste reduces the pressures and elevation of delivery in any other part of the city as well, but to a lesser degree. As soon as a householder or tenant finds the force of water in his house diminished in the least, he lays the blame on the department which has charge of the water supply without giving a thought to the true causes."

Mechanical filtration has been under investigation at Sacramento, Cal., where a Jewell plant has been run experimentally under the direction of Dr. A. M. Henderson, of the city board of health, and Dr. D'Arcy Power. The water is taken from the Sacramento River, and was found during six consecutive days of March to contain from 500 to 6,800 bacteria per cubic centimeter. After filtration the numbers ranged from 10 to 90, and the bacterial efficiency of the filter was ascertained to be from 95 to 99.38 per cent. during the period covered by the investigation.

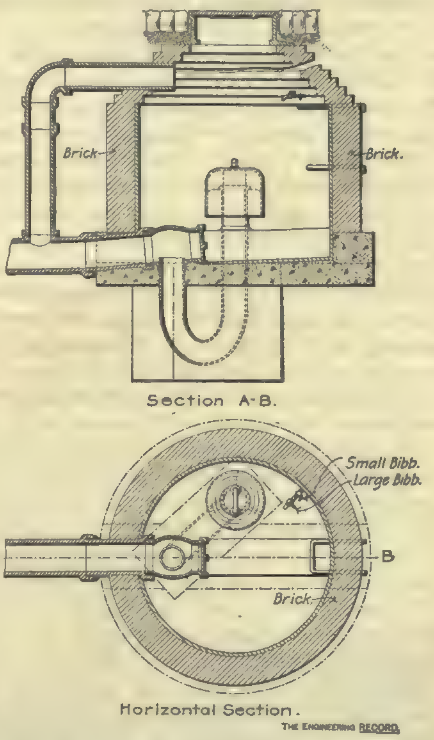
Crude petroleum for sprinkling shell roads has been tried at Jacksonville, Fla., under the direction of City Engineer Philip Prioleau, who states that up to the present time the results have not been important. He writes: "I fear that it will prove too expensive for us, and that we will have to resort to the ordinary watering cart. I used two barrels on 300 square yards of road surface, and, after 30 days, that portion of the road showed some dust in the center, where the travel is greatest. If the oil is not almost puddled on the road, I think it will evaporate to a marked degree in 60 days and will have to be followed up with a second application after that time."

The water meter has proved decidedly successful in Marshalltown, Ia., acording to a report of the superintendent of the water-works in that city. It seems that for some time the State paid $720 a year for water, but was believed to be using a larger quantity than this sum represented. A 6-inch meter was accordingly bought late in 1897 and set at a total expense of $420.25. The rate charged has been 5 cents per thousand gallons. During fourteen months the State paid at meter rates the sum of $1,309.82, while under the old schedule it would have paid but $840. The meter not only paid for itself in this time, but has also compelled the State to pay for all the water used on its property.

A contract for water between a private corporation and a city has been declared invalid by the Supreme Court of Georgia if it runs for more than one year, unless previously authorized by a vote of the people, who have been informed as to the amount of the payments to be made annually. The court held in the case of the Dawson City Council vs. the Dawson Water-Works Company that a contract for annual payments for a supply of water is a debt, and as such comes under the constitutional provisions governing the limit of indebtedness of municipalities.

An electric pumping plant has been proposed as an auxiliary to the present works at La Porte, Ind., by Prof. Charles E. Greene. The supply used at present is occasionally insufficient for the demand, and it is proposed to put in a generating set at the main pumping station and erect a transmission line to another source of supply, where an electric pumping station is to be constructed. This will only be operated when more water is needed than the present source furnishes, and can be run at such times at its rated capacity and thus avoid the uneconomical conditions due to operation at half power.

A combined flush-tank and manhole used on the Newport News and other sewer systems built from the plans of Mr. Alexander Potter is shown in the accompanying cut. Mr. Potter sends the following note concerning this device: "From the drawing sent herewith you will recognize the device as a modification of the Miller flush-tank syphon in which we are enabled to have performed the double function of flush-tank and manhole with one construction, simply by the removal of a little cast-iron lid. The use of this lid is made possible by turning the position of the long leg of the syphon to one side of the brick tank. The advantage of having a manhole on the upper end of all sewers is certainly great, and as this can be secured without any additional cost over an ordinary flush-tank, the value of the device is apparent. Mr. William Mackintosh, C. E., of my staff, is entitled to the credit of this suggestion."



The report of Mr. A. W. Kingsbury, Clerk of the Board of Water Commissioners of Yonkers, N. Y., contains a paragraph in which the cost of water in that city is figured out in an unusual manner. On the basis of the water pumped, as measured by plunger displacement without any deductions, the pumping for both high and low service cost one cent per hundred cubic feet; maintenance cost 1.53 cents, water purchased cost 0.06 cent, interest on bonds called for 4.54 cents and the sinking fund for 1.57 cents, making the total cost of water 8.8 cents per 100 cubic feet. It is of interest to notice in connection with these figures that the city has made a contract with the New Rochelle Water Company for a small supply by meter, at 10 cents per thousand gallons, with a minimum charge of $25 per quarter. This water is for use in a section of the city too remote to be readily reached by the municipal plant.

The amateur water specialists of Cincinnati are adding to their earlier amusing performances some entertaining proceedings over the proposal to construct a mechanical filter plant at that city. A few nights ago an organization known as the Taxpayers' Association held a meeting to protest against "chemical" filtration, as they call the use of a coagulent in the mechanical process. Some of the members of the association have visited Europe and learned

that mechanical filters are not used there, hence, they argue, they should not be used in Cincinnati. The remarks made concerning the use of alum by these experts would indicate they consider a little coagulant makes water considerably worse than straight vitriol. If it were not for the possible effect these strange tales may have on some of the people who read them in the papers, they would not be worth notice except in a humorous journal, but under the circumstances it is certainly the province of a technical publication to assure the people of Cincinnati that Messrs. Bouscaren and Fuller are not the kind of engineers to recommend anything but the best methods of purifying the water supply, and no attention should be paid to the ridiculous talk of people who seem possessed of a tremendous desire to get their names in the papers, even at the expense of their reputation for common sense.

The filtration of the Pittsburg water supply is strongly opposed by the Director of Public Works, Mr. E. M. Bigelow, M. Am. Soc. C. E., in his annual report for the past year. He says: "The report of the filtration committee (see 'The Engineering Record' of February 11, 1899) is voluminous, but for practical purposes the result of the investigation can be put in a very few words. It leaves to the people the plain question whether they desire to put this additional tax upon themselves for the purpose of having clarified water at all seasons of the year. So far as the public health is concerned the investigations of the committee, although conducted with faithful diligence, with practically unlimited command of money and time, and with the assistance of the foremost experts upon this subject in the United States, have not developed a single fact to show that the seat of typhoid fever is to be found in the water which is to be drawn from the city pipes. The indirect testimony of typhoid fever statistics, when analyzed with regard to location, corresponds with this, and the entire outcry against unfiltered water as a vehicle of typhoid fever, however honest, so far as it applies to Pittsburg, is purely theoretical." It will be seen that Mr. Bigelow takes the opposite view to that of Prof. William T. Sedgwick and apparently is not an enthusiastic advocate of the recommendation of the filtration committee, of which he was a member, that the city should increase its bonded indebtedness some $3,000,000 for the construction of a large sand filtration plant.

The ownership of underground water, which was referred to in these columns on April 15 and in previous issues, was recently before the Supreme Court of Pennsylvania in the case of Brown v. Kistler et al., 42 Atl. Rep. 885. That court adopted the following language of the judge of a lower court as a satisfactory definition of the rights of land owners to percolating waters: "It is the law that water that is in the earth, and finds its way through the soil by percolating or seeping, and has not a defined flow in a stream either underground or above the ground, is absolutely the property of the man who owns the land in which that water is found. He has the same right to it as he has to anything else in the ground. But where there is a defined stream, whether on or below the surface, a flow of water that is visible, there the rule is different; and if there is a well-defined flow in the channel or stream underground, so that it is not the mere percolating of water through the earth, but a well-defined flow, and it flows from the land of one above to the lands of another, where there is such a flow in a channel from the lands of one to the lands of another, there the owners of the land through which it flows have the right to use the water, within certain bounds. The upper owner has the right to use the water for household purposes, and for watering stock, and other purposes, to an extent that is not unreasonable, bearing in mind the size of the stream. Of course, the upper owner of a large stream might divert a large quantity of water, and it might be permissible for him to do it—might be termed reasonable—where the taking of the same quantity from a small stream would not be reasonable."

The propeller pumps recently mentioned in these columns are discussed as follows in a letter recently received from the Edward P. Allis Company: "We notice in 'The Engineering Record' of March 25 and April 22, some mention of propeller pumps. We can subscribe to Mr. Maury's statement that the general proposition of propeller pumps is a very old one. Mr. Edwin Reynolds, our general superintendent, built pumps of this type about 1858, and in 1859 exhibited a pump of this class at the Exhibition of the U. S. Agricultural Society at Cincinnati, the pump afterwards being used as a wrecking pump on the Ohio River. We believe that pumps of this kind were used in some of the Pennsylvania coal mines many years ago, the pumps being arranged in series on a vertical shaft, with guide blades between each set of pumps. In connection with the subject of guide blades it would appear to us that the guides of the wood pump illustrated in the issue of March 25 are not of the best form for the purpose, their principal office (as designed) being to hold the driving shaft central in the well tube. We have built a number of very large propeller pumps, perhaps the most notable being located at the Milwaukee flushing tunnel (built in 1886). This wheel has a diameter of 14 feet and delivers from 400 million to 500 million gallons of water in 24 hours against a maximum head of 4½ feet. On the official trials it gave an efficiency of 87 per cent. It is driven by a 400-horse-power vertical compound engine, and gave a duty of over 76 million foot-pounds for each 100 pounds of coal burned. We have also built pumps of this type having a capacity of from 7 to 30 million gallons in 24 hours, and working under heads of from 10 to 30 feet. We are at present erecting three for the City of New Orleans, two of them having a capacity of 162 million gallons in 24 hours raised 3 feet, and one having a capacity of 126 million gallons in 24 hours raised 5 feet. The New Orleans pumps are to be driven by direct-connected electric motors. Our experience with pumps of this type has been such as to lead us to believe that they are particularly well adapted for raising large volumes of water to a comparatively small height. Perhaps under exceptional circumstances they may be advantageously adopted for pumping against comparatively high heads."

THE NEW WATER-WORKS OF CAMDEN, N. J.

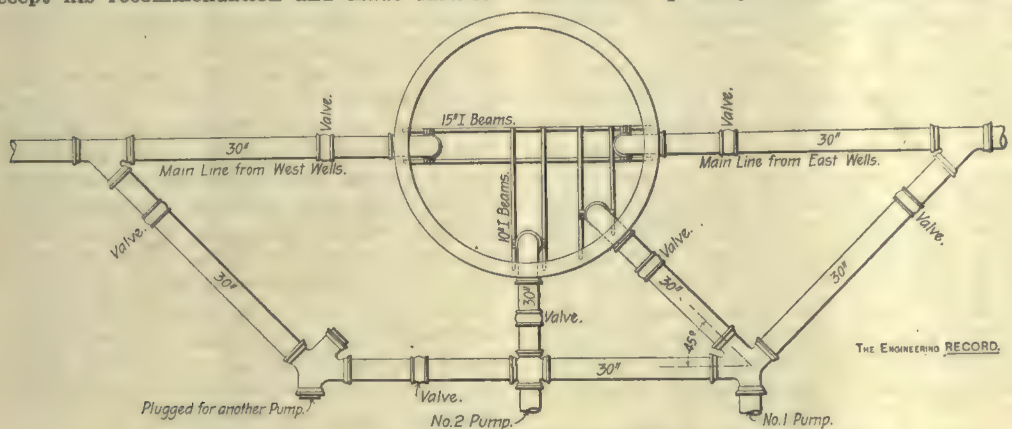
The city of Camden has had a system of water supply since 1853. Previous to 1870 the works were owned by a private company, but in that year the city bought the system and has improved it from time to time, until, in 1896, it consisted of a brick pumping station in the adjoining town of Stockton, containing one Blake pump, with a capacity of 10,000,000 gallons, and an old pump, with a capacity of 5,000,000 gallons. The engine house was located on a wharf on the bank of the Delaware River and pumped water from a forebay which was connected with the river by a 48-inch pipe. The water was pumped through a 30-inch force main about 2,800 feet long to a stand-pipe, and through a by-pass to a reservoir with a capacity of about 8,000,000 gallons. The stand-pipe is 10 feet in diameter and 75 feet high; the elevation of the top is 139 feet and the flow line of the reservoir is at an elevation of 65 feet. The distribution system of the city consists of about 70 miles of pipe, mostly 6 and 8 inches in diameter, with a complete circuit of 16, 20 and 30-inch mains.

The quality of the Delaware River water has been open to suspicion for many years, as it is a tidal stream, receiving considerable quantities of sewage. It receives the sewage of Camden at a point about a mile below the water intake, and a portion of the sewage of Philadelphia and of the towns above Camden. At

ARRANGEMENT OF WELLS. NEW CAMDEN WATER-WORKS.

best, owing to the tidal influences, it is muddy and frequently oily from refineries in Philadelphia, depending on the direction of the wind.

In 1894 a joint committee of the City Council was appointed to investigate the question of a new supply, and Mr. J. T. Fanning, M. Am. Soc. C. E., was retained as consulting engineer. Among the sources he investigated were tributaries of the Delaware river in the vicinity of Camden, driven wells, and the Delaware River with new intakes further up the river. He recommended that the city continue to use the river water, with a new intake, a settling basin having four or five days' capacity and a new pumping station. The committee did not accept his recommendation and made further investigations regarding a supply of ground water, and four experimental wells were sunk with satisfactory results. Later other test wells were sunk and from the results of these and from the records of existing wells it was decided to purchase land lying along the Delaware river at a point six miles above the city as a site for a ground-water supply. A contract was made in June, 1896, for a guaranteed supply of 20,000,000 gallons every 24 hours from this locality. The contract price was $561,500, and included the sinking of sufficient wells, a new pumping station with engines, boilers, chimney and coal house, a new force main to the city's old pipe-system, and a continuation of the main under a creek to a new stand-pipe in the southern part of the city.



PUMP-WELL CONNECTIONS AT NEW CAMDEN WATER WORKS.

According to the reports of the State Geologist of New Jersey the southern and eastern part of the State has been formed by successive upheavals of the ocean floor, the ridge trending northeast and southwest through the central part of this territory being uplifted at an earlier date than the adjoining lands. Approximately following the line of the Delaware River as far north as Trenton and extending across the State to Perth Amboy, there was a wide belt of land which received the deposits from the streams on the northwest and southeast, which, by later and gradual uplifts, formed a part of what is known as the coastal plain, having elevations less than 50 feet. Throughout the whole region south and east of a line from Trenton to Jersey City artesian wells have been more or less successful. The water has been found lying between the alternate layers of clay or above the clay and decomposed rock which forms the floor known as the crystalline schist. The depth of this floor around Camden is from 120 to 150 feet, decreasing to the northeast and dipping towards the southeast at the rate of 25 to 40 feet to the mile.

The location selected for the wells for Camden consists of about 100 acres of meadow land lying along the Delaware River at the junction of a creek about six miles above the city. It is at about the level of mean tide and is banked to keep out high tides, the banks having sluiceways to allow the rainwater to run off. The general character of the materials passed through in driving the wells was as follows: Meadow aluvium, 5 to 20 feet; sand, 5 to 6 feet; clay, 1 to 2 feet; yellow or white sand, 5 to 8 feet; clay, 2 to 5 feet; water-bearing gravel with a little sand, about 20 feet; clay, 5 to 20 feet; white sand, 5 to 15 feet; yellow gravel, 5 to 20 feet; clay, 0 to 1 foot; water-bearing gravel and sand, from 25 to 60 feet. Below this is a layer of clay and decomposed rock about 40 feet thick, and then comes the crystalline schist or bed rock.

Eleven wells were sunk in the upper water-bearing stratum at depths from 50 to 70 feet, and 92 into the lower stratum from 90 to 125 feet deep. The water-bearing strata are composed of medium coarse white sand, interspersed in places with small white gravel stones and a small quantity of fine white clay, which washes out with pumping and leaves, practically, sand and gravel. They are rarely less than 25 feet and in some wells are 30 to 40 feet thick.

LAYING 30-INCH PIPE UNDER CREEK.

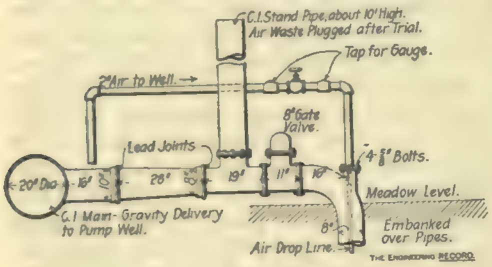
The wells are arranged in four groups surrounding the pumping station, three of which are operated by pumping and one by compressed air. From the pumping station are two 30-inch pipes which bring the water from the three groups to a pump well located in front of the station. This well is 30 feet in diameter and 35 feet deep. It is of brick work 2 feet thick except for the top 4 feet, which are above ground and 18 inches thick. It was sunk with a cutting shoe of iron segments bolted together. It has a conical frame roof, with ventilator, door and hatchway. Considerable water was found at the level of the bottom of the well and two 10-inch wells were sunk during construction to assist in draining the pit. Steam ejectors were placed in them and the pumps aided in this way. They were allowed to remain flowing after the bottom was concreted, and, in addition, two iron pipes 3 feet in diameter were also sunk into the water-bearing sand. They have double brass-cloth screens between the two stiffening rings, which are set flush with the concrete.

One group of wells is situated on the bank of the river a short distance below the pumping station. It consists of thirty-six 8-inch and twelve 6-inch wells. A main suction pipe, 24 and 30 inches in diameter, extends through this group and has 8-inch pipes running to the wells, the connections being made with 45-degree branches. The second group of wells lies between the pumping station and the river and consists of thirteen 8-inch wells. They connect with the 30-inch mains through branch mains varying from 10 to 18 inches in diameter. The third group is situated above the pumping station on a creek, and consists of twenty-nine 8-inch wells and one 6-inch well. These are not arranged in any regular order, but are situated on four branch mains which discharge into the 30-inch main running to the cistern. The suction mains are laid with a rising grade to the pump well and bend down into it, forming a syphon with the wells. On the highest point of each is an air chamber connected to an air pump in the station. By pumping the air from the mains the pipes syphon the water from the wells to the cistern. The pipes are also connected directly with the pumping station. The suction pipes were cut through the masonry of the pump well after the latter had been allowed to stand long enough to be free from settlement.

The fourth group consists of ten wells 8 and 10 inches in diameter, located on the same creek as the third group, and over 4,000 feet from the pumping station. They are operated by compressed air under a pressure of about 47 pounds per square inch. The air is furnished by an Ingersoll-Sergeant compressor having a steam end 18 inches in diameter, an air end 22 inches in diameter and a stroke of 22 inches. The receiver is 10 feet 6 inches long and 4 feet 6 inches in diameter. The air is conducted from the receiver to the wells through a pipe 7¼ inches in diameter, decreasing to 4 inches at the last well. The air pipe down each well is 1½ inches in diameter, with about 60 per cent. submergence, and the air escapes through holes in the lower portion. At the head of each well is a broad quarter-bend connecting with the main discharge pipe and the air pipe passes

into it through a flanged shoulder. Between each well and the main discharge pipe is an 8-inch stop valve. The water from these wells is conducted to the pump well through a 20-inch gravity main, 4,596 feet long. At its extreme end there is a 10-inch Y branch and stand-pipe for the escape of air, which is now plugged. The pipe does not flow full, and the air escapes at the open end at the cistern.

The twelve 6-inch wells were sunk by Messrs. Kisner & Bennett of Belmar, N. J., and the balance by the Cook Well Company of St. Louis, Mo. The strainers on the wells sunk by the former are galvanized iron pipe with ⅜-inch holes covered with brass cloth soldered on the outside. These wells were washed down, the strainer end of each was plugged and the top of the strainer carried a lead washer which was expanded against the inside of the casing pipe. The Cook wells are sunk by driving and the use of the sand bucket. The strainers are

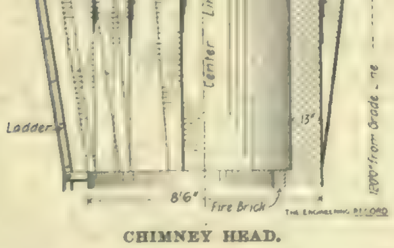


AIR PIPING AT WELL HEADS.

the Cook brass strainer, having either longitudinal or circular slots, which are wider on the inside than on the outside. The average length of the strainers on all the wells was 24 feet. The tops of the well tubes are capped with a removable air-tight cover, the connection for the branch being made with a cast tee leaded on the casing pipe.

The water in the wells before pumping stood at about mean tide, some few of the wells with the top of the casing near the surface being flowing wells. The water in them rises and falls from 15 to 20 inches with the rise and fall of the tide, which averages 5.8 feet.

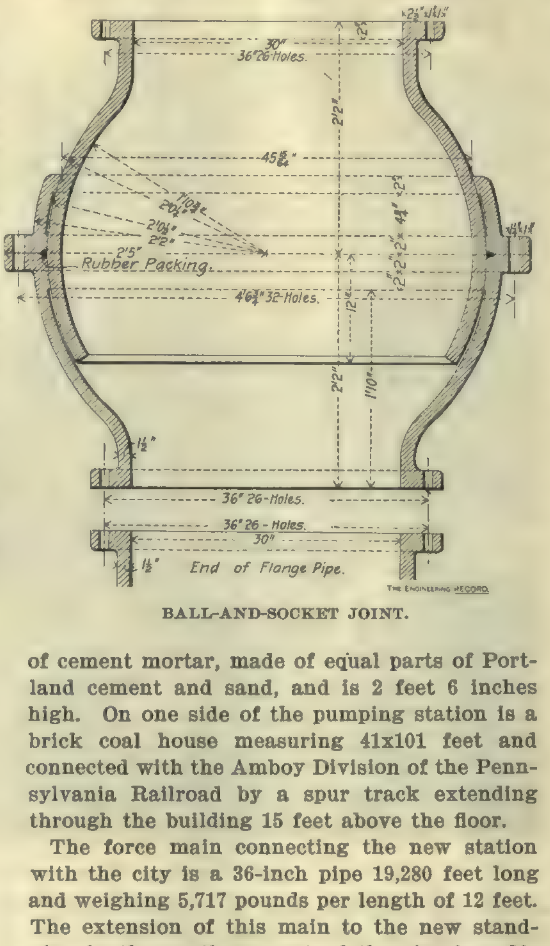
The plant was run at intervals after October, 1896, while a part of it was under construction. Seventy-two syphon wells produced during 80 days a daily average flow of 6,860,000 gallons and 93 wells, including the 72, produced during 150 days, a daily average flow of 10,500,000 gallons. These quantities were determined by



CHIMNEY HEAD.

plunger displacement without deductions. A recent test of all the wells for 17 days and 15 hours gave a daily average of 18,203,000 gallons, with 2 per cent. deduction. The deduction was determined by weir measurement over a 10-foot weir during the latter part of the test by two runs of 41 and 22 hours each. Since the test the city has assumed charge of the plant and has obtained with 26 feet suction head between 15,000,000 and 16,000,000 gallons per day. Twenty per cent. of the contract price has been retained by the city pending a settlement.

The pumping station is a 94x95-foot brick building, divided into a 38x90-foot boiler room and a 52x90-foot engine room. The floor of the engine room is sunk 10 feet below the surface of the ground and is cemented with a layer of asphalt between the concrete and top coat. There are two Holly engines of the high-duty, horizontal, compound type, each with a capacity of 10,000,000 gallons in 24 hours. The boiler room contains six National water-tube boilers with an aggregate capacity of 750 horse-power. The pumps on a test delivered 10,230,902 and 10,245,309 gallons each, measured by plunger displacement. The duty developed was 128,154,541 and 130,855,989 foot-pounds each, based on 1,000 pounds of steam supplied to the pumps. The boilers evaporated 10.43 pounds of water from and at 212 degrees Fahrenheit, for each pound of dry "Puritan" coal from the Clearfield District. The chimney is 120 feet high and is built of brick. It is 14 feet in diameter at the bottom, 8 feet 6 inches at the neck under the cornice; the internal diameter is 5 feet, and it is lined with 8 inches of firebrick for 48 feet and with 4 inches above that. The flue connecting with the boilers is 5 feet 2 inches square and is lined with 8 inches of firebrick. The foundation consists of stone masonry 9 feet 6 inches deep, supported on piles, the top of the piles being filled around with a 16-inch layer of concrete. The cap of the chimney is



BALL-AND-SOCKET JOINT.

of cement mortar, made of equal parts of Portland cement and sand, and is 2 feet 6 inches high. On one side of the pumping station is a brick coal house measuring 41x101 feet and connected with the Amboy Division of the Pennsylvania Railroad by a spur track extending through the building 15 feet above the floor.

The force main connecting the new station with the city is a 36-inch pipe 19,280 feet long and weighing 5,717 pounds per length of 12 feet. The extension of this main to the new stand-pipe in the southern part of the city is a 30-inch pipe 12,780 feet long and weighing 4,217 pounds per length of 12 feet. This 30-inch main was carried under a creek with ball-and-socket joints between 12-foot lengths of flanged pipe. The joints alternate with the lengths of the pipe except at the angles of the creek bed, where two joints were used together. The joints are 45½ inches in inside diameter and 4 feet 4 inches long, turned and faced. The two parts of the joints were fastened together with thirty-two 1¼-inch bolts, and the lengths of pipe were fastened to the joints with twenty-six 1-inch bolts. The ditch for the pipe was dredged about 10 feet deep and the pipe was laid by means of a launching way. The pipes were bolted together on a scow and the scow and skid were warped ahead by the engine used for swinging the pipe. The accompanying illustration shows this work in progress.

The steel stand-pipe is 30 feet in diameter, 110 feet high and consists of twenty-two courses, each with a build of 5 feet. The bottom plates are ¾ inch thick and are connected together with single riveted lap joints. The lowest pair of courses is ⅞ inch thick, each pair decreasing in thickness by 1/16 inch, to the top of which is ¼ inch thick. The lowest course is fastened to the bottom plates by means of a 6x6x⅞-inch angle iron, double riveted to the bottom and side plates. Around the top course is a 4x4x⅜-inch angle iron and across the top are two 3x3x⅜-inch angle irons. For ten courses up from the bottom the vertical joints are butt joints, with inside and outside plates, and above that they are double-riveted lap joints. The horizontal joints are all single-riveted lap joints. A steel ladder was built on the outside of the stand-pipe. All of the steel and iron work was painted with Edward Smith & Company's Durable Metal Coating. The foundation was built of random stone and is 35 feet in diameter. This plant was partly designed by and was constructed under the direction of Mr. L. E. Farnham, City Engineer of Camden. He writes that Mr. W. H. Boardman, the engineer for the general contractor, and Mr. Cook of the Cook Well Company, are entitled to equal credit with himself for the engineering features of the work. Mr. Cook suggested the air system and many of its details, and his practical knowledge of wells and water strata proved very valuable.

The weir test was supervised by Mr. J. W. Ledoux, M. Am. Soc. C. E., and Mr. Howard Murphy, both of Philadelphia, for the contractor, and by Mr. Charles G. Darrach, M. Am. Soc. C. E., of Philadelphia, for the city. Mr. Jay M. Whitham of Philadelphia made the duty tests on the pumps and was also called in to assist in the allowances made for the water used at the pumping station during the weir test. Mr. George Pfeiffer, Jr., was the general contractor for the work, Messrs. B. F. Sweeten & Son of Camden laid the 36-inch pipe and R. D. Wood & Company of Camden were the contractors for the stand-pipe. Mr. Thomas Stephens of Camden was the architect of the pumping station and coal house. The pipe was furnished by the McNeal Foundry and Pipe Company of Burlington, N. J., and by the Camden Iron Works of Camden. The valves were furnished by the Union Hydraulic Company of Philadelphia.

STREET CLEANING IN SAN FRANCISCO.

The contract for cleaning the streets of San Francisco, which was awarded late last year to the City Street Improvement Company, was made in accordance with specifications prepared by the local Merchants' Association. A copy of them is contained in the annual report of Mr. John A. Russell, clerk of the Board of Supervisors, and from this source the following abstract of their leading provisions has been prepared. Like the Washington specifications, which were reviewed in these columns recently, they provide for minimum rate of pay for the sweepers; in this case not less than $2 a day of 8 hours, the amounts due the men to be paid at least twice a month. The men must be American citizens. The contractor is bound not to be interested in any way in boarding or lodging the men except the teamsters, whom he agrees in the contract to charge not more than 50 cents a day for board and 15 cents a day for lodging. The contractor must furnish two uniforms for the sweepers, at their expense, not to cost more than $2.25 each. Each consists of a white demin or duck blouse and overalls of a suitable weight for use in warm weather, together with a cap and leather belt of a pattern selected by the Merchants' Association. All sweepers engaged on the streets during the day wear numbered badges which are the property of the contractor, and the foremen are required to wear a cap and badge marked "Foreman Street Sweeper." No sweeper is permitted to work for more than three

days without a uniform, but he is not required to buy more than one uniform during the first ten days of his employment. The men must renew their uniforms when they are no longer neat.

The cleaning of the streets is performed by the contractor under the direction of the Superintendent of Streets and the Committee on Streets of the Board of Supervisors. Most of the work is done by hand between six o'clock in the morning and five o'clock in the afternoon. In those sections where it is inconvenient to work during business hours, the cleaning is done at night, and all machine sweeping is done at the same time. The specifications state the least number of men which the contractor will be permitted to employ on the different blocks where continual day cleaning is required. The men are allowed to assist one another in the adjoining blocks to those apportioned to them, provided that at no time the number employed in day cleaning is less than the total number fixed in the schedule. In case this number is not maintained a pro rata reduction is made in the payments to contractor. When the work is delayed on account of rain or any other cause, one-eighth of the total daily payment is deducted for each hour lost.

Particular stress is laid in the specifications on the prevention of dust while sweeping, as the following quotations show:

"Sweeping by hand labor on streets of the first class [those constantly cleaned during the day], shall be preceded by sufficient sprinkling by watering carts so that no dust arises from or during the sweepings, and, in order that the sweepers may be effectually prevented from raising dust, the contractor shall keep constantly employed on the streets not less than four watering carts of a carrying capacity of not less than 500 gallons each, except on Sundays and days on which no sweeping is being done, and on such days or parts of days when the dampness absolutely prevents the dust from rising from and during the sweeping. Sweeping by hand labor on the streets and alleys designated in the schedule as of classes two to seven inclusive [which are not constantly cleaned], shall be preceded by sufficient sprinkling by a watering cart or hand sprinkler so that no dust shall arise from or during the sweeping.

"Sweeping by machine labor shall be preceded by sprinkling of the entire surface of the roadway by a watering cart, except when impracticable by reason of the grade, and on such streets or portions thereof the sprinkling shall be performed in such a manner as may be directed by the proper authorities, so that no dust arises from or during the sweeping. It is the intent of these specifications that no dust whatever shall be raised by the sweeping. The penalty for any violation of the specifications in this respect shall be 50 cents for each block or crossing upon which dust is caused to rise by the sweeping, and the said amount or amounts accruing during each month shall be deducted by the Superintendent of Streets each month from the bill rendered for the work performed. No sprinkling carts shall be used which are not provided with appliances for controlling the flow of water, so that said flow may be reduced to any degree which may be required less than the full head of water, to the end that perfect regulation and adjustment of said flow may at all times be secured and the flooding of the pavement with water be prevented."

On what are known as streets of the first class, no dirt of any sort is allowed to remain for any time whatever, and the contractor is also required to keep the sidewalks free from paper and refuse, except sweepings from stores, between nine in the morning and five in the afternoon. In the case of streets which are not swept every day the contractor is required to submit a report before 2 o'clock in the afternoon to the Superintendent of Streets, giving a schedule of the route he proposes to clean on the following day. The portions of the route to be cleaned by machine sweepers are carefully designated, but the exact location of the hand work need not be specified until eight o'clock on the morning of the day on which it is to be done. The Superintendent of Streets has until five o'clock in the afternoon to object to the route of the machine sweepers for the following day. The clause governing this work reads as follows: "The entire surface of the roadway of each street, alley or portion thereof, unless prevented by obstructions, is to be thoroughly swept; the sweepings to be immediately removed from the street, and if any of the sweepings should be deposited upon the sidewalks or remain in the gutters or upon the cesspool covers at the corners of the streets, the same shall be taken up and removed at the same time as the rest of the sweepings; and all of the work shall be done and performed to the entire satisfaction of the Superintendent of Streets."

A portion of the sweepings must be delivered to the Golden Gate Park when the Park Commissioners desire, in order that experiments may be made to determine their fertilizing value. The remainder are taken to the city dumps. All carts used for moving street sweepings between six in the morning and five in the afternoon must be kept partly covered while they are being loaded and wholly covered while on their way to the dump. On streets of the first class the contractor is required to provide at least 450 metal receptacles painted white and lettered conspicuously "For Clean Streets," together with the name and address of the contractor. These have covers which must be kept on them. Every man employed in shoveling dirt from the streets into the carts must be furnished by the contractor with a broom to sweep on to his shovel all dirt left after the piles have been thrown into the cart. There is a fine of 50 cents for each block on which any remnants of dirt piles appear after the block has been reported cleaned.

Special provisions are made in the specifications for cleaning crosswalks and sidewalks; such requirements are unusual and are quoted verbatim:

"The contractor shall, during rainy weather, caused to be cleaned and kept clean each day, Sundays excepted, between the hours of 7 A. M. and 5 P. M. such public crosswalks as may be designated by the schedule for crosswalks annexed and made part of these specifications; and also clean and keep clean the sidewalks of such streets as are enumerated in said schedule for sidewalk cleaning, and the contractor shall keep employed during the cleaning of all such schedule for sidewalks and crosswalks not less than fifty men, not including foremen, and the contractor shall be compensated for such cleaning of sidewalks and crosswalks as follows: Fifteen cents per day or portion thereof for each single set of crosswalks, consisting of one or more rows of parallel flags of stones, crossing a street at intersections or between the corners of streets. No more compensation shall be allowed for cleaning of sidewalks and crosswalks during rainy weather than stated in this clause.

"The contractor shall not be compensated for any cleaning of crosswalks or sidewalks commenced during the day later than 1 P. M., and when said cleaning of said sidewalks and crosswalks has not been commenced earlier than 1 P. M., it shall not cover any more of the schedule for sidewalk and crosswalk cleaning than is included on streets designated in the sweeping schedule of the first class. On streets that have a smooth pavement, and in consequence no parallel rows of stone or crosswalks have been placed, a strip of pavement 10 feet wide from curb to curb shall be kept clean in rainy weather with a rubber scraper. Such strip of pavement shall be kept clean at street corners and across such smoothly paved streets and in front of the entrances to hotels, theatres, large buildings and prominent points where pedestrians generally cross such streets. The compensation for the said strip of pavement as aforesaid shall be the same as for one set of crosswalks, namely fifteen cents. The compensation for cleaning sidewalks as provided above shall only apply when such cleaning is done in rainy weather, during which no street cleaning is done, and shall not apply to sidewalk sweeping which is done in connection with street cleaning during dry weather and for which there shall be no extra compensation."

The cleaning of gutters, crossings and other special work during the intervals of the regular sweeping of any street is done by three crews, each comprising three men, a team of horses and a wagon. On holidays and Sundays the contractor must furnish the Superintendent of Streets not more than twelve men, who are to work from six to ten in the morning, at the rate of 30 cents per hour. They are required to clean the gutters and other parts of the streets needing cleaning in a district which is designated in the specifications.

The contractor is required to report in writing by 12 o'clock daily the streets and alleys which he cleaned during the 24 hours ending at 6 o'clock in the morning of the day of the report. The Superintendent or one of his deputies then examines the streets so designated, and if the work has been satisfactorily performed the contractor is credited with the full number of square yards he reported. If, however, portions of the district have not been satisfactorily cleaned, the contractor is notified that he will not be paid for them. He then has the right to appeal to the Committee on Streets of the Board of Supervisors, who have the final decision on the subject.

THE PROFESSION OF BRIDGE ENGINEERING.

Mr. John Sterling Deans, chief engineer of the Phoenix Bridge Company, recently gave a lecture on "Experiences and Lessons from the Life of a Bridge Engineer" to the students of Lehigh University. The following extracts from his address contain suggestions and advice of the highest value to young men who are intending to make a specialty of bridge engineering:

"In this short talk, I thought that the subject might be handled most advantageously by dividing it into two main divisions. First, taking up the manner in which these bridge enterprises develop, following the business forward through the natural steps to the actual condition of the work. Second, starting from college, giving the preparation required and leading up through the several stages of construction and business to the inception of the work.

"Considering the first, bridge enterprises emanate from the necessities and the demands of better transit facilities. The sagacious railroad officer or municipal authority turns naturally to those bridge companies or consulting engineers of acknowledged standing, character and ability, for advice. Here we come to the most important attribute of an engineer—a staunch character. He must be absolutely beyond reproach if he expects to be eminently successful in his noble profession. The interests placed in his hands are too vast and important, involving the success of great enterprises, the expenditure of vast sums, the marring or beautifying of city streets and parks and vistas, and involving also the safety of hundreds of human lives, these interests surely can only be trusted to the highest characters. No profession demands more. This is a sufficient reason why a long successful engineering life is so honorable, and why we honor the great names in the profession. The engineer must be able to withstand the strongest pres-

sure, and be able, at all times, to reach correct conclusions and make truthful reports—be able to turn down without hesitation any work, however tempting otherwise, which involves the expenditure of money or character of design, quality of material or workmanship, which his professional judgment condemns. Sharp practices once entered into, work slighted, or false reports made, are not forgotten, and the engineer or firm so acting is more surely spotted and condemned than the unscrupulous lawyer or quack doctor. The profession is to be congratulated that instances of breach of trust and professional dishonesty are rare. The report of an experienced and able engineer should, and does carry with it the same grade of authority as a judge's decision, and it becomes the basis of future actions and decisions. If all its members work on this high plane of professional honesty, there need be no fear of the ultimate position of the engineer in the community and of his place in the learned professions.

"Assuming, then, the wants of the railroad company, municipality or state, and that an engineer is competing for the work, he must be prepared to support his claim to attention not alone through his technical knowledge; but he must be able to present his case, lucidly in good English, in a clear, convincing manner; he must be shrewd to discover the main features of the business propositions involved, and to take advantage of every surrounding condition. Engineers are often spoken of as narrow and as only being able to talk 'shop;' if there is any truth in this assertion it may be traced to a lack of a general and broad education in those branches and studies outside of his special work. Whenever possible, let no opportunity be neglected, which tends to increase your general knowledge and which will assist in laying a broad and thorough foundation for a general education. I well know the feelings of the average technical student and his belief that time spent on the classical studies, history, literature and languages, is in a manner wasted, or at least unnecessary. In after years a lack of training in these very branches will be keenly felt by the engineer in his effort to attract attention to his designs and plans. It may be assumed that all students here will take an interest in their mathematics, physics, chemistry, construction and other purely scientific studies, and I would strongly recommend the closest attention also to the classical branches as well. A profession full of cultured as well as thoroughly trained engineers, need have no fear of its standing in the world at large, and that fees of proper size will be expected and paid as cheerfully as to the lawyer or doctor.

"Assuming that the engineer has been successful in securing the business in view, he is now in the position of adviser, and must do the best for his client. It is not to be assumed that he has now the opportunity of exploiting his purely theoretical knowledge, but he must adapt himself to the surrounding conditions. An engineer has no more right to needlessly expend his client's money than a doctor has to needlessly drug his patient.

"Many enterprises have been wrecked by a lack of due regard to the surrounding conditions. A good engineer is pre-eminently one who most carefully considers these surroundings, and the practical features of the work involved. If the general market is furnishing a reliable class or grade of material which has been abundantly proved in practice, under trying conditions, it would be folly to force a special material, demanding special processes at greatly increased cost, upon your client, simply to satisfy your craving for a theoretical metal. It is unnecessary to specialize further; I only wish to impress upon you the importance of avoiding carrying theoretical considerations to an extreme. You may succeed in making a monument to yourself, and there are a number of such that might be instanced, but they are not such monuments as are to be desired by any engineer. I do not wish, however, to lessen the value of giving the most careful theoretical consideration to every problem; it is far better to err on the side of extra weight and expense, as was the case in the early days of bridge construction, when designing was more a matter of ingenuity and practical consideration alone, than a matter of theoretical skill. The successful engineer must combine the two.

"Proceeding to the designing of the structures—the preparation of the stress diagram and the design of the general outlining of the structure, while calling for a high grade of ability and experience, demands, if possible, less experience than the detailing. This important work can only be left to the most painstaking and thoroughly trained engineers and draughtsmen. The requisite knowledge and experience cannot be imparted by books or lectures; it is only obtained by actual and prolonged experience over the draughting table.

"With the work designed and specifications written, it is ready for the constructions in the mills and shops. Here the bridge engineer ceases to be the ruling factor; he should, however, maintain a close supervision of the construction, through a careful, intelligent inspection, during the various mill and shop stages, and final passing of finished parts; but in the rarest instances should he interfere with or dictate shop practice—it is the final result he is after, and he is not interested in the intermediate steps leading to this result. To check mill and shop results, full size tests are often specified, mainly tests of eyebars; the result of these eyebar tests sufficing to satisfy the engineer that his structure is all right. This, however, has developed, in many instances, into a fad; it really adds but little knowledge as to the condition of the finished structure, composed of many members not eyebars. If general testing of various members is not done, the testing of eyebars might be dispensed with.

"With the work finished in the shop, there remains one more stage to the completed structure, a stage which has been neglected by the great majority of engineers, although it offers every inducement and opportunity for the exercise of every faculty of the well trained mind, both in theory and practice. I refer to the erection of the structure at the site. The engineer, to properly take charge of this field erection, must be thoroughly trained in all of the previous steps—in the theoretical and practical education of an engineer. He must be familiar with the office to be performed by each member of the structure, the design and duty of each detail and the method of shop construction, to the end that each part may be erected in such a manner as to develop the full value of the structure in all its parts. In carrying out this work the engineer must depend upon the skill and fidelity of the bridge erector.

"These bridge erectors are little known and appreciated, except by those who are brought into close contact with them. They are as essential to the success of the bridge enterprises as the skilled mechanic in the shop, and are composed of a body of hardy, active, fearless young men, leading a life which necessarily makes them rough; yet they are tender-hearted to a fault to those in trouble. They are men, in other words, you can depend upon to stand shoulder to shoulder with you in all your efforts—stand by you in storm as in sunshine—work for you day and night, without rest, if necessary to make a connection safe, when threatened by storm or flood. I number among them many of my best friends. If in this stage of the work the bridge engineer is not able to command the support of the best bridge erectors, he is in a sorry plight indeed; no amount of theory or individual ability will offset this lack. It is a case of practical experiences and acquaintances and the ability to command the respect, interest and real devotion of this peculiar class of workmen. When you have once gained their confidence you have assistants who will accept any privation and danger willingly for your interests. It is not easy for all men to make even passing acquaintances, much less to accommodate themselves to those in 'various walks of life,' with whom they are necessarily brought in close contact. The successful engineer, however, must have this ability; if not natural, it should be cultivated at every opportunity. Start in early—you cannot begin too soon—in your visits to shops and important works in course of construction during your college course; become acquainted with not only the officers in charge, but meet the workmen, if possible. Do not make the terrible mistake of thinking it may detract from your own standing as an educated engineer to associate with intelligent workmen, to talk with them in detail of their individual work and to be interested in their remarks. Nine times out of ten they can give you valuable information, which will be of use to you in your practice of the profession. As has been previously intimated, the field erection of structures demands the exercise of all the faculties of the engineer, his theoretical knowledge, his practical business training, and his ability to handle men; not alone workmen, but the handling of inspectors and engineers.

"It would be interesting if we had before us the original reason or idea for the selection of an engineering life by each of those present here to-day. In my own particular case I believe it was my fondness for out-door life and the accidental associations with a field party of bright young engineers during the summer of my twelfth year that first inclined me toward the profession. I was told by friends that the profession was overcrowded, that the colleges were turning out engineers out of all proportion to the demand, etc. But a lack of work has not been one of my experiences up to this time, nor are there any prospects that it will be in the near future. There are many positions waiting for good men to-day. Do not be discouraged by any such idle, pessimistic talk. The United States has really just begun to develop as far as permanent important bridge structure is concerned; and, aside from this, as a result of the conclusion of the late brilliant war—which was, by the way, pre-eminently an engineer's war—new countries have come to us, requiring development; and they incidentally brought us at a jump into a world's business instead of a mere home trade.

"Now how shall the young engineer enter the field and commence life in earnest? This first step from college is the beginning, and it is all important to take this first step and make these first associations carefully. I assume every man is taking advantage of his inestimable opportunities in being here; for every year we progress demands more in the matter of thorough theoretical training.

"When taking this first step from college, it is most important to shun influential friends, who have it in their power to place you in positions beyond your experience; remember it is just as important to progress step by step in the practical work in your profession as it is to follow your regular course in the university. In bridge engineering and construction there are several channels of entering the profession, which open before the graduate, any of which may be followed to advantage. The course I shall outline to you, however, appears to me to be the best as indicated by my experience.

"I would suggest as the first step a position in the erecting department of some well known bridge company or firm of erection contractors, and the taking up of the work in the same manner as you would in entering a machine shop to acquire familiarity with the use of

tools. Start in the gang and learn everything connected with the erection, and further, learn as you gain in experience the power of handling men and the business involved in this important part of your work. It is not necessary to continue at this particular work after it is thoroughly understood; one of the seeming paradoxes of life is the fact that, after you thoroughly know how certain work should be done, it is no longer necessary for you to do it yourself. But you must know how first.

"After finishing in the field, I would suggest association with an inspecting firm, one that actually and intelligently inspects; there are many so-called inspecting firms to which the name is a misnomer. In this position as inspector you will be expected to see that your specifications and plans are adhered to, and this will not be hard to do if you proceed about it in the right manner. Do not start in by thinking all reputable concerns and contracting engineers are dishonest—on the contrary, they all court intelligent, sensible inspection, and will assist you. A sly, detective manner is not necessary, or 'a-know-it-all' air, both of which are sure to bring trouble. While inspecting there is excellent opportunity to study shop practice, etc., and everything gained here will be of great benefit to you in the next step which I would suggest—the draughting room. The engineering profession may be called the exact profession; probably no other profession can lay claim to the title with the same warrant. The young engineer who has learned to be accurate has made a long step in advance. This is the first habit to be acquired in the draughting room. A beautiful drawing is not essential; a correct one is an absolute necessity. A proper experience in detailing takes time; one drawing or many drawings might make simply a good draughtsman, but it requires many months of actual work at the draughting table to make a good engineer. After this training the next is the designing room, where the general outline and main features of the bridge are decided upon, and where stresses are figured and main features are determined. All of the training at college and the practical experience gained are needed here, and here the same and even greater accuracy and care must continue.

"The four steps I have outlined very roughly compass what I would suggest as the training of a bridge engineer; it can possibly be obtained in ten years, certainly not sooner. Don't push yourself faster than you feel you are moving. Do not let a salary be your first consideration in these years of training, let the experience you are gaining have the greater weight. A proper salary will come later."

REFUSE CREMATION AT EDINBURGH, BRADFORD AND OLDHAM.

Mention has been made from time to time in these columns of the refuse cremator or destructor of the Horsfall type, which is used in a number of places abroad. The Horsfall Furnace Syndicate, Limited, of London, which builds these furnaces, recently requested Lord Kelvin and Prof. Archibald Barr, M. Inst. C. E., of Glasgow University, to make a careful study of the system employed. These eminent scientists accordingly made a personal study of the plants at Edinburgh, Bradford and Oldham, consulted with the authorities in charge of the works, made experiments at Bradford, and conducted a careful test, lasting 24 hours, at Oldham. Their report is a valuable one, particularly at the present time, when so much attention is being paid to the subject of refuse disposal; the most important portions are presented herewith:

"In none of the three plants inspected is the heat generated as fully utilized as it might be; the plants were not put down with a view to the complete utilization of the heat produced. We would recommend to local authorities the careful consideration of the economic aspect of the problem. With such town refuse as is treated at Oldham we consider that it should be easy to obtain a steam production equivalent to the evaporation of 1 1/3 pounds of water from and at 212 degrees F. per pound of unscreened refuse treated, and we believe that, in a plant designed to utilize the heat to the fullest extent, an evaporation of 1½ pounds of water per pound, or even more, could be reached; and that without in any way affecting the perfection of the process from a sanitary point of view. These figures show that the Oldham refuse has a fuel value of about one-seventh that of good steam coal.

"Figures 1 and 2 represent, in a somewhat diagrammatic manner, the general arrangement of the furnace. Figure 1 shows the independent cell type, as built at Oldham, while Figure 2 represents the arrangement of two cells back to back, as used at Edinburgh and at Bradford. The details of construction are necessarily modified in accordance with the requirements of the site and other conditions peculiar to particular installations. It will be seen that the charging hole is situated at the back of and above the furnace, while the flue for the emission of the gaseous products is situated over the dead-plate in front. This construction ensures that the gases distilled from the raw material must, on their way to the main flue, pass over the hottest part of the furnace, and be brought at the earliest possible time into contact with the intensely hot gases arising from the combustion of the previously dried and now incandescent material which has been raked over the grate bars and is burning there under forced draught.

A second important feature in this connection is the use of steam jets to produce the forced draught. The steam so used is condensed by contact with the cold air which it injects, and the water thus produced is re-evaporated in contact with the furnace bars, keeping down their temperature. In this way the life of the furnace bars is greatly increased. A more important function is, however, fulfilled by the steam. In coming into contact with the incandescent fuel it is decomposed, the hydrogen being freed while the oxygen combines with the carbon in the fuel to form carbon monoxide. This decomposition of the water is affected by heat abstracted from the lower part of the fire where it can be of comparatively small value for the cremation of the distillate. The water gas passes upwards to be burned by the excess air which it meets with over the fire, thus serving to increase the temperature which would otherwise exist at the meeting of the products of combustion wth the gases distilled from the raw material.

"The gases next pass through flues the walls of which are constantly maintained at a glowing temperature. The effect of the hot brickwork was well illustrated by observations which we made on the Bradford plant. In watching, through the open clinkering door of a cell, the operation of raking forward a change on to the grate bars, dense smoke, as might be expected, was observed; but on looking through a sight hole at the end of the main flue no trace of such smoke could be seen issuing from the discharge end of the cell flue, and only the faintest trace of discharge (probably consisting largely, if not entirely, of steam) was observable at the chimney top. The absence of any hydrocarbons from the products of combustion as shown by the analyses given below of flue gases collected at Oldham, may be taken as a further indication of the completeness of the destruction of all organic matter in the plant tested.

"No coal or coke is required for the cremation of the gaseous products issuing from the Horsfall cells. The use of fuel for this purpose with some forms of destructors leads to a large additional item in the cost of treatment of refuse, and may even then be far from successful in accomplishing the desired object —as was proved in the case of the destructors formerly in use at Edinburgh. Even when the fires at the Horsfall destructor are banked over Sunday it is found that they can be maintained alive and operations recommenced on Sunday night without the addition of any purchased fuel.

"Still another important feature is the arrangement by which (except in the very smallest examples) a number of cells—charged and clinkered in rotation—deliver their gases into one main flue. When the fire in one cell is green, the other cells are discharging hotter products, so that the temperature of the main flue is maintained sufficiently high to prevent any possibility of noxious vapors reaching the chimney. It is only after such mixing that the products of combustion reach the boilers. We are convinced that this is a most important matter, and that in no destructor plant should the products of combustion from one cell be taken directly to a boiler so situated that the gases can possibly reach the boiler surfaces before combustion is complete.

"The provisions above enumerated for the maintenance of a high temperature in the region of the exit opening of the cells and in the flue leading therefrom, renders sufficient a very moderate blast pressure. We are of the opinion that it is indeed advisable to avoid the use of a blast pressure exceeding about one inch of water. The use of a high blast pressure in a destructor furnace in which cakes of clinker are produced leads unavoidably to the blowing of holes in the fire, unless the fire is very frequently raked over, and frequent raking, involving as it does the frequent opening of a working door, must lead to the carrying into the furnace of a large excess of air, and thus to a reduction of the temperature of the flues. Such reduction of temperature is in itself an evil from the sanitary point of view, besides reducing the economy in cases in which the heat is to be utilized. Frequent raking also adds greatly to the manual labor required for the process, and therefore to the cost of treatment.

"Again, as a large amount of fine dust is contained in all town refuse, it is advisable to keep the blast pressure low, in order to prevent any important carriage of such dust to the chimney, even in cases where, as in the Horsfall destructor, a considerable height is provided over the fire to minimize the blowing of dust through the discharge aperture. Of course the rate of consumption of a cell of given grate area can be increased by the use of a higher blast, and the treatment of a given quantity of material per day may thus be provided for at a smaller initial cost. High blast pressure and high rate of consumption can be maintained if desired in Horsfall cells as in cells of other constructions. We observe, indeed, that in trials of a Horsfall destructor at Leeds, Dr. Cameron of that city found that 26¾ tons of refuse could be consumed per cell per day.

"A novel feature of the Horsfall cells is the provision, at the sides of the furnaces, of cast iron boxes, through which the blast air is taken on its way to the grate. No doubt these boxes, to some extent, effect a heating of the blast, but their chief use is to prevent the adhesion of clinker to the side walls of the cells. In the absence of such a provision, destructor cells, in which a high temperature is maintained, rapidly deteriorate; possibly partly because of a direct chemical action, but mainly through the necessity for continually breaking off the adhering clinker, and so damaging the brickwork as ultimately to undermine the side walls. The iron boxes seem to be thoroughly effectual in preventing this trouble.

"We consider the special arrangement of charging-hole at the back and clinkering door at the front of the destructor to have impor-

THE OPERATING STATISTICS AT BRADFORD AND OLDHAM.

	Bradford.	Oldham.
Number of cells	12	10
" " stokers and weekly wages	8 at $6.72	12 at $7.20
" " fillers " " "	4 at $6.00	
Number of boiler and mortar mill attendants, and weekly wages	2 at $6.72 1 at $5.52	1 at $6.48 1 at $5.76
Extra man at mortar mill occasionally employed	$1.44	....
Total wages of furnacemen per week	$77.76	$86.40
Total wages of funace, boiler and mortar mill men per week	$98.16	$98.64
Hours of work of furnacemen per week	66	48
Shifts of furnacemen per week	5 of 12 hours 1 of 6 hours	6 of 8 hours
Time of working destructor per week	(Start) Sunday midnight (Finish) Saturday noon	Sunday 10 p. m. Saturday 10 p. m.
Hours of working the destructor	132	144
Frequency of clinkering of each cell	Every 1½ hours	Every 2 hours
Average amount of muck burned per week	650 tons	480 tons
Rate of working of each cell per 24 hours	10 tons	8 tons
Average bulk of muck in cubic feet per ton	40	50
Cost of labor of furnacemen per ton	12 cents	18 cents
" " " " boiler and mortar mill men per ton	15 cents	20½ cents

tant advantages. It provides for the entire separation of the charging platform from the clinkering floor, and this gives great facilities for the storage of the surplus refuse during the hours of maximum delivery, while it leaves the whole range of clinkering doors in one line free for the operations there to be performed. Moreover, from the charging hole the operator can see right through to the front of the fire, so that the working of the whole cell is under his observation, and the operator at the front of the furnace, who has also a clear view, has only, in spreading a new charge over the fire grate, to rake it directly towards himself, thus involving a minimum amount of labor.

"With these features in view we are not surprised to find that the cost for labor in stoking and clinkering the Horsfall furnaces at Bradford works out at the very low figure of 6d. per ton of refuse treated. At Oldham, where higher wages per hour are paid, the cost of labor is about 9d. per ton.

Destructor at Powderhall, Edinburgh.—"We visited the destructor on February 19th, 1898. It consists of ten cells in two rows of five, back to back. . . . The principal feature of the plant as it now stands is a dust collector. It consists of a circular brickwork building about 16 feet internal diameter and 12 feet internal height, lined throughout with fire brick. In the center of this is built an inner cylindrical chamber, 5 feet 8 inches internal diameter, communicating with the surrounding annular space through arched openings at the top of the separating wall. The main flue from the destructors enters the annular chamber tangentially at the bottom, so that the gases have to pass around and upwards through the annular space before they enter the central chamber, from the bottom of which again they pass off to the boiler or to the bye-pass flue as desired. The annular chamber is partially obstructed by the entering flue, the bye-pass flue, the boiler flue, and a rake passage communicating with the central chamber; the spaces between these obstructions form pockets in which the dust, carried outwards by centrifugal action from the whirling gases, may be quietly deposited. Each of the pockets is provided with a cleaning door, through which the dust may be withdrawn.

"At our request, Mr. Cooper, the city engineer, caused the dust intercepted during the week ending March 13th, 1898, to be measured and found it to be in bulk 53 cubic feet. This may serve at once to indicate the efficiency of the design and the need for such an appliance in the case of Edinburgh, where the refuse is collected dry every day and is very light and dusty in character. Mr. Cooper has kindly furnished us with particulars with regard to the weight and bulk of the refuse. It appears that the bulk per ton is very variable, but we estimate that the mean bulkiness throughout the year may be taken at from 70 to 80 or more cubic feet per ton, showing that it is of an exceptionally light character. The dust from the collector is perfectly clean and free from soot—as might be expected from the high temperature at which the plant operates. It closely resembles finely ground reddish firebrick.

"We had not with us, on the occasion of our visit, an electric pyrometer, which we believe to be the only thoroughly satisfactory means of measuring such temperatures as exist in destructor flues, but we inserted a metallic expansion pyrometer into the dust collector and we found it to indicate just over 1,600 degrees F. We also inserted three metal discs having melting points respectively of about 2,000 degrees, 1,800 degrees and 1,100 degrees F. On withdrawing the wire on which the discs were strung after one minute's exposure we found the last of the discs gone but the others intact. We also observed that the discharge from the chimney was almost wholly invisible, only the faintest trace of whitish 'smoke' was perceived. The slight discharge detected on close observation of the chimney no doubt consisted largely, if not entirely, of vapor produced by the recombination of the elements of the decomposed steam from the jets and from the wet materials treated.

The Bradford Destructors.—"The destructors at Bradford were visited on the evening of May 3rd, 1898, and again on May 4th. The installation here consists of 12 cells, arranged in two groups of six cells, in lines of three, placed back to back, having one charging hole common to two cells.

"These furnaces, we understand, represent the latest type constructed by the Horsfall Company, and we noted that in many details they showed great improvements over earlier examples. More especially, we would instance (1) the single clinkering doors of exceptional width, giving most convenient access for the working of the cells, (2) the manner in which these doors are suspended (instead of being hinged) which removes the inconvenience to the operator caused by radiation from the hot brick linings of the doors, and (3) the general arrangement and construction of the iron work of the furnace front.

"The gases from the main flue pass through two multitubular boilers. These, however, have not sufficient heating surface to utilize the heat completely.

"An examination of the superintendent's books, giving the records over a considerable period, shows that the mean rate of working is about 650 tons per week, or say 10 tons per cell per working day.

"The muck treated is of a very unpromising looking character, and is in itself a proof of the necessity for an efficient system of destruction. It consists of damp ashpit refuse containing a large proportion of nightsoil and of vegetable refuse from the market and from shops. It measures about 40 cubic feet to the ton. The nightsoil amounts—on the estimate of the superintendent—to 40 per cent. of the whole, and the green vegetable refuse to 5 or 6 per cent.

"Observations through a sight hole at the end of the main flue showed that the whole length was at a glowing heat. A thermoelectric pyrometer recorded a temperature of 1,550 degrees F. for the gases in the main flue, but the superintendent states that 'for two nights previous to (our) visit, the collecting carts had been at work in one of the poorest districts in the city......in which the refuse is of the very poorest calorific value. At no time during (our) visit was there anything approaching (the) usual working temperature.'

"Observations of the chimney showed here, as at Edinburgh, only a faint trace of whitish smoke, becoming invisible at a very short distance from the chimney top.

"A portion of the steam produced is utilized on the premises for supplying the steam jets, driving mortar mills and for the electric lighting of the works, while another portion is supplied to an adjoining fish refuse manure factory. Even with the small amount of boiler power provided, steam was continually blowing off. We would judge that 400 horse-power could be generated continuously from this destructor.

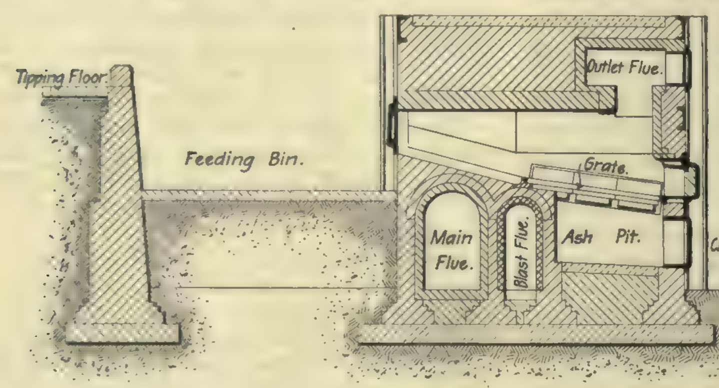


FIGURE 1.—SINGLE CELL DESTRUCTORS.

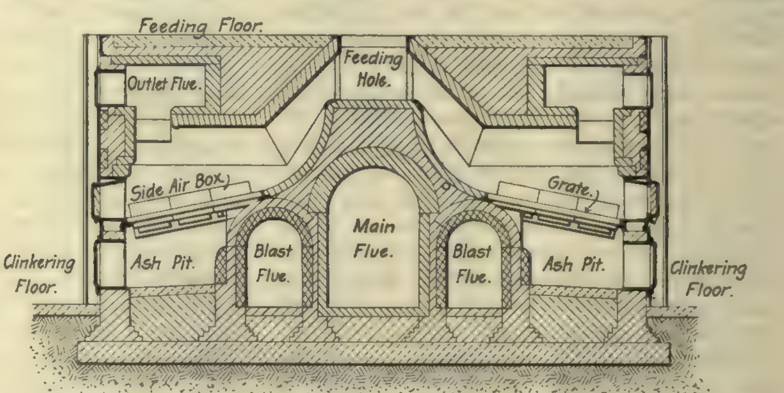


FIGURE 2.—CELLS ARRANGED BACK TO BACK.

"The clinker and ash produced amount in weight to about 30 per cent. of the material treated. We are informed by Mr. McTaggart that the whole of this clinker and ash is now utilized, none having been taken to tips for about three years. From 100 to 150 tons are used per week (or, say, two-thirds of the whole) for the manufacture of mortar, which finds a ready sale—the output for the year ending 31st March, 1897, was 6,000 tons. The remainder of the clinker and ash is passed through a breaking and grading machine, and sold to contractors and others at 8d. per ton—lifted and removed by the purchaser.

Oldham Destructor.—"We visited Oldham on the afternoon and evening of 4th May, and on the 5th and 6th of May we carried out a continuous test of the plant extending over 24 hours. There are here ten cells, one battery of six and another of four cells.

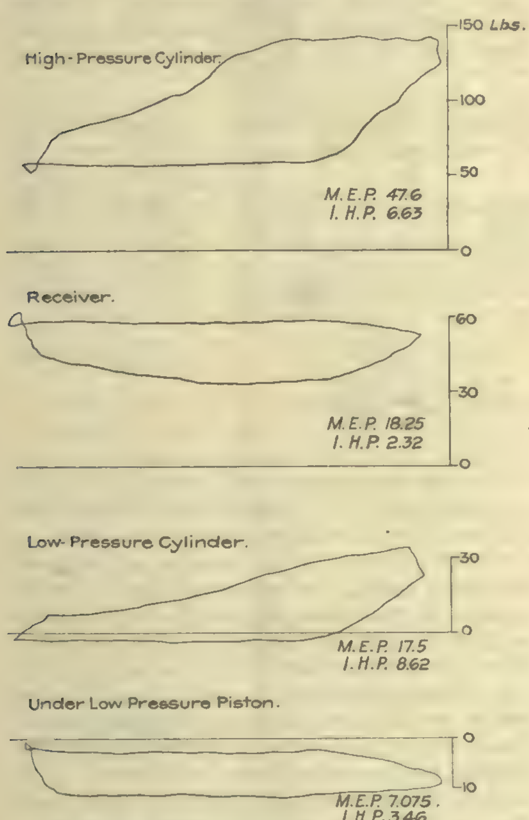
"The muck at Oldham consists principally of cottage ashes (from exposed ashpits), fish offal and market garbage, and it measures on an average 50 cubic feet per ton.

"Besides supplying steam to the corporation electric lighting station, the plant supplies

steam for heating food and driving the wheelwright's shop in the horse and provender department. The latter small application alone, we are informed, saves the corporation £60 a year in fuel, besides the time of a stoker. Some power is also utilized for the manufacture of mortar from clinker and lime, about 15 tons of clinker being used in this way per week. The sale of mortar so produced brings in a revenue (after paying for the lime required) of some £215 per annum.

"Continuous observations of the temperature of the main flue from the four newer cells were made by means of a thermo-electric pyrometer. These observations extended from 10.50 p. m. of the 5th of May to 2.05 a. m. of the 6th of May, and from 4.40 a. m. till 7.20 a. m. of the 6th of May. The thermo-electric pyrometer gave a mean temperature of 1,643 degrees F., with a minimum of 1,370 degrees F., and a maximum of 1,875 degrees F. The temperature in individual cells must have been considerably higher even than this. Observations of the temperature in the flue leading to the boiler, at some distance beyond the six older cells, indicated a somewhat lower temperature for these cells. They were made over a shorter time, and we had not access to the cells themselves for temperature observations.

"The mean air pressure under the grates of six cells was 1⅜ inches of water, and for four cells ⅞ inch. How far the higher temperature in the case of the four cells is due to the improved construction, and how far due to the



SAMPLE SET OF INDICATOR CARDS.

lower blast pressure, we are unable to say; but the result would appear to indicate an advantage from the use of the lower pressure, and at least demonstrates that a pressure under an inch of water is sufficient to give admirable results in cells constructed on the Horsfall system.

"Samples of the gases were collected (over mercury) from the main flues. As will be seen from the table below, some of these were collected slowly, so as to cover considerable periods of ordinary working, including clinkering, and others were taken in shorter periods while no clinkering was being done. These samples were submitted to Messrs. R. R. Tatlock & Thomson, city analysts of Glasgow, whose report upon their analyses is as follows:

	Per cent. by volume.				
	A.	B.	C.	I.	II.
Carbonic acid......	8.60	15.50	18.10	8.50	13.30
Oxygen	10.90	3.90	1.40	10.70	6.30
Nitrogen	80.50	80.60	80.50	80.80	80.40

"The samples were taken as follows:

	Date.	Time.	Aver. Temp. F.	Remarks.
A...............	5th	10.59 p. m.-11.33 p. m.	1505°	Clinkering in cells 3 and 4 occupying 18 minutes.
B	6th	1.23 a. m.-1.54 a. m.	1600°	Clinkering in cells 4 and 1 occupying 20 minutes.
C	6th	5.14 a. m.-5.46 a. m.	1730°	Clinkering as usual.
I..................	5th	11.40 a. m.-12.25 p. m.	not taken	Clinkering in two cells.
II....	5th	12.50 p m.-1.0 p. m.	not taken	No clinkering.

"These analyses must be considered as exceedingly satisfactory. It will be observed that in no case was a measurable amount of carbonic oxide found, and only in one case were traces noted. Further, the proportion of carbonic acid is very large, and that of free oxygen very small. The small proportion of free oxygen—which means small excess of air—is to be attributed, on the one hand, to the avoidance of a high blast pressure, which would blow holes in the fire, and on the other to the small chimney draught, which would draw a large amount of air through the furnace during the operation of clinkering. The absence of even traces of hydrocarbons shows that in all cases the furnace was completely destroying the gases distilled from the refuse, while the absence of carbonic oxide shows that the combustion of the carbon was complete. This is a most satisfactory result, especially when coupled with the small amount of excess air above noted. The results of the combustion and evaporation tests are given in the accompanying table.

RHODES BANK DESTRUCTOR, OLDHAM.

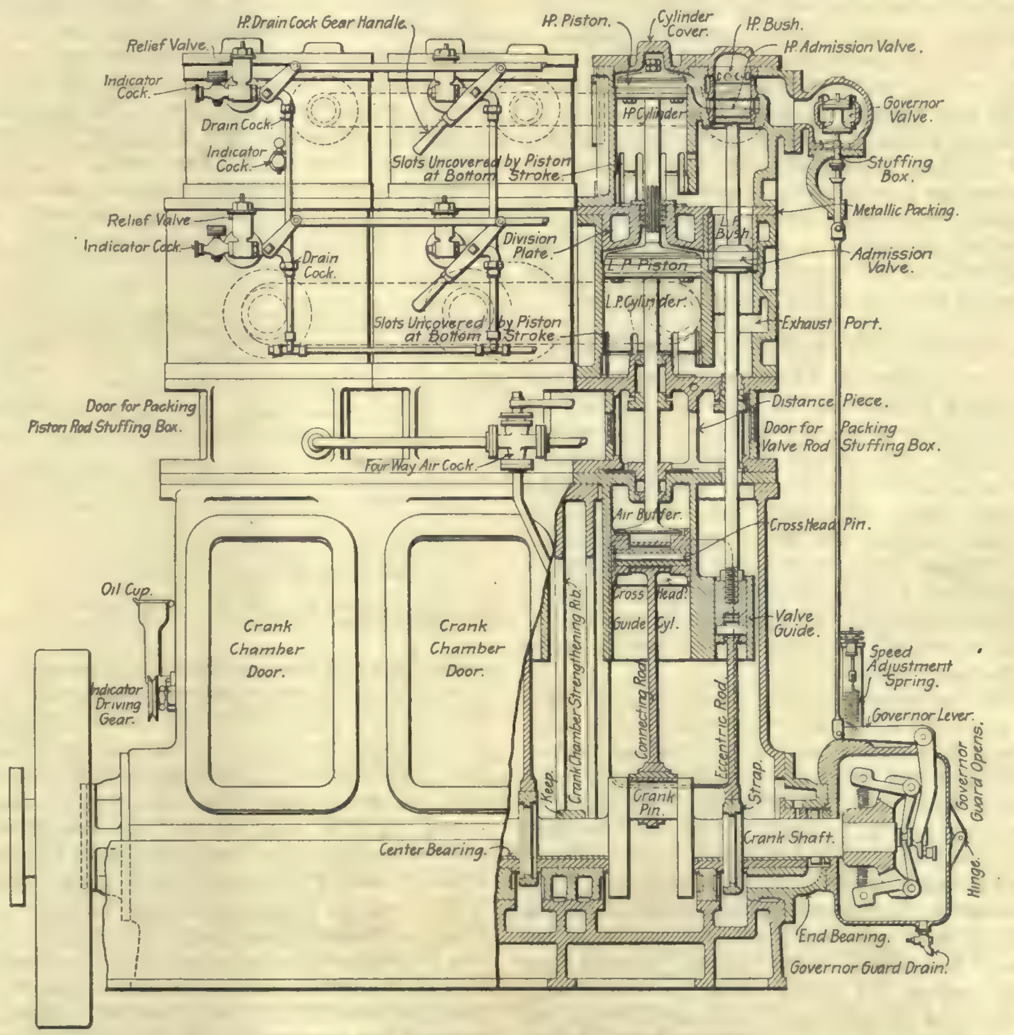
Date and Duration of Trial: 8 a. m., 5th May to 8 a. m., 6th May, 1898. Twenty-four hours.

	Four cell group.	Six cell group.
Refuse consumed, lbs. per cell per 24 hours	17,830	17,830
Average boiler pressure lbs. per sq. in	128	128
Average temperature of feed water	57°F.	57°F.
Water evaporated, lbs	78,900	78,100
Equivalent evaporation in lbs. of water from and at 212° F.	95,100	94,100
Equivalent evaporation per lb. refuse	1.33	0.88
Air consumption per lb refuse (calculated approximately). ..	25.8 c. ft.	28.6 c. ft.
Draught in ashpit in of water....	⅞	1⅜

"The storage space for refuse was not found sufficient to enable us to have supplies for the batteries of six cells and four cells respectively kept separate, so that the amount consumed in each battery was not determinable. The figures given above for the refuse burned in the two batteries separately were obtained on the assumption that the rate of combustion per cell in the battery of four cells was the same as that in the battery of six cells. There seems rather to be a likelihood that the combustion was slower in the four cells than in the six, since the draught was considerably less, so that the evaporation figures given for the four cells should probably be increased to show the best return in steam that can be obtained per pound of the muck treated at Oldham."

TEST OF A FAN AND ENGINE.

An interesting test was recently made of a fan and direct-connected engine constructed by Messrs. Bumsted & Chandler of Hednesford, England, for the Belgia, a vessel lately completed for the Hamburg-American line. According to "The Engineer," the fan is 78 inches in diameter, with air inlets on each side, and discharges downward into the stokeholds. The blades of the fan are flanged and riveted to a steel disk, twelve blades each side of the center



A THREE-CRANK COMPOUND SINGLE-ACTING ENGINE.

plate. The disk is bored to fit a center casting, which is keyed to the engine shaft. The type of engine employed is the vertical tandem-compound. It is single-acting, steam being admitted into the upper part of each cylinder. The lower end of the high-pressure cylinder is open to the receiver, and when the steam is admitted to the receiver from the upper part of the cylinder during the up-stroke, the pressure in the lower part of the cylinder is higher than that existing during the down stroke, by reason of the draft of steam which the low-pressure cylinder makes at that time. Work is therefore done by the steam in its passage from cylinder to cylinder. The steam ejected from the upper part of the low-pressure cylinder is likewise used in the lower part of the cylinder, as connection is made with the condenser during the down-stroke only. Piston valves are employed, one high-pressure and one low-pressure to each cylinder, and the steam acting on

the top of each keeps a downward pressure on the eccentric. The engine runs silently as a result, it is said, of the fact that everything is maintained in compression. Lubrication is effected by the splash system, the crank dipping into oil at every revolution and throwing it on the working parts. The accompanying drawing is an elevation and part section of a three-crank compound engine, made by the same engineers, and shows the features of this type of design. The tri-compound engine shown is rated at 76 brake horse-power at 425 revolutions per minute and 125 pounds steam pressure. The cylinders are 8 and 11 inches in diameter with 6-inch stroke.

The engine tested has cylinders 5 and 9½ inches in diameter, with a stroke of 7 inches. It was desired to make the test a severe one, and the discharge of the fan was partly choked. A four-hour test was made, and indicator diagrams were taken and the speed, the height of water gauge in the fan outlet, and the boiler pressure were recorded every 45 minutes. The steam consumption was measured every 30 minutes. A sample set of the indicator cards are given in an accompanying cut. The average number of revolutions per minute was 400 and the boiler pressure was 150 pounds. The indicated horse-power from the cards was found to be 21.03. The average water consumption was 20.65 pounds per indicated horse-power per hour. The size of the choked fan discharge was 8⅛ inches by 2 feet 1¼ inches, and 13,978 cubic feet of air were passed through the opening per minute at an average pressure of 6⅛ inches of water. The horse-power represented by the air was calculated as 13.47 and the combined efficiency of the engine and fan, equal to 13.47 divided by 21.03, was found to be 64 per cent.

GRAVITY STEAM HEATING PROBLEMS.

A short time ago a letter was received by Mr. William J. Baldwin, M. Am. Soc. C. E., from a contractor of heating and ventilating work in England. The writer was about to install a plenum system for warming and ventilating a school house. He had read Mr. Baldwin's "Steam Heating Problems" and "Steam Heating for Buildings," and wrote to the author for advice on some proposed steam connections. "The Engineering Record" is allowed to print the following abstract of the interesting correspondence:

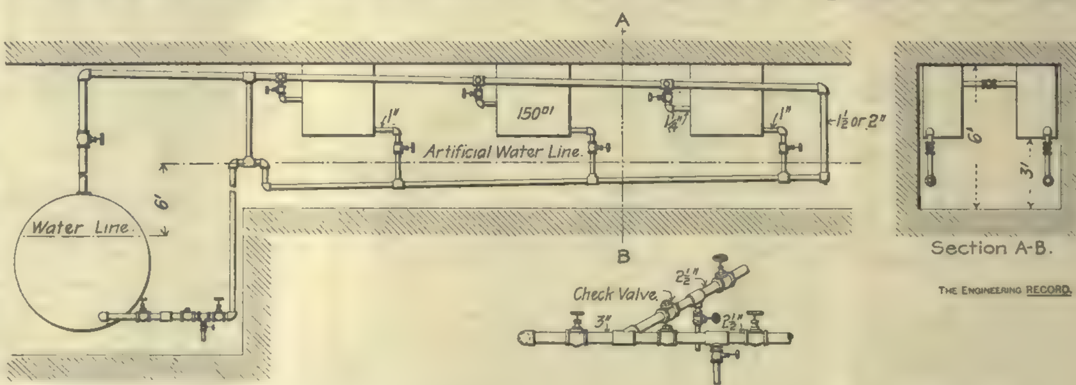
The heating chamber of the school house was a large air duct, 6 feet high and 100 feet long. There were 3,000 square feet of heating surface placed in the duct, distributed in twenty coils ten on each side. The coils were 3 feet high and supported so as to leave 3 feet clear between them and the floor. A Cornish boiler was used and it was proposed to keep its water line 6 feet below the bottom line of the coils. A 3-inch steam main, as calculated from tables in the books mentioned, was to be used, with 1¼-inch feed valves and 1-inch check valves to each coil, and a 2-inch return pipe on each side of the duct, the two pipes continuing to a point below the boiler water-line before uniting. The two return pipes were to be connected into a single 2-inch pipe, with a stop valve next the boiler, and a 2-inch swinging check in each return before the point of junction.

The questions were as follows: Was one 2-inch return sufficient, or would the two 2-inch returns make a better job? Were the check valves necessary, and if so, were they in the proper position? Would it be necessary to insert a pet cock at a point outside of the stop valve to draw off the first water of condensation in order to get a dry return and thus start the circulation, or did the proper circulation depend on the relief from the main steam pipe into the return pipe? What was the shortest difference of level under which a gravity system would work, measuring from the water line of boiler to the bottom line of the coils? Were check valves best fixed near the coils or near the main return? Where would it be advisable to fix air valve? Would it be advisable to run the returns near the floor line, giving them a slight fall, or would it be better to grade them to a quick pitch? What advantages were there in trapping branch returns over connecting them to the main returns without a syphon? Which system worked better, gravity dry-return or gravity water-line return?

In reply Mr. Baldwin said that the distance from the lowest coil to the water line of the boiler, 6 feet, was considered ample, provided the steam mains were sufficiently large. Some error, however, had apparently been made in the calculations for determining the size of the main steam pipe. According to the rule, 3,000 square feet of surface would call for a pipe between 4 and 5½ inches in diameter, varying with the distance the steam had to be carried. A pipe 4 inches in diameter was thought about the right size for direct radiation; one 5½ inches in diameter would be used for indirect work. The rule stated that the diameter in inches was equal to one-tenth of the square root of the number of square feet of heating surface to be supplied. The value would vary, of course, with the distance above the water line. Six feet was considered good, and while the rule called for 5½ inches, it was quite possible to get along with 5 inches, a 5½-inch pipe not being a standard in America. If one wanted to be absolutely sure, a 6-inch pipe could, of course, be adopted. The size of the main decreased as branches were taken off, the sizes being ascertained by the rule given.

Branches 1¼ inches in diameter were all right for the coils, although one size might be added, making them 1½ inches, the friction of the boiler hindered the flow of water a little, but, on the other hand, was a protection against sudden loss of water from the boiler, should an accident happen to any part of the piping system. It also prevented the sudden backing of water from the boilers and the filling of the coils through the return pipe, should the steam valve be accidentally closed and the return valve at the boiler forgotten. A good practice was to place a stop valve on each side of the check, so that when the check valve got foul or gave trouble with new work, it might be opened to inspection without allowing the apparatus to cool. A tee was placed outside of the check valve, so that water could be drawn from the return pipe without letting it out of the boiler. The position of the pet cock, as suggested, might result in losing water from the boiler if the stop valve should be forgotten. When placed inside of the check valve the comparative safety which the check valve gave might be relied on.

A relief, or a number of them, was very essential and should be of large size; they are used to relieve the main of water and to establish as much or nearly as much pressure in the return pipe as in the steam pipe. This balancing of the pressure was the true secret of the return of the water of condensation by gravity. There was nothing to help the water return unless gravitation in the vertical water head produced in the pipe; and the conclusion was reached that the main steam pipe and the return pipes of an apparatus could not be too large. Economy compelled stopping at some point and hence the rule. If the mains were so large that the loss of pressure between the



small pipes being proportionately greater. A 1-inch pipe was thought sufficiently large for returning the condensed steam. A check valve would not be used in this country in the return pipe, unless, indeed, a stop valve were used as well. A check valve was not deemed sufficiently tight to keep water from backing up when the steam valve was closed for any considerable time, and it would not help the water to go down. A 2-inch return pipe on each side would carry the water back, provided the return pipe was below the water line. The return pipe in the case at hand was above the water line and practically became a drain through which the water would run and fall into the vertical pipe near the boiler, leaving the return very largely full of steam. To get the water to return to the boiler, the pressure in the vertical drop pipe near the boiler would have to be within two pounds, at least, of the initial boiler pressure. When the steam was passed through the mains, through the coils (where there was the greatest condensation), through the 1-inch return pipes and then back through the main return pipe to the drop, there was considerable pressure lost in the circuit, so that the return pipe had either to be enlarged to carry the pressure back, or it had to be sealed—compelled to remain full of water up to some safe distance below the indirect coils. The working rule to follow would be to make the return pipe one size smaller than the steam pipe until it had reached 2½ inches. The two returns would then be run 2½ inches in diameter, connecting together and entering the boiler through a 3-inch pipe. A check valve at

boiler and the surface of the water in the return pipe was only one-quarter of a pound, the difference of level theoretically would have to be only 7 inches. When the loss of pressure was one pound, the difference would be 28 inches. It was necessary to add an extra foot or two for practical reasons. That was why 3 or 4 feet was considered the least safe allowable difference between the water levels in the boiler and the return pipes. Nothing was to be gained by the use of a syphon where the branches connected with the main return. The gravity water-line system worked better than the gravity system with dry return. Mr. Baldwin made it a rule to get the return pipes entirely below the water line of the boiler, and when this could not be done, to get as high as possible above the water line. In other words, he either held the returns full of water or made sure that water could not rise to them, for the reason that when they were between wind and water, as might be said, the water was kept surging back and forth within them at every little variation of pressure, always resulting in noise. A quick pitch was not necessary in return pipes, and if it was necessary to run a return pipe which was below the water line up and down without regard to alignment, it could be done if provision was made for a small connection between the steam main and the upper part of the imperfect alignment. This let the air out of that part of the return pipe, and when it was not air bound, the water would move through it, due to the head in the vertical legs. The accompanying drawing will show the arrangement advised.

PERSONAL AND OBITUARY NOTES.

Mr. A. J. McCune has been appointed state engineer of Colorado.

Mr. C. U. Boley has been appointed city engineer of Oshkosh, Wis.

Mr. W. H. Caldwell has been elected city surveyor of New Britain, Conn.

Mr. Otis F. Clapp, M. Am. Soc. C. E., has been re-elected city engineer of Providence, R. I.

Mr. George Janin has been appointed assistant superintendent of the Montreal water department.

Messrs. Hill & Turner, architects, announce the removal of their offices to 150 Fifth Avenue, New York City.

Mr. John J. Downey and Mr. J. R. Rackliffe have been appointed city clerk and city engineer respectively, of St. Joseph, Mo.

Messrs. Alvord and Shields have removed their offices to Suite 127, Hartford Building, corner of Madison and Dearborn streets, Chicago.

Mr. Samuel McLoon, who has been assistant city engineer of Kansas City, Kan., for the past two years, has been elected to the post of city engineer.

Lieut. Edgar Jadwin, Corps of Engineers, U. S. A., who has recently returned from Cuba with the Third Volunteer Engineers, of which regiment he has been lieutenant-colonel, has been ordered to proceed to Chicago, for duty under Major William L. Marshall, Corps of Engineers.

Mr. Charles S. Tilton, city surveyor of San Francisco, Cal., Mr. C. E. Grunsky, M. Am. Soc. C. E., and Mr. Marsden Manson, M. Am. Soc. C. E., of the department of highways, Sacramento, Cal., have been appointed a board to prepare plans and estimates of sewers needed in San Francisco.

Colonel Robert Burke has been appointed superintendent of sewers for Chicago, Ill. Assistant Engineer Robert B. Wilcox has been appointed to take charge of the harbor operations and the erection of new bridges, both of which departments have been in the hands of Col. Burke for the past 15 years.

At a meeting of the American Society of Civil Engineers, held May 3, the following admissions to the society were announced: As members; Mr. F. M. Bisbee, Springfield, Mo.; Mr. F. A. Hinds, Watertown, N. Y.; Mr. I. W. Leer, Havana, Cuba; Capt. C. H. McKinstry, Corps of Engineers, U. S. A., Key West, Fla.; Mr. D. H. Maury, Peoria, Ill.; Mr. F. L. Stuart, Washington, D. C.; Mr. George Tatnall, Wilmington, Del. As associate members; Mr. A. P. Boller, Honolulu, H. I.; Mr. J. M. Braxton, Key West, Fla.; Mr. F. G. Frink, Moscow, Idaho; Mr. F. F. Harrington, Philadelphia, Pa.; Mr. E. F. Kenney, Moore, Pa.; Mr. K. L. Martin, Brooklyn, N. Y.; Mr. G. C. Mason, University Heights, N. Y.; Mr. F. V. Pitney, Morristown, N. J.; Mr. W. B. Poland, Cincinnati, O.; Mr. H. W. Preston, Athens, Pa.; Mr. C. S. Towle, New York City; Mr. B. M. Wagner, Brooklyn, N. Y.

Captain J. B. West, who has been superintendent of the water-works of Marietta, O., since the plant was built, has tendered his resignation, to take effect July 1.

The Bellefontaine Bridge & Iron Co., Bellefontaine, Ohio, sends the following self-explanatory note: "A party giving his name as D. Diamond and representing himself to be connected with this company has victimized firms in Xenia and Cincinnati, Ohio, and Lexington, Ky., by obtaining goods from them and claiming they were for work which we are building in the country nearby. The description given us of this party is that of a man about 60 years of age, rather heavily built and having side whiskers. We warn all firms to extend no credit to him on our account."

CONTRACTING NEWS

OF SPECIAL INTEREST TO

CONTRACTORS, BUILDERS, ENGINEERS, AND MANUFACTURERS

OF ENGINEERING AND BUILDING SUPPLIES.

For Proposals see pages xi, xii and 536.

WATER.

Enterprise, Kan.—Bids will be opened May 10 for the construction of a power house, pumping machinery, well and stand pipe 12x80; also for 1 mile of 4 and 6-in. pipe, 10 hydrants and 6 gate valves, for an extension to the present system. James Frey, City Clk.; H. V. Hinckey, Cons. Engr., Topeka.

Montreal, Que.—Bids are wanted May 16 for supplying cast-iron pipe, special castings, lead pipe, brass castings, etc., for 1899. Geo. Janin, Acting Supt. Water Wks.

Valley Junction, Ia.—M. J. Cleary, City Clk., writes that it has been voted to grant a 25-year franchise to a private corporation to build water-works and an electric light plant.

Independence, Mo.—The Independence Water Works Co. is preparing to lay 7 miles of mains. R. D. Wirt, Supt.

Denver, Colo.—The County Commissioners have granted a franchise to the Union Water Co. to lay water mains, not exceeding 4 ft. in diameter, along certain county roads.

Birmingham, Ala.—A correspondent writes that the American Water Works & Guarantee Co. has purchased the Birmingham water-works and will make extensive extensions and improvements.

Newark, N. J.—Bids are wanted May 11 for 600 gross tons of 4 to 10-in. water pipe, 200 gross tons of 12 to 36-in. pipe, and 100,000 lbs. of 4 to 36-in. specials, as advertised in "The Engineering Record."

Washington, D. C.—Bids are wanted May 27 for furnishing a quantity of cast-iron water pipe, as advertised in "The Engineering Record."

Winnipeg, Man.—Bids are wanted June 5 for a softening plant, as advertised in "The Engineering Record."

Gaffney City, S. C.—Bids are wanted May 24 for the construction of a water-works plant, as advertised in "The Engineering Record."

San Luis Obispo, Cal.—J. A. Goodrich, City Clk., writes that it was voted April 20 to issue $80,000 water bonds and $36,000 sewer bonds.

West Superior, Wis.—A correspondent writes that the Superior Water, Light & Power Co. proposes to construct a purification plant.

Fairfield, Conn.—E. W. S. Pickett writes that the Uncowa Water & Light Co. have been granted charter rights.

Florence, Colo.—It has been voted to adopt the meter system in connection with the new water-works plant. J. E. Blunt, Chmn. Water Com.

Fulton, N. Y.—W. R. Hillick, City Clk., writes that an election will be held May 16 to vote on the proposition to purchase the plant of the Fulton Water Works Co. for $172,500.

Minneota, Minn.—It is stated that A. M. Haynes of Mankato is preparing plans for water-works.

Walker, Minn.—Fairbanks, Morse & Co. of St. Paul are stated to have secured the contract for the water-works system, at $5,975.

Oconomowoc, Wis.—It is stated that a vote will be taken in May on issuing $42,000 bonds for a water system.

Roswell, N. M.—The Felix Irrigation Co. has been organized with a capital of $50,000. The company will construct a 33-mile irrigation canal from the Rio Hondo in Chavez County to within 6 miles of the Rio Felix. The directors are: Edwin F. Draper, Irving S. Osborne and Samuel Atkinson, all of Eddy, N. M.

Lincoln, Mo.—A company with $160,000 capital has been organized in Lincoln for the purpose of constructing and maintaining a canal for irrigating purposes in Chambers County. Incorporators: Fred and William Schwettman, Fred Brill, J. C. Gerkin of Lincoln, Mo., and others.

Brownsville, Tenn.—An election will be held May 9 to vote on the issue of $27,000 bonds for the extension and improvement of the water-works system; also for the issue of $12,500 bonds for a public school.

Lakeport, Cal.—Herbert V. Keeling, Town Clk., writes that the contract for constructing a system of water-works has been awarded to Jas. Stanley of 518 15th St., Oakland, Cal., for $15,591.

Washington, D. C.—The District Commissioners have ordered a water main laid in Connecticut Ave., at an estimated cost of $4,600.

New Brunswick, N. J.—Press reports state that $30,000 have been appropriated for the purchase of a pumping engine and boiler.

Rockyford, Colo.—Bonds to the amount of $17,000 have been sold for the purpose of extending the water system.

Bath, Pa.—A charter of incorporation has been granted to George S. Mauser, Moses George, Wilson Seem, Allen Cressman, Victor H. Barrall, Thomas D. Danner and C. F. Smith, under the corporate name of the Bath Water Power Co. Capital, $10,000.

Titusville, Pa.—The contract for a pumping engine has been awarded to the Snow Steam Pump Wks. of Buffalo for $21,848.

Pekin, Ill.—The city has under consideration a proposition to purchase the water-works plant.

Paris, Ark.—The matter of constructing water-works is under consideration. Col. B. B. Chism of Paris is interested.

Detroit, Mich.—The Water Board has decided to lay mains on 4 avenues and 2 streets.

Moroni, Utah.—Articles of incorporation have been filed by the Freedom Irrigation and Water-Works Co. The capital stock is $5,012. Benjamin F. Taylor, Pres.; Andreas Jensen, Vice-Pres.; and James W. Lowry, Sec. and Treas.

Davis, Ill.—There is a proposition under consideration to issue $5,000 bonds for water-works construction.

New Castle, Pa.—Press reports state that steps are being taken with a view to the municipal ownership of the water-works.

Covina, Cal.—The Columbia Land and Water Co. has been incorporated with a capital stock of $60,000. Incorporators: A. W. Seeley, F. M. Chapman, R. A. Meredith and others.

Spartanburg, S. C.—The Home Water Supply Co. has applied for a charter. The capital stock to be $50,000. J. H. Montgomery, R. K. Carson, D. E. Converse, J. F. and J. B. Cleveland are the incorporators.

Berryville, Va.—T. S. Thompson, Recorder, writes that a committee has been appointed to employ an engineer to furnish estimates of cost of completing the water-works plant.

Tacoma, Wash.—See "Government Work."

St. Louis, Mo.—Bids are wanted June 27 for 2 pumping engines at high service pumping station No. 3. Robt. E. McMath, Pres. Bd. Pub. Improvements.

Nyack, N. Y.—G. N. Houston, Engr. of Water Commrs., writes that it was voted May 1 to issue $35,000 bonds for completing the filter beds and the high service reservoir.

Milnor, N. D.—The Postmaster writes that bids will be asked about Aug. 1 for water-works.

Allentown, Pa.—Bids are wanted May 29 for one 8,000,000 gal. pumping engine, as advertised in "The Engineering Record."

Pendleton, Ore.—Bids are wanted May 31 for 253 tons of 6 to 12-in. pipe and special castings, 29-4 to 12-in. stop gates, 26 hydrants, etc. F. W. Vincent, Mayor.

Lancaster, Pa.—The contract for furnishing pipe to the Water Department from April 1, 1899, to April 1, 1900, has been awarded as follows: To the Reading Foundry Co., Lim., Reading, 4-in., $25.09 per gross ton, delivered; 6-in., or larger sizes, $24.19 per gross ton; total quantity of pipe not to exceed 1,000 tons.

Doylestown, Pa.—Bids are wanted May 11 for drilling and casing 2 or more 8-in. wells, 100 ft. deep. J. Harrison Wilson, Chmn. Water Com.

Seattle, Wash.—According to local press reports, contracts for the Cedar River water system have been awarded as follows: Subdivision No. 1 to the Pacific Bridge Co. of Portland, Ore., their bid being $911,007.08. The three other subdivisions to Smyth, Wakefield & David of Portland, Ore., at a total of $282,904.95.

For list of bids received see our issue of Apr. 22.

Cincinnati, O.—The following bids are stated to have been received April 28 for constructing settling reservoirs, laying pump mains from the Eastern Pumping Station and other work near California: Folz, Willard & Co., of Cincinnati, $1,069.231.83; J. M. Quill, Cincinnati, $1,434,785; F. H. Kirchner & Co., Cincinnati, $1,145,045; M. Sullivan, Cincinnati, $1,324,466; Hughes Bros. & Bangs, Syracuse, N. Y., $1,237,578; Wagner Water Supply Co., Dayton, O., $1,451,676.50; Mason, Hoage & Co., Frankfort, Ky., $1,189,498; A. J. Henkel, Cincinnati, $1,171,428; Guy M. Gest, Cincinnati, $1,198,409.

Hintonburg, Ont.—Local press reports state that contracts for the water-works system have been awarded as follows: To A. McDonald, Aylmer, for pipe trenching, laying and refilling, $14,570; Montreal Pipe and Foundry Co., Montreal, 641 tons pipe, $17,627, 12 tons special castings, $564; St. Lawrence Foundry Co., Toronto, valves and hydrants, $1,994; W. J. Campbell, Ottawa, 120 ft. 12-in. steel pipe, $390; H. B. Merrill, New York City, 2 pumping engines, $2,450, 2 boilers as per specified, $1,900; total, $39,446.

SEWERAGE AND SEWAGE DISPOSAL

St. Louis, Mo.—Bids are wanted May 16 for 20,240 ft. of 12 to 30-in. pipe sewers. Robt. E. McMath, Pres. Bd. Pub. Improvements.

Tacoma, Wash.—See "Government Work."

Syracuse, N. Y.—Bids are wanted May 8 for sewer work in Belden Ave., Townsend and Park Sts. M. Z. Haven, City Clk.

Muncie, Ind.—Bids are wanted May 22 for 8 and 12-in. sewers in Monroe and Wysor Sts. F. W. Clevenger, City Clk.

Derby, Conn.—Bids are wanted May 12 for the construction of sewers and appurtenances, as advertised in "The Engineering Record."

Ann Arbor, Mich.—Bids are wanted May 10 for the construction of storm water sewers, as advertised in "The Engineering Record."

New Orleans, La.—Bids are wanted July 5 for the new drainage system, as advertised in "The Engineering Record."

Wakefield, Mass.—Press reports state that the Town Board proposes to make extensive improvements in the sewer system.

St. Cloud, Minn.—The City Council is considering the matter of constructing a sewer on Fourth St., estimated cost $6,000 to $10,000.

Fort Wayne, Ind.—Plans are being prepared for the construction of the South Wayne sewer.

Sleepy Eye, Minn.—City Engineer Haynes of Mankato has completed surveys, etc., for a complete sewerage system.

St. Joseph, Mo.—The Finance Committee of the City Council has been requested to appropriate $15,000 this spring for the completion of a section of the Blacksnake sewer.

Quincy, Mass.—Sewer bonds to the amount of $70,000 have recently been sold.

Redbluff, Cal.—An election has been ordered for May 13 to vote on the issue of $35,000 bonds for the construction of a system of sewers.

West Orange, N. J.—Alexander Potter of N. Y. City has presented revised apportionment of the cost of the sewer to tidewater to be constructed jointly by a number of municipalities. Under this apportionment the cost to West Orange will be $53,228. The total estimated cost of sewers for the township, including both the trunk line outlet and the laterals, will be $111,168.

San Francisco, Cal.—Steps have been taken to provide for the construction of main outlet sewers and the reconstruction of existing sewers by appointing C. E. Grunsky, Marsden Manson and Charles S. Tilton as a board of engineers to examine into the condition of the drainage facilities of the city, and to prepare plans and an estimate of the cost of the proposed work.

Moline, Ill.—According to local press reports it is proposed to build a $15,000 sewer extension.

Lorain, O.—The State Board of Health has approved the plans for a sewer system, prepared by City Engineer L. A. Fauver and Riggs & Sherman of Toledo, O.

Charleston, S. C.—The Council's Committee on surveys has agreed to report favorably a number of sewer bills, including one for a sewer to drain the properties in the Jewish Hospital section, to cost $28,000, and one to drain the Feltonville section at a cost of $17,000.

The Dalles, Ore.—Press reports state that Wm. J. Roberts of Spokane has been employed to examine the proposed city sewer system and make an estimate of cost.

Waterbury, Vt.—Press reports state that surveys are being made preparatory to building a system of sewerage for Randall St.

Warsaw, Ind.—Frank T. Oakley of Toledo, O., has been employed to prepare plans and specifications for a complete sewer system.

Norristown, Pa.—Bids are wanted May 20 for furnishing 6 to 36-in. vitrified, salt-glazed pipe, etc., for one year. John C. Shanks, Chmn. Sewer Com.

Quincy, Mass.—Bids are wanted May 15 for 10,000 ft. of 8 to 20-in. pipe sewers in Ward 5. William T. Shea, Chmn. Bd. Sewerage Commrs.

Allegheny, Pa.—It is stated that bids are wanted May 8 for sewers in several streets. Robt. McAfee, Dir. Pub. Wks.

Greensburg, Ind.—Press reports state that it is proposed to build a system of sewers.

San Luis Obispo, Cal.—See "Water."

Haverhill, Mass.—City Engineer Evans has presented a plan for a sewerage system in Wards 4 and 6; estimated cost, $110,000.

Carnegie, Pa.—Local press reports state that plans have been adopted for a trunk sewer; estimated to cost $50,000.

Warren, Pa.—It is stated that bids are wanted May 15 for furnishing sewer pipe, brick, castings, etc., and for constructing sewers in several streets. Levi Smith, Chmn. Com.

New Castle, Pa.—Bids are wanted May 8 for a lateral sewer in Butler Ave. Will E. Marshall, City Clk.

Chillicothe, O.—Bids are wanted May 12 for a storm sewer. W. A. Wallace, City Clk.

St. Paul, Minn.—Local press reports state that the following bids were opened May 1 for constructing the Hamline sewer system: Kerkland & Deeks, $46,700; P. Doherty, St. Paul, $47,973; Lindqvist & Johnson, St. Paul, $50,980; P. J. Ryan, $53,000; Preston & Keigber, St. Paul, $45,400. Engineer's estimate, $48,000.

Logansport, Ind.—A. D. Fransler, City Clk., writes that the following bids were opened May 1 for 1½ miles of 24-in. to 4 ft. brick sewers and 3 miles of 8 to 24-in. pipe sewers, 70 manholes, 48 catch basins and 22 flush inlets; the trench is expected to average 13 ft. in depth and be excavated 2/3 in rock: M. A. Talbot & Co., Logansport, Ind., *$89,154.59; Munger & Bros., Dayton, Ohio, $90,730.23; T. O'Brien, St. Louis, Mo., $96,690.54; Roberts & Co., Pittsburg, Pa., $93,810.94.
* Contract awarded.

Braddock, Pa.—Samuel A. Taylor of Pittsburg, Boro. Engr., writes that the following bids were opened May 1 for pipe sewers: Cronin & O'Herron, Pittsburg, Pa., $7,760.50; Ott Bros., Allegheny, Pa., $7,637.30; Cono Acetta, Pittsburg, Pa., $8,965.55; John Dell, Braddock, Pa., $8,044; Jas. H. McQuaide, Pittsburg, Pa., $7,943.50. The contract was awarded to Cronin & O'Herron at $4.50 per cu. yd. for concrete; $23 each for 12 manholes; $2.85 per ft. for 1,800 ft. of 30-in. pipe; $1.73 per ft. for 1,100 ft. of 24-in. pipe, and $1.22 per ft. for 265 ft. of 20-in. pipe.

Cohoes, N. Y.—Wm. J. Elliot, City Clk., writes that the following bids were opened April 26 for approximately 8¾ miles of 24 to 10-in. pipe sewers, as advertised in "The Engineering Record: R. H. Strong, Albany, N. Y., $67,261.75; E. H. Post, Wilkesbarre, Pa., *$46,363.15; Harrington & Besch, Troy, N. Y., $53,341.79; Thos. Karr, Troy, N. Y., $76,410.26; Cohoes Construction Co., Cohoes, N. Y., $54,962.83; A. M. Banker, Gloversville, N. Y., $48,381.47; J. H. Neary, Cohoes, N. Y., $54,596.48; F. S. Ablett, Cohoes, N. Y., $52,624.41; P. H. Harrison & Son, New York City, $52,334.20; Baker & Judson, Gloversville, N. Y., $60,717.81; Chas. T. Hookway, Syracuse, N. Y., $53,687.25.
*Contract awarded.

Independence, Mo.—City Engr. H. H. Pendleton states that contracts have been awarded for 13 sections of sewers as follows, prices including labor and materials: Black & Laird, Des Moines, Ia., 709 ft. 18-in. pipe, at 78 cts. per ft., 5,582 ft. of 15-in. at 64.6 to 72.4 cts., 3,940 ft. of 12-in. at 45 to 48.7 cts., 8,171 ft. of 10-in. at 29 to 42.3 cts., 13,642 ft. of 8-in. at 29.5 to 38.5 cts., manholes at $31.50 for the first 10 ft. and $2 for each additional foot. Matt & Roberts, Jefferson City, Mo., 4,888 ft. of 8-in. pipe at 62 and 68 cts., manholes at $38 for the first 10 ft. and $3.80 for each additional foot.

BRIDGES.

Breckenridge, Colo.—A bill has been signed by the Governor for a bridge across Blue River, at Mumford's Crossing. Appropriation, $5,000.

Atlanta, Ga.—Press reports state that the Council has notified the Consolidated Railway to build an iron bridge over the tracks at Humphries St.

Grand Rapids, Mich.—The construction of a steel viaduct across Grand River, between North Park and West Michigan Fair Grounds, estimated to cost $14,000, is stated to be under consideration.

Elizabeth, N. J.—The Board of Freeholders has decided to build a one-span, iron girder bridge, with buckle plates, to cost about $12,000, to replace the West Jersey St. structure.

Duluth, Minn.—The Board of Public Wks. requested the City Engineer to have plans and specifications of the Tenth Ave. West viaduct made.

Santa Cruz, Cal.—The Board of Supervisors has accepted plans for the Valencia bridge. Two sets were submitted, one for a steel bridge and the other for wood and stone. Bids will be asked for both.

Cumberland, Md.—A joint survey by Baltimore & Ohio and West Virginia Central & Pittsburg officials has been made and plans perfected for the proposed double-track bridge over the Potomac, to connect the West Virginia Central yards at Ridgeley with the Baltimore & Ohio yards in South Cumberland.

Easton, Pa.—The Select Council passed a resolution authorizing plans to be prepared for a bridge across the Lehigh River.

Pittsburg, Pa.—The Schultz Bridge and Iron Co., McKee's Rocks, is stated to have secured the contract for rebuilding Main St. bridge across Sawmill Run, for $10,105.

Columbia, S. C.—Press reports state that a draw bridge will be built by the Southern R. R. across the Savannah River.

Westerly, R. I.—The construction of a bridge across the Pawcatuck River, between the towns of Hopkinton and Westerly, is stated to be under consideration.

Utica, N. Y.—The Havana Bridge Wks., Montour Falls, N. Y., are stated to have secured the contract for the lift bridge over the canal at Washington St., for $16,480.

Indianapolis, Ind.—Local press reports state that bids are being prepared for a bridge over Fall Creek, on Meridian St.

Burlington, Ia.—Two bridges will be built by the Board of Supervisors; one over Hawkeye Creek, the other over Flint Creek.

Brewton, Ala.—Press reports state that the County Commissioners are having plans prepared for one or more steel bridges across the Conecuh River.

Sandyhill, N. Y.—Local press reports state that Monty, Higley & Co. submitted the lowest bid, at $5,600, for the steel bridge over the canal at Main St.

Modesto, Cal.—Local press reports state that the Board of Supervisors are considering the construction of a bridge at Hill's Ferry.

Columbus, O.—County Surveyor Maetzel has been directed to arrange plans for a truss bridge over Big Walnut Creek at Hibernia.

Middlesex, Vt.—The Selectmen of Middlesex and Moretown have decided to construct an iron bridge across the river at Middlesex Narrows.

Buffalo, N. Y.—The State Engineer has decided against a bascule bridge over the canal at Ferry St., and recommended the construction of a swing bridge, to cost $18,000.

Sewickley, Pa.—The Council has granted permission to the Pennsylvania R. R. to build a stone arch culvert over Ferry St.

Lajunta, Colo.—Governor Thomas has signed a bill appropriating $6,000 for a bridge over Arkansas River.

Peoria, Ill.—Willard & Cornwell, Louisville, Ky., is stated to have received the contract for a steel bridge over Kickapoo Creek, for $20,000.

Hardin, Colo.—Local press reports state that the Union Pacific R. R. will build an iron bridge on the Julesburg branch near here.

Boston, Mass.—City Engineer Jackson has awarded to William J. Lawler of Boston the contract for building draws and piers for the temporary pile bridge across the Charles River, near the old West Boston Bridge, at $20,199.

Verona, N. J.—Local press reports state that arrangements have been completed for the building of a bridge over the Erie R. R. tracks at Bloomfield Ave. Estimated cost, $25,500.

Santa Rosa, Cal.—Local press reports state that bids will soon be asked by the Board of Supervisors for a bridge over Green Valley Creek.

Wilkesbarre, Pa.—Press reports state that bids will soon be asked by the County Commissioners for stone and iron bridges.

Williamsport, Pa.—Bids are wanted May 9 for 3 steel highway bridges. J. P. Bubb, Chmn. Co. Commrs.

Boston, Mass.—Bids are wanted May 10 for bridges on Summer St. extension, over A and C Sts. William Jackson, City Engr.

Albany, N. Y.—Bids are wanted May 16 for building a number of bridges in connection with the N. Y. State canals, as advertised in "The Engineering Record."

Cohoes, N. Y.—Plans have been received by Mayor Mitchell for a new iron bridge to replace present structure across the Mohawk River on Ontario St.

Hailey, Idaho.—Bids are wanted May 22 for a steel bridge across Wood River. W. E. Heard, Clk. Bd. Co. Commrs.

Cleveland, O.—Local press reports state that the City Council rejected all bids received April 7 for the superstructure of the Center St. bridge and will readvertise for same.

Washington, D. C.—See "Government Work."

Buffalo, N. Y.—Bids are wanted May 16 for the superstructure for a viaduct over the New York, Chicago & St. Louis R. R., Western New York & Pennsylvania Ry. and the Buffalo Creek R. R. in Abbott road; also for masonry, paving and other work necessary for constructing piers, abutments of and approaches to the same. Edward B. Guthrie, Ch. Engr. of Grade Crossing Commrs.

PAVING AND ROADMAKING.

Chicago, Ill.—Local press reports state that the lowest bid recently received for paving was from J. H. Covode of New York City at $1.90 per sq. yd. for alcatraz asphalt. Total amount about $107,000.

Union City, Pa.—Bids are wanted May 15 for paving with brick on Main St., as advertised in "The Engineering Record."

Hamilton, O.—The Board of Control has ordered South Third St. paved. City Engineer Dillon estimates the cost at $19,722 for asphalt.

Anderson, Ind.—Charles H. Daniels of Indianapolis has secured a brick paving contract at $1.24 per ft. The total amount of contract is stated to be about $60,000.

Batavia, N. Y.—The Board of Aldermen has authorized the improvement of about 3 miles of highway. Total cost about $5,000.

Hamilton, Ont.—A vote will probably be taken about May 25 on the proposition to issue $150,000 bonds for street improvements.

Albany, N. Y.—Local press reports state that Henry Dumary of Albany has secured contract for paving Orange St. for $9,888 and Second St. for $8,840, and Mulderry Bros. have been given the contract for paving Howard and William Sts. for $13,797.

Bloomfield, N. J.—Bids are wanted May 15 for $75,000 street improvement bonds. William L. Johnson, Township Clk.

Brunswick, Ga.—The Committee on Public Works is considering the matter of street paving.

Michigan City, Ind.—It is stated that J. M. Spiker of Aurora, Ill., has secured a paving contract amounting to about $135,000.

Reading, Pa.—An ordinance has been passed providing for brick or asphalt pavement on several streets.

Ferguson, Mo.—According to press reports it has been decided to improve the streets; vitrified brick will probably be used.

Newport News, Va.—A vote will be taken May 25 on the question of issuing $90,000 bonds for street improvements. J. A. Massie, City Clk.

Bowling Green, O.—Bids are wanted May 29 for macadamizing a road in Liberty Township. W. J. Digby, Township Clk.

St. Louis, Mo.—Bids are wanted May 16 for brick, macadam and Telford pavement on several streets. Robt. E. McMath, Pres. Bd. Pub. Improvements.

Kansas City, Kan.—Bids are wanted May 9 for paving Greeley Ave. E. R. Ireland, City Clk.

Brooklyn, N. Y.—Bids are wanted May 13 for furnishing granite paving blocks. James P. Keating, Commr. of Highways, New York City.

Jersey City, N. J.—Bids are wanted May 9 for 3,287 sq. yds. Belgian pavement on Duncan Ave. Geo. T. Bouton, Clk. Bd. Street & Water Commrs.

Kansas City, Mo.—Bids are wanted May 10 for paving Benton boulevard. Geo. E. Kessler, Secy. Bd. Park Commrs.

Boston, Mass.—Bids are wanted May 11 for paving 2,000 lin. ft. on South Boston Flats. Woodward Emery, Chmn. Harbor & Land Commrs.

Indianapolis, Ind.—Bids are wanted May 10 for asphalt pavement on Pennsylvania St. M. A. Downing, Chmn. Bd. Pub. Wks.

Alliance, O.—Bids are wanted May 25 for asphalt and brick block pavement on 3 streets. J. H. McConnell, City Clk.

Whatcom, Wash.—Bids will be received about June 1 for asphaltum paving to cost $40,000. A. R. Campbell, Engr. in Charge, New Whatcom, Wash.

Stamford, Conn.—Bids are wanted May 15 for paving Main St. with asphalt block, as advertised in "The Engineering Record."

Cincinnati, O.—Bids are wanted May 9 for brick paving on Zeltner St., and until May 26 for asphalt paving on Spring Grove Ave. Samuel Nieman, Pres. Bd. City Affairs.

San Antonio, Tex.—Bids are wanted May 20 for 14,457.2 sq. yds. of asphalt pavement, as advertised in "The Engineering Record."

Schenectady, N. Y.—It is stated that bids are wanted May 9 by the Schenectady Locomotive Works for 4,600 sq. yds. asphalt or brick paving and 2,900 ft. of curbing on 2 streets. W. D. Ellis, Pres.

New Castle, Pa.—Bids are wanted May 8 for paving Market St. Will E. Marshall, City Clk.

Albany, N. Y.—Bids are wanted May 15 for brick paving on Lexington and New Scotland Aves. Thos. J. Lanahan, Clk. Bd. Contract and Apportionment.

Lansingburg, N. Y.—Local press reports state that bids are wanted May 10 by the Clerk of the Board of Trustees for $63,264 paving bonds, to be used to pave 5th Ave.

Boston, Mass.—Bids are wanted May 9 for paving 4 streets and Charles River bridge. George G. Crocker, Chmn. Boston Transit Com.

Erie, Pa.—Bids are wanted May 15 for about 4,400 sq. yds. asphalt pavement on Walnut St. Benj. E. Briggs, City Engr.

Veedersburg, Ind.—Bids are wanted May 24 for brick paving on Main and Second Sts. I. J. Walker, Town Clk.

Minneapolis, Minn.—It is stated that bids are wanted May 12 for brick paving on Royalston Ave. G. W. Sublette, City Engr.

Roselle, N. J.—Bids are wanted May 19 for 9,000 sq. yds. macadam pavement. G. A. Rawlins, Boro. Clk.

Bethlehem, Pa.—Bids will probably soon be asked for rebuilding with macadam the Bethlehem-Nazareth road, which is about 6 miles long.

Vanwert, O.—C. F. Manship, Town Clk., writes that the following bids were opened April 24 for 30,324 sq. yds. of asphalt paving, and 10,410 ft. of curbing: Trinidad Asphalt Paving Co., N. Y. City, $54,203; Vulcanite Paving Co., Philadelphia, $64,882; Barber Asphalt Paving Co., Detroit, Mich., $63,372; Metropolitan Paving Co., N. Y. City, $66,274.

Nazareth, Pa.—O. H. Knecht, Secy. of the Northampton County Agricultural Society, writes that the contract for constructing a half-mile of regulation race track has been awarded to John F. Dolan, Elizabeth, N. J., as follows: 24 cts. per cu. yd. for earth excavation; 37 cts. per cu. yd. for loose stone; 80 cts. for solid rock and 37 cts. for top dressing. There will be required approximately 40,000 sq. yds. of cutting and 5,500 yds. of top dressing.

Newark, N. J.—Local press reports state that the following bids were opened April 27 for asphalt paving in six streets: George McDonald, formerly connected with the Newark Asphalt Paving and Construction Co., $2.03 per sq.yd. for each street; New Jersey Asphalt Co., $1.99 for one street and $1.89 for each of the other streets; Barber Asphalt Paving Co., $1.95 for one street and $1.90 for each of the other streets Atlantic Alcatraz Asphalt Paving Co., $1.99 for each street.

Ithaca, N. Y.—C. C. Platt, Clk. of the Paving Commission, writes that the following bids were received for furnishing bricks. The first two bidders offer to deliver on the streets as directed by the Superintendent: Mack Manufacturing Co., Philadelphia, Pa., wire cut block, 99 cts. per sq. yd.; wire cut brick, $1.05 per sq. yd.; repressed bevel edged brick, $1.14 per sq. yd.; repressed bevel edged block, $1.07 per sq. yd. Campbell Brick Co., Ithaca, N. Y., Newfield repressed pavers, 95 cts. per sq. yd. Costello & Neagle, Elmira, N. Y., McMahon Porter Standard brick, 93 cts. per sq. yd., f. o. b. cars Ithaca. The contract was awarded to the Campbell Brick Co. They will be required to give a bond to furnish the bricks in quantities not less than 40,000 each week, commencing June 1. The brick next to the street car rails, shaped to fit are to be furnished at the same price.

Meriden, Conn.—W. S. Clark, City Engr., writes that the following bids for about 4,200 sq. yds. of sheet asphalt paving on North Clinton St. were opened April 27, as advertised in "The Engineering Record": Sicilian Asphalt Paving Co., Times Bldg., N. Y. City, $12,829; Boston Asphalt Co., Boston, Mass., $15,731.10; Southern New Eng. Paving Co., Hartford, Conn., $13,882.90. The contract was awarded to the Southern New Eng. Paving Co. at $2.96 per sq. yd. for sheet asphalt, 88 cts. per lin. ft. for 1,250 ft. of new curb, 53 cts. per lin. ft. for 250 ft. of old curb and 28 cts. per lin. ft. for 780 ft. concrete tie.

Norwich, Ont.—It is stated that bids are wanted May 15 for about 4,800 sq. yds. macadam and cobblestone pavement. A. J. Yeo, Chmn. Com.

Boston, Mass.—The following bids were opened May 1 by the Metropolitan Park Commission, Wm. T. Pierce, Engr., for building Mystic Valley Parkway, Main St. to Middlesex Fells Reservation, Winchester Mass. The principal item on which bids were received was the 3,700 net tons of broken stone surfacing: *a*, trap rock; *b*, local stone:

Name of Bidders.		Stone Surfacing per ton.	Totals.
James J. Welch & Co., Salem	*a*,	$1.90	$28,435.90
	b,	1.35	26,400.90
Baker & Judson, Gloversville, N. Y.	*a*,	$1.70	$27,517.50
	b,	1.25	26,222.50
T. Stuart & Son Newton	*a*,	$1.70	$27,088.85
McCusker Bros. Waltham	*a*,	$1.85	$26,547.20
	b,	1.65	25,807.20
Mirick & Wentworth, Malden	*a*,	$1.85	$26,173.10
	b,	1.85	26,173.10
T. H. Gill, Somerville	*a*,	$1.95	$25,38[illegible].95
	b,	1.50	23,718.95
Charles G. Craib Boston	*a*,	$1.40	$25,312.20
	b,	1.10	24,232.20
*Coleman Bros., Charleston	*a*,	$1.75	$24,612.50
	b,	1.50	23,687.50

* Contract awarded.

POWER PLANTS GAS AND ELECTRICITY.

Danville, Pa.—The citizens have voted to issue $15,000 bonds for an electric light plant.

Springfield, Ill.—The Governor is stated to have signed the bill appropriating $20,000 for the erection of an electric light plant for the Capitol.

Hartford, Conn.—The Engineering Contract Co. of New York is stated to have received the contract for building a dam and power house on the Farmington River for the Hartford Electric Light Co. The Westinghouse Electric & Mfg. Co. of Pittsburg will furnish the machinery and the Stilwell-Bierce & Smith, Vaile Co. of Dayton, O., will furnish the wheels for the power house; estimated cost of entire plant, $175,000.

Columbus, Ga.—A correspondent writes that bids will soon be asked by the Eagle & Phoenix mills for the construction of a power plant, to cost $50,000. W. C. Whitner of Anderson, S. C., is the engineer in charge.

Fairfield, Conn.—See "Water."

Elroy, Wis.—It is stated that the Council will secure plans at once for an electric light plant.

Portland, Me.—The Portland Light & Power Co. has been incorporated, to furnish this city with electric lights; capital, $100,000. Incorporators: Henry P. Cox, Lyman N. Cousens and others.

Manitowoc, Wis.—Wm. H. Killen of Milwaukee is stated to have applied for a franchise to erect a gas plant.

Williamsburg, Ia.—H. E. Hull, G. H. Hughes and T. T. Osborn are said to have been appointed a committee to investigate the question of lighting the town.

Sparta, Mich.—J. L. Hisey is stated to have received a franchise for an electric light plant.

Lewiston, Idaho.—L. A. Osborne, Asst. Mgr. Westinghouse Electric & Mfg. Co., of Pittsburg, is said to be investigating the feasibility of developing power from the surplus water of the Vineland flume and canal and making an estimate on the cost of utilizing it through an electric power plant and transmission by wire to Vineland and Lewiston for street railway, electric lighting and manufacturing purposes. The Lewiston Water & Power Co. is said to be interested. E. H. Libby, Pres.

Salina, Kan.—W. E. Whitaker, representing the Saline Ice & Cold Storage Co., has received a franchise for an electric light plant.

Port Clinton, O.—E. H. Fall, E. A. Powero and others have received a franchise for a hot water heating plant.

Independence, Mo.—S. A. Sullivan, City Clk., writes that the city is looking into the matter of lighting the city under a new contract. Both gas and electricity are used at present.

Worcester, Mass.—The Bradley Hubbard Mfg. Co. of Meriden, Conn., is stated to have received the contract for the electric light fixtures for the Court House, at $8,461.69.

Missouri City, Mo.—W. F. Norton and G. A. Chanstor are said to be interested in a company which proposes to install an electric power plant in the coal mines.

Brooklyn, N. Y.—The power house of the Brooklyn Rapid Transit Co., at Kent Ave. and Rush St., was damaged by fire May 1, to the extent of about $100,000.

Norwalk, Conn.—It is stated that the entire plant of the Norwalk Gas Light Co. is to be rebuilt. Dr. W. F. Acton, Supt.

Valley Junction, Ia.—See "Water."

Almonte, Ont.—C. Simpson, F. A. Cowie and J. K. Cole are stated to have been appointed to secure estimates on an electric plant.

Larchmont, N. Y.—The New York & Suburban Gas Co. is stated to have applied for permission to extend its mains through the village.

Pittsburg, Pa.—A charter has been granted to the Monongahela Light & Power Co. to supply electric light in Westmoreland, Allegheny and Washington counties. Principal office to be located here. Directors: W. E. Walsh and Chas. F. Farren of Allegheny, Geo. B. Motheral of Pittsburg, and others.

Niantic, Conn.—Butts & Crosby, 49 Pearl St., Hartford, who are preparing plans for a power plant, write that they expect to use undershot water wheels, 30 ft. in diameter, 40 ft. face, to be built of structural steel, in addition to toothed gearing, air compressors, piping and storage tanks.

Alpena, Mich.—The House has passed a bill authorizing the city to issue $100,000 bonds for an electric light plant, the proposition to be submitted to the people.

New York, N. Y.—See "Schools."

Columbus, Wis.—The Council is stated to have employed F. H. Ford of Madison, to prepare plans for the electric light plant; probable cost, $10,000.

Scranton, Pa.—The West Side Electric Light & Power Co. has been incorporated; capital, $20,000. Incorporators: Fred Wamke, M. F. Sands and others.

Schuyler, Va.—It is stated that the Virginia Soapstone Co. will purchase machinery for about 200 h. p. for lighting and a trolley line. J. W. Foster, Mgr.

Marietta, O.—The Council is stated to have instructed the Light and Building Committee to secure plans for a city electric light plant.

Connellsville, Pa.—The Youghiogheny Electric Light, Heat & Power Co. has been incorporated; capital, $15,000. Incorporators: Robt. W. Saisson, S. R. Slaymaker and others.

Macon, Ga.—J. B. English, R. E. Park and G. L. Patrick have applied for charter for Ocmulga Power Development Co.

Wilkesbarre, Pa.—Hessel, Lewis & Co. of Wilkesbarre are stated to have received the contract for an electric light plant at the new asylum building, at Retreat, at $10,956.

Buffalo, N. Y.—The plans for the municipal gas plant, prepared by Engineer Merrifield of the Economical Gas Apparatus Co. of Toronto, were filed by the Board of Public Works with the Bureau of Buildings May 2.

Camden, N. J.—The following bids have been received for the installation of an electric light plant in the new High and Manual Training School: Fredk. Kauffman, Camden, N. J., $8,194.80; R. C. Strange, 723 Walnut St., Philadelphia, $6,065; De Olier Engineering Co., 129 S. 11th St., Philadelphia, $8,355; Wesley Bartine, 2,045 N. 13th St., Philadelphia, $5,000. According to local press reports all bids were rejected and the work was ordered readvertised.

ELECTRIC RAILWAYS.

Darby, Pa.—The Philadelphia, Morton & Swarthmore St. Ry. Co. is stated to have received a franchise.

San Francisco, Cal.—The Market St. Ry. Co. is stated to have petitioned the Supervisors for permission to change the motive power of its line to electricity.

Woonsocket, R. I.—John D. Turner of Saylesville, R. I., is said to be interested in the construction of an electric railway from this place to Providence.

Mamaroneck, N. Y.—The Larchmont Horse Ry. Co. is stated to have applied for a franchise to construct a trolley on Grove, Mamaroneck and Railroad Aves.

Saratoga Springs, N. Y.—The Saratoga & Northern R. R. Co. is stated to have received a franchise on Spring Ave.

Elizabeth, N. J.—The Elizabeth Ry. Co. is stated to have received permission to change its motive power from horse to electricity.

Tacoma, Wash.—The County Commissioners have granted a franchise to the Tacoma Ry. & Power Co. to construct an electric railway from Tacoma to American Lake.

Dexter, N. Y.—The Brownville & Dexter St. Ry. Co. is stated to have received a franchise. J. A. Lebkuecher, Pres.

Chicago, Ill.—The Chicago Western Elevated R. R. Co. is stated to have applied for a franchise to construct and operate an elevated railway.

Fremont, O.—The Commissioners of Sandusky and Huron counties are stated to have granted a franchise to the Toledo, Fremont & Norwalk Electric Ry. Co.

Perth Amboy, N. J.—The Perth Amboy R. R. Co. is stated to have secured a right of way from Perth Amboy to Metuchen and Woodbridge.

Bay City, Mich.—It is stated that the St. Ry. Co. will expend about $20,000 in improving its line.

Macon, Ga.—Senator A. O. Bacon is stated to have applied for a franchise.

Hamilton, O.—Chas. L. Cornell of Hamilton is said to be interested in the construction of an electric railway from Hamilton and Lebanon.

Brookville, Ind.—B. F. Wissler, John W. Barnes and others, representing the Richmond Interurban Ry. Co. of Richmond, Ind., have received a franchise through Franklin county.

Massena, N. Y.—The Railroad Commission is stated to have granted permission to the Massena St. Ry. Co. to build and operate a street railway in the village. Robt. Swan, Massena, is one of the Directors.

Pottstown, Pa.—The Pottstown Passenger Ry. Co. is stated to have decided to extend its line from Saratoga to Limerick Square, a distance of about 4 miles.

Sycamore, Ill.—The Geneva Lake, Sycamore & Southern Electric Ry. Co. is stated to have received a farnchise through DeKalb County.

St. Joseph, Mo.—The St. Joseph Ry., Light, Heat & Power Co. is stated to have applied for a franchise to construct a railway in the northeast part of the city.

Corydon, Ind.—Wm. Rathrock of White Cloud, Ind., writes that he will donate the water power necessary to operate the 13 miles of electric railway which it is proposed to build between Corydon and Leavenworth, at an estimated cost of $130,000.

Marine City, Mich.—The Detroit & Northern Ry. Co. is stated to have received a franchise.

Pomeroy, O.—Senator J. M. Camden of Parkersburg, W. Va., is said to be interested in the construction of an electric railway from this place to Racine.

Riverside, Cal.—The Riverside & Arlington Ry. Co. has applied for a franchise. It is stated that bids will be received for same May 23. C. R. Stibbens, City Clk.

Gardner, Mass.—The Gardner, Westminster & Fitchburg St. Ry. Co. has been incorporated, with a capital of $100,000, to construct a railway 10 miles long from Gardner through Westminster to Fitchburg. Incorporators: J. A. Stiles, F. S. Coolidge, and others.

Urbana, O.—The Dayton, Springfield & Urbana Ry. Co. has applied for a franchise.

RAILROADS.

Boulder, Colo.—The Boulder Ry. & Utility Co. has been incorporated, with a capital of $250,000, to own and operate a railroad in this place, and also from Boulder to Lafayette. Incorporators: Saml. R. Thompson, Denver; Guy D. Duncan and Edw. C. Allen of Boulder, and others.

Mason City, Ia.—The citizens are stated to have voted to aid the Iowa, Minnesota & Northwestern Ry. Co. to construct a railroad from Blue Earth, Minn., to Belle Plaine, Ia., a distance of 227 miles.

Arkansas City, Kan.—A charter has been granted to the Arkansas Valley & Gulf Ry. Co. to construct a railroad from Arkansas City to Texarkana. Directors: Dwight Braman of New York, Harry S. Moffitt of Boston, Fred D. Fuller of Topeka, and others.

Denver, Colo.—The Denver & Montana R. R. Co. has been incorporated to construct a railroad through Morgan, Washington and Logan counties; capital, $1,000,000. G. W. Holdredge, Gen. Mgr. Burlington & Missouri River R. R. Co., Omaha, Neb., is one of the incorporators.

Blue Earth City, Minn.—C. T. Dike of Mason City, Ia., is the engineer in charge of constructing a railway, estimated to cost about $2,000,000.

PUBLIC BUILDINGS.

(See also Schools and Government Work.)

Butler, Pa.—C. H. Owsley of Youngstown, O., is said to be preparing plans for a $70,000 almshouse for Butler County.

Schenectady, N. Y.—The congregation of the Emanuel Baptist Church is stated to have decided to erect a $15,000 edifice.

Philadelphia, Pa.—J. D. Lengel of Wayne, Pa., has received the contract to erect the Memorial Church of St. Paul at Lancaster and Overbrook Aves. Cost, $30,000. F. M. Mann, Archt., 328 Chestnut St.

Worcester, Mass.—Geo. T. Rockwood has prepared plans for a $20,000 addition to the City Hospital for a power plant and laundry.

Kankakee, Ill.—The Supervisors are stated to have appointed a committee to secure plans, etc., for a jail and sheriff's residence; probable cost, $20,000. J. Frank Leonard, Chmn. Com.

Elmira, N. Y.—The Senate is stated to have passed a bill appropriating $150,000 for the extension of the south wing of the Reformatory.

Enterprise, Ore.—The County Commissioners are said to be considering the matter of erecting a court house.

Rome, N. Y.—The House is stated to have passed a bill appropriating $80,840 for improvements to the Rome State Custodial Asylum.

Sault Ste Marie, Mich.—Charlton, Gilbert & Demar of Marquette are stated to have prepared plans for the $20,000 church for the Presbyterian Society. Rev. G. P. Bates, pastor.

Gardner, Mass.—Plans have been prepared by Barker & Nourse of Worcester for a $12,000 brick post office building. Henry Heywood and others owners.

Braddock, Pa.—It is stated that a $25,000 municipal building will be erected.

Clinton, Ill.—Gottschalk & Beadle of Galesburg, Ill., are stated to have prepared plans for a $14,000 church for the Congregational Society.

Bridgeport, Conn.—The House is stated to have passed a bill authorizing the Council to issue $300,000 bonds for new city buildings.

Carlisle, Pa.—The plans of J. A. Dempwolf of York are stated to have been accepted for a new edifice for the First Lutheran Church; probable cost, $15,000.

Sharon, Pa.—L. S. Morgan of New Castle, Theo. Morgan of Atlanta, Ind., and J. W. Morgan of Sharon, are said to be interested in the erection of an opera house; probable cost, $50,000.

Champaign, Ill.—The Baptist Society is stated to have decided to erect a $16,000 church.

Boston, Mass.—Wheelwright & Haven, Tremont Bldg., have been selected to prepare plans for the new Massachusetts Horticultural Society building.

Athens, O.—Press reports state that separate bids are wanted May 18 by the Board of Trustees of the Athens State Hospital for alterations to the old boiler house and for furnishing 2 horizontal multi-tubular boilers, including pipe work.

Covington, Ky.—The Council on April 24 is stated to have adopted the plans for the proposed city hall and court house.

Vineland, N. J.—Bids are wanted May 15 for alterations and additions to the Home for Disabled Soldiers, Sailors or Marines and their wives. E. C. Stahl, Secy. Bd. Mgrs., 35 E. Front St., Trenton.

Newark, N. J.—The Mayor in his annual message recommends the erection of a city hall in Military Park.

Lake Park, Minn.—Bids are wanted May 15 for an Orphan's Home. Rev. G. A. Larsen, Chmn. Bldg. Com., Moorhead.

Kingston, N. Y.—Local press reports state that bids are wanted May 17 by the Board of Supervisors for a jail.

Blackwood, N. J.—The Camden County Board of Freeholders, Camden, N. J., are stated to have rejected all bids received April 25 for the addition to the Insane Asylum here. New bids will be received May 10. For list of bids see issue of "The Engineering Record," April 29.

New York City.—It is stated that the Woman's Hospital on Lexington Ave. and 50th St. will soon be replaced by a $600,000 building.

Stillwater, Minn.—Local press reports state that bids are wanted May 16 by County Auditor Browne for a jail.

Grand Forks, N. D.—Bids are wanted May 24 for a dormitory at the State University. Joseph Kennedy, Secy. Bd. Trustees.

Montpelier, Vt.—The Pauly Jail Bldg. & Mfg. Co., of St. Louis, Mo., is stated to have received the contract for the Washington County jail, at $23,000.

Carnegie, Pa.—It is stated that Struthers & Hanna of Pittsburg have completed plans and the contract will soon be let for the proposed $90,000 Carnegie Library.

Pittsburg, Pa.—Bids are wanted May 13 for alterations and additions to Engine House No. 12. J. O. Brown, Dir. Dept. Pub. Safety.

Anderson, Ind.—It is stated that plans have been prepared for a $35,000 edifice for the Methodist Church.

Des Moines, Ia.—Garthwait & Co. of Chicago are stated to have received the contract for a building for the Home of the Aged, at $29,016.

Elwood, Ind.—It is stated that bids are wanted May 15 for a city building. Jas. J. Davis, City Clk.

Piggott, Ark.—Bids are wanted May 15 for 2 court houses, one at Piggott and one at Corning. H. W. Moore, Chmn. Commrs.

Ft. Steilacoom, Wash.—It is stated that bids are wanted May 24 for a wing at the Western Washington Hospital for the Insane. Ernest Lester, Secy. State Bd. of Audit & Control, Tacoma, Wash.

Danville, Ill.—The following bids were opened April 29 for work at the Danville branch of the National Home for D. V. Soldiers: For officers' residences, L. M. Moore & Son, Danville, Ill., $27,395; L. P. Hazen & Co., Cincinnati, O., $23,835; Ed. S. Moore, Kokomo, Ind., $24,797; M. Yeager & Son, Danville, Ill., $21,224. Heating apparatus for each of six barrack buildings, the Prox & Brinkman Mfg. Co., Terre Haute, Ind., $3,670 and $3,400 for plumbing; L. J. Mueller Furnace Co., Milwaukee, Wis., $2,836; R. W. Kyle, Wheeling, W. Va., $3,348 and 3,270 for plumbing; Pittsburg Heating Supply Co., Pittsburg, Pa., $5,200.

BUSINESS BUILDINGS.

Buffalo, N. Y.—The Stockholders of the Union Station Terminal Ry. Co. of Buffalo are stated to have approved the plans prepared by Shepley, Rutan & Coolidge of Boston, for the new station to be erected on Main and Exchange Sts.

Williamsport, Pa.—Bennett & Rathrock have prepared plans for a $10,000 addition to the plant of the Valley Iron Wks.

The Lycoming Rubber Co. proposes to build a $15,000 addition to its works.

A. C. Wagner of Philadelphia has prepared plans for a $25,000 brewery to be erected by Jacob Fleck on Franklin St.

Houston, Tex.—H. Henke is about to erect a $20,000 brick store building on Main St.

New Haven, Conn.—The Seamless Rubber Co. will erect a $10,000 brick building on Daggett St. Wilford E. Griggs, Archt., Waterbury.

Reading, Pa.—Wm. A. Fink, 426 Franklin St., has prepared plans for a 4-story brick and stone office building to be erected by J. K. Grant on 5th and Washington Sts. Cost, $14,000.

Springville, Utah.—A $30,000 sugar factory is about to be erected by the Utah Sugar Co. T. R. Cutler, Mgr., 20-26 South Main St., Salt Lake City, Utah.

Grinnell, Ia.—S. E. Scales of Waterloo is stated to have received the contract to erect an opera house here for Mr. Cappron; estimated cost, $25,000.

Martinsville, W. Va.—Wm. M. Goodrich of Baltimore is stated to have prepared plans for a $25,000 theatre for Irwin & Richardson of Pittsburg.

Altoona, Pa.—W. H. Hughes & Sons of Altoona are stated to have received the contract for erecting a silk mill, at $65,000.

Nashville, Tenn.—Robt. Sharp, 21 Cole Bldg., has prepared plans for a $12,000 brick storehouse, to be built by S. Murphy, at 215 N. College St.

Manhattan, Kan.—H. M. Hadley, Topeka, is stated to have prepared plans for a $14,000 hotel to be erected by R G Gillett.

Toledo, O.—It is stated that plans are about completed for the union depot to be erected on Adams St. by the Toledo Union Ry. Co.

NEW YORK CITY.

Permits for the following buildings have been issued; o, signifies owner; a, architect; b, builder, and c, contractor.

303 & 305 Broome St, br stores & flat, cost, $25,000; o, Harris Fine; a, Horenburger & Straub.

241 & 243 Rivington St, br stores & flat, cost, $30,000; o, Polstein & Feinberg; a, M Bernstein.

367 & 369 E 10th St, br store & flat, cost, $30,000; o, Jacob Moersfelder; a, G F Pelham.

Cherry & Oliver Sts, br stores & flat, cost, $24,000; o, Elias Feldman; a, M J Smallheiser.

297 to 303 Mercer St and 258 & 260 Greene St, 2 br stores & lofts, cost, $180,000 all; o, Sailors Snug Harbor; a, Robert Maynicke.

Rutgers & Madison Sts, br store & flat, cost, $25,000; o, John Katzman; a, Horenburger & Straub.

Commerce & Bedford Sts, br store & flat, cost, $35,000; o, Emanuel Glauber; a, W. C. Dickerson.

683 & 685 Broadway, br & stone stores, cost, $200,000; o, Robert Hoe; a, W Wheeler Smith.

371 & 373 E 10th St, br store & tenem't, cost, $30,000; o, Samuel Greenwald; a, Geo F Pelham.

Lexington Ave & 39th St, br stores & flat, cost, $75,000; o, Chas Lane; a, H S Howell.

36 & 38 E 20th St, br warehouse, cost $212,000; o, John Walker; a, Franklin Baylies.

31 & 33 W 15th St, br warehouse, cost, $130,000; o, Peter Dooley; a, Cleverdon & Putzel.

234 E 106th St, br store & flat, cost, $28,000; o, P J Herter; a, P Herter's Sons.

Madison Ave & 98th St, 4 br stores and flats, cost, $100,000 all; o, Isaac Mayer; a, John Hauser.

174 & 176 E 104th St, br stable, cost, $25,000; o, Michael Carroll; a, Spencer O'Hea; b, Michael Duffy.

72d St, 73d St & North River, br Y M C A bldg, cost, $25,000; o, N Y C & H R R R; a, C L W Eidlitz.

Broadway & 108th St, br stdores & flat, $80,000; o, S C Judson; a, Clarence True.

Southern Boulevard & Cypress Ave, br factory, cost, $60,000; o, Jacob Doll; a, Chas Fox.

Barney & Chapman, 1286 B'way, have filed plans for a 10-story hotel, to be erected on 38th St. and 7th Ave., to cost $300,000.

DWELLINGS.

Salt Lake City, Utah.—Frank Weir is about to build a $30,000 residence on Brigham St. W. E. Ware, Archt., Hooper Bldg.

Binghamton, N. Y.—S. O. Lacey of Binghamton has prepared plans for a $10,000 brick and stone apartment house to be erected by Wm. F. Shultz at 86 Carroll St.

Reading, Pa.—H. G. Landis is about to erect 5 stone dwellings on 3d and Center Avs. Cost, $18,000.

Fitchburg, Mass.—The Old Ladies' Home is about to build a $15,000 brick residence at 41 Orange St. Henry M. Francis, Archt., Wallace Bldg.

The Church of the Immaculate Conception will build a $12,000 brick parochial residence at 57 Walnut St. Plans prepared by Onesime E. Gault of Worcester.

Fredericksburg, Va.—It is stated that W. G. Newman will erect a $45,000 residence.

Macon, Ga.—Mrs. J. C. Wise is about to build a $10,000 residence at 224 Georgia Ave. P. E. Dermis, Archt., 617½ Poplar St.

Atlanta, Ga.—Andrew J. Bryan & Co., of Atlanta, are stated to have prepared plans for a $250,000 apartment house to be erected on Peachtree St. and Linden Ave. for Wm. B. Lowe.

NEW YORK CITY.

Permits for the following buildings have been issued; o, signifies owner; a, architect; b, builder, and c, contractor.

348 E 9th St, br flat, cost, $24,000; o, August Buermann; a, Chas Rentz.

255 to 259 Monroe St, 3 br tenem'ts, cost $75,000 all; o, Joseph Friedman; a, M Bernstein.

136 & 138 Rivington St, br tenem't, cost, $30,000; o, Lippman & Friedman; a, M Bernstein.

415½ & 417 Grand St, br tenem't, cost, $28,000; o, Sol Littenberg; a, M Bernstein.

Scammel & Cherry Sts, br tenem't, cost, $35,000; o, William Sugarman; a, M Bernstein.

35 & 37 E 27th St, br bachelor apartments, cost, $93,000; o, R H Spaulding; a, H B Mulliken.

Broadway & 55th St, br & stone flat, cost, $25,000; o, Peter Wagner; a, Henry Andersen.

Park Ave & 81st St, br flat, cost, $75,000; o, J C Lyons; a, Cleverdon & Putzel.

113th St & 3rd Ave, 6 br flats, cost $138,000 all; o, August Jacob; a, John Hauser.

125th St & Boulevard, 4 br flats, cost, $80,000 all; o, Anthony Clinchy; a, W C Dickerson.

124th St & Amsterdam Ave, 2 br flats, cost, $44,000 all; o, G F Quinlan; a, Franz Wolfgang.

110th St & Lenox Ave, br flat, cost, $20,000; o, Thos Kirkland; a, Richard R Davis.

128th St & Park Ave, br flat, cost, $25,000; o, Phillip Enter; a, Lawrence & Ringrose; b, John Allan.

134th St & 8th Ave, br flat, cost, $22,000; o, Stone & Crawford; a, Neville & Bagge.

133d St & 12th Ave, 4 br flats, cost, $80,000 all; o, Daniel Mac M Niven; a, John De Hart.

St Anns Ave & Rae St, 5 br flats, cost, $115,000 all; o, Mary Schafer; a, Edw Wenz.

Union & Boston Aves, 2 br flats, cost, $44,000 all; o, Wm Ueckermann; a, Chas Stegmayer.

Eagle Ave & 163d St, 2 br flats, cost, $44,000 all; o, August Jacob; a, John Hauser.

NEW INDUSTRIAL PLANTS.

Sharp & Dohme of Baltimore, Md., are building a 7-story, 54x50-ft. addition to their present plant and will require a 250-H.-P. boiler and a 125-H.-P. engine.

The Jos. Schlitz Brewing Company of Milwaukee is putting up a new bottling plant, 270x150 ft., to be run by an electric power plant of about 50-H.-P.

B. P. Thornhill of Lynchburg, Va., is to build a 50x110-ft. wagon factory, 3 stories high, and will need a 30-H.-P. engine, a 35-H.-P. boiler, pulleys, shafting and other machinery.

The Brown Shoe Co. of St. Louis, Mo., is erecting a 101x150-ft. factory, 6 stories high, and will need a power plant.

The Cambridge Tile Mfg. Co. of Covington, Ky., contemplates making an addition to its works, including an increase of its power plant.

R. D. Henderson and associates of Anderson, Ill., contemplate the erection of a soda water bottling establishment and want machinery.

The New Castle, Ind., Coil Hoop Co. states that it is rebuilding its plant recently burned. There will be a 60x100-ft. main building with a wing for a 90 H. P. engine and 125 H. P. boiler.

The Wolf River Paper & Fiber Co., Shawano, Wis., will put up a sulphite mill with a capacity of 15 tons of dry pulp in 24 hours. The plans are being drawn by Chas. H. Vogel, Appleton, Wis., and are not yet finished. It is intended to place orders about May 15 for a 350 H. P. condensing Corliss engine and for a 600 H. P. battery of boilers.

BUSINESS NOTES.

Moffat & Hewitt, agents for the Rapp fireproof floor system, have removed their offices to 10-12 East Twenty-third St., New York City.

The Berlin Iron Bridge Co., East Berlin, Conn., has received a contract for furnishing and erecting the structural steel work for the New Britain Institute, New Britain, Conn., and a steel roof for the torpedo storehouse belonging to the United States at Port Caswell, N. C.

The Melan Arch Construction Co. announces the removal of its offices from 35 Nassau St. to the Park Row Building, 13-21 Park Row, New York City.

The New England Structural Co., Boston, reports receiving a number of contracts, including two 60-ft. traveling cranes for the pumping stations of the Metropolitan Water Board at Chestnut Hill and Spot Pond, and the steel work for the new pumping station at Chestnut Hill: a double-track 126-ft. transfer bridge for the New England Gas & Coke Co., at Everett, Mass., and the steel work for several buildings for the great plant which is being erected for the last named company.

The Ajax Metal Co. of Philadelphia reports that its business has been steadily increasing, that of last month being the largest in its history. It has refused to join the brass trust, and proposes to erect plants at several points in the near future, beginning at Chicago and St. Louis.

The Taunton Locomotive Mfg. Co., Taunton, Mass., announces that it will be represented in New York by Mr. Charles H. Paine, with offices in the Singer Building, Broadway and Liberty St.

The Elgin, Ill., Watch Co. has lately bought an engine for electric service from the Ball Engine Co., Erie, Pa. The latter company has recently sold a 100-H.-P. engine to the Western Union Paper Co., Chicago; one to the Edelweiss Restaurant in the same city for direct connection to a Western Electric generator; and has furnished one for the George Public School in Philadelphia, which is arranged for direct connection to a Westinghouse generator.

The International Heater Co., Utica, N. Y., has recently moved into a new office building designed for its exclusive use, and furnished with all the appliances needed for conducting a business extending over the entire country. The card index system is employed at this office for keeping track of orders. When one is

received it is copied in quadruplicate on a typewriter. One copy goes to the foundry at which it is to be filled, there being three foundries in Utica and two in Syracuse, another copy goes to the billing department, the third to the customer as an acknowledgement of the receipt of the order, and the fourth is filed. All letters are copied on an endless roll of paper, and the copies are kept in letter files like original letters. All books and important papers are placed every night in a fire-proof vault about 10x12 feet in plan, which extends through three stories. The building has a telephone outfit with 18 stations, and the three foundries in Utica are on the same line. These stations are united at a switchboard on the second story of the building, which is connected with four lines running to the local office of the long distance service, so that the responsible officers of the company can talk with each other and with people in any city reached by telephone, without leaving their desks.

PROPOSALS OPEN.

Bids Close — See Eng. Record

WATER-WORKS.

May 8. Pima, A. T......Apr. 15
May 8. Orange, Cal......Apr. 15
May 8. San Carlos, A. T......Apr. 22
May 8. St. James, Minn......Apr. 29
Adv., Eng. Record, Apr. 29
May 8. Pumping machinery, Willimantic, Conn......Apr. 29
Adv., Eng. Record, Apr. 29, May 6.
May 10. Enterprise, Kan......May 6
May 11. Newark, N. J......May 6
Adv., Eng. Record, May 6.
May 11. Wells, Doylestown, Pa......May 6
May 11. Boston, Mass......Apr 29
Adv., Eng. Record, Apr. 29, May 6.
May 12. Dam, etc., White Plains, N. Y......Apr. 29
Adv., Eng. Record, May 6.
May 13. Yonkers, N. Y......Apr. 29
May 15. Gallatin, Tenn......Apr. 22
May 15. Wellsville, O......Apr. 22
Adv., Eng. Record, Apr. 29.
May 16. Pipe etc. Montreal, Que......May 6
May 16. Ottawa, Ont......Apr. 22
May 16. Boilers, Chicago, Ill......Apr. 29
May 17. Washington, D. C......Apr. 29
May 17. Boston, Mass......Apr. 29
Adv., Eng. Record, Apr. 29, May 6.
May 22. Cullman, Ala......Apr. 29
Adv., Eng. Record, Apr. 29.
May 24. Gaffney City, S. C......May 6
Adv., Eng. Record, May 6.
May 25. Tacoma, Wash......May 6
May 26. Cincinnati, O......Apr. 29
May 27. Washington, D. C......Apr. 29
Adv., Eng. Record, Apr. 29.
May 27. Pipe, Washington, D. C......May 6
Adv., Eng. Record, May 6.
May 29. Allentown, Pa......May 6
Adv., Eng. Record, May 6.
May 31. Pendleton, Ore......May 6
June 5. Winnipeg, Man......May 6
Adv., Eng. Record, May 6.
June 27. St. Louis, Mo......May 6
—— Grand Forks, N. D......Apr. 22
—— Peekskill, N. Y......Apr. 15
Adv., Eng. Record, Apr. 15, 22.
—— Napoleonville, La......Mar. 25
—— Corinth, Miss......Mar. 25

SEWERAGE AND SEWAGE DISPOSAL.

May 8. San Carlos, A. T......Apr 22
May 8. Elyria, O......Apr. 8
May 8. South Bend, Ind......Apr. 29
May 8. Dayton, O......Apr. 29
May 8. Allegheny, Pa......May 6
May 8. New Castle, Pa......May 6
May 8. Syracuse, N. Y......May 6
May 10. Ann Arbor, Mich......May 6
Adv. Eng. Record, May 6.
May 12. Derby, Conn......May 6
Adv., Eng. Record, May 6.
May 12. Chillicothe, O......May 6
May 13. Evansville, Ind......Apr. 29
May 15. Elizabeth, N. J......Apr. 29
May 15. Lead, S. D......Apr. 29
May 15. Supplies, Worcester, Mass......Apr. 29
May 15. Medford, Ore......Apr. 1
May 15. Quincy, Mass......May 6
May 15. Warren, Pa......May 6
May 16. St. Louis, Mo......May 6
May 17. Auburn, Ind......Apr. 22
Adv., Eng. Record, Apr. 22.
May 18. Norristown, Pa......Apr. 29
May 19. Cambridge, O......Apr. 29
Adv., Eng. Record, Apr. 29.
May 20. Auburn, Ind......Apr. 8
May 20. Norristown, Pa......May 6
May 22. Muncie, Ind......May 6
May 25. Tacoma, Wash......May 6
July 5. New Orleans, La......Apr. 29
Adv., Eng. Record, May 6.

BRIDGES.

May 6. Washington, D. C......Apr. 22
Adv. Eng. Record, Apr. 22.
May 8. Birmingham, O......Apr. 22
May 9. Birmingham, O......Apr. 22
May 9. Binghamton, N. Y......Apr. 22
May 9. Williamsport, Pa......May 6
May 10. Boston, Mass......May 6
May 10. Chicago, Ill......Mar. 18
Adv., Eng. Record, Mar. 25.
May 10. Cleveland, O......Apr. 29
Adv., Eng. Record, Apr. 29, May 6.
May 11. London, O......Apr. 22
May 12. St. Joseph, Mo......Apr. 29
May 15. Wessington Springs, S. D......Apr. 29
May 15. Honolulu, H. I......Apr. 22
May 16. Albany, N. Y......May 6
Adv., Eng. Record, May 6.
May 17. Norristown, Pa......Apr. 22
May 17. Forman, N. D......Apr. 29
May 22. Toronto, Ont......Apr. 29
Adv., Eng. Record, Apr. 29, May 6.
May 22. Hailey, Idaho......May 6
May 24. Aberdeen, S. D......Apr. 29
May 27. Washington, D. C......Apr. 29
Adv., Eng. Record, Apr. 29.
May 31. Chicago, Ill......Apr. 8
Adv., Eng. Record, Apr. 15.
—— Quincy, Ill......Feb. 25
Adv., Eng. Record, Feb. 25.
—— Bradford, Pa......Apr. 15
—— Randolph, Utah......Apr. 15

PAVING AND ROADMAKING.

May 6. Jamestown, N. Y......Apr 29
Adv., Eng. Record, Apr. 29.
May 8. Lafayette, Ind......Apr. 22
May 8. Houston, Tex......Apr. 29
May 8. New Castle, Pa......May 6
May 9. Marion, Ind......Apr. 29
May 9. Schenectady, N. Y......May 6
May 9. Cincinnati, O......May 6
May 9. Jersey City, N. J......May 6
May 9. Kansas City, Kan......May 6
May 9. Boston, Mass......May 6
May 10. Indianapolis, Ind......May 6
May 10. Kansas City, Mo......May 6
May 10. Buffalo, N. Y......Apr. 29
May 11. Union, N. J......Apr. 29
May 11. Boston, Mass......May 6
May 12. Minneapolis, Minn......May 6
May 13. Paving blocks, Brooklyn, N. Y......May 6
May 15. Norwich, Ont......May 6
May 15. Erie, Pa......May 6
May 15. Albany, N. Y......May 6
May 16. Union City, Pa......May 6
Adv., Eng. Record, May 6.
May 15. Stamford, Conn......May 6
Adv., Eng. Record, May 6
May 16. St Louis, Mo......May 6
May 15. Plainfield, N. J......Apr. 29
May 15. Petersburg, Va......Apr. 29
Adv., Eng. Record, Apr. 29.
May 15. Haverhill, Mass......Apr. 29
May 15. Road roller, Nanaimo, B. C......Apr 22
May 16. Buffalo, N. Y......May 6
May 19. Roselle, N. J......May 6
May 20. San Antonio, Tex......May 6
Adv., Eng. Record, May 6.
May 20. Washington, D. C......Apr. 22
(2 advts.) Adv., Eng. Record, Apr. 22.
May 22. Cincinnati, O......Apr. 29
May 22. Glens Falls, N. Y......Apr. 22
Adv., Eng. Record, Apr. 29, May 6.
May 23. Watertown, Wis......Apr. 29
Adv., Eng. Record, Apr. 29, May 6.
May 24. Veedersburg, Ind......May 6
May 25. Alliance, O......May 6
May 26. Cincinnati, O......May 6
May 29. Bowling Green, O......May 6

POWER, GAS AND ELECTRICITY

May 8. Harrisburg, Pa......Apr. 29
May 8. San Carlos, A. T......Apr. 22
May 9. Franchise, Midway, Ky......Apr. 22
May 10. Galt, Ont......Apr. 15
May 10. Cleveland, O......Apr. 15
May 13. Charleston, S. C......Apr. 15
May 13 Washington, D. C......Apr. 22
Adv., Eng. Record, Apr. 22.
May 15. Lebanon, Pa......Apr. 22
May 15. New York, N. Y......May 6
May 22. Vincennes, Ind......Apr. 8
Adv., Eng. Record, Apr 8, 22, May 6.
May 22. Cullman, Ala......Apr. 29
Adv., Eng. Record, Apr. 29.
June 1. Prineville, Ore......Apr. 15
—— Pleasantville, O......Dec. 24

GOVERNMENT WORK.

May 6. St. Louis, Mo......Apr. 8
Adv., Eng Record, Apr. 8 to 29.
May 6. Steel roof, Washington, D. C......Apr. 29
May 8. New York City......Apr. 15
Adv., Eng. Record, Apr. 15 to May 6.
May 8. Brockton, Mass......Apr. 15
Adv., Eng. Record, Apr. 15, 22.
May 8. San Carlos, A. T......Apr. 22
May 9. Chicago, Ill......Apr. 8
Adv., Eng. Record, Apr. 8 to May 6.
May 10. New London, Conn......Apr. 15
May 10. Buffalo, N. Y......Apr. 15
Adv., Eng. Record, Apr. 15 to May 6.
May 10. San Francisco, Cal......Apr. 22
May 11. West Point, N. Y......Apr. 15
Adv., Eng. Record, Apr. 15 to May 6.
May 12. Mobile, Ala......Apr. 15
Adv., Eng. Record, Apr. 15 to May 6.
May 13. Charleston, S. C......Apr. 15
May 13. Chattanooga, Tenn......Apr. 15
Adv., Eng. Record, Apr. 15 to May 6.
May 15. New York City......Apr. 15
Adv., Eng. Record, Apr. 15 to May 6.
May 15. Cleveland, O......Apr. 22
Adv., Eng Record, Apr. 29, May 6.
May 15. Fort Myer, Va......May 6
May 16. Ellis Island, N. Y. Harbor......Apr. 22
Adv., Eng. Record, Apr. 22, 29.
May 17. Milwaukee, Wis......Apr. 22
Adv., Eng. Record, Apr. 22, May 6.
May 17. New York, N. Y......Apr. 22
Adv., Eng. Record, Apr. 22, May 6.
May 17. Wreck, Boston, Mass......Apr. 22
May 18. Baltimore, Md......Apr. 15
Adv., Eng. Record, Apr. 15 to May 6.
May 18 Ellis Island, N. Y. Harbor......Apr. 22
Adv., Eng. Record, Apr. 22, 29.
May 18. Dredging, etc., New London, Conn. Apr. 22
May 18. Fort Trumbull, Conn......Apr. 29
Adv., Eng. Record, Apr. 29, May 6.
May 19. Pier, St. Joseph, Mich......Apr. 22
May 20. Buffalo, N. Y......Apr. 22
May 22. Ellis Island, N. Y......Apr. 29
Adv., Eng. Record, Apr. 29, May 6.
May 22. Oswego, N. Y......Apr. 29
Adv., Eng. Record, Apr. 29, May 6.
May 22. Cement, Louisville, Ky......Apr. 29
Adv., Eng Record, Apr. 29, May 6.
May 25. Storehouse, Baltimore, Md......Apr. 29
May 25. Milwaukee, Wis......Apr. 29
Adv., Eng. Record, Apr. 29, May 6.
May 25. Mobile, Ala......Apr. 29
Adv., Eng. Record, Apr. 29, May 6.
May 25. Chicago, Ill......Apr. 29
Adv., Eng. Record, Apr. 29, May 6.
May 25. Hospital, Chicago, Ill......May 6
Adv., Eng. Record, May 6.
May 25. Tacoma, Wash......May 6
May 27. San Francisco, Cal......Apr. 29
Adv., Eng. Record Apr. 29, May 6.
May 29. Dredging, San Francisco, Cal......May 6
May 29. Louisville, Ky......May 6
May 31. Armor plate, Washington, D. C......Apr. 8
May 31. St. Louis, Mo......Apr. 22
Adv., Eng. Record, Apr. 22, 29.
May 31. Rock Island, Ill......Apr. 29
Adv., Eng Record, Apr. 29, May 6.
May 31. St. Augustine, Fla......May 6
Adv., Eng. Record, May 6.
June 3. Excavating etc., New York City......May 6
Adv., Eng. Record, May 6.
June 3. Dredging, New York City......May 6
Adv., Eng. Record, May 6.
June 8. Dredging, New London, Conn......May 6
June 8. New Orleans, La......May 6
June 9 Dredging, New London, Conn......May 6
June 10 Bremerton, Wash......May 6
June 10. Dry dock, San Francisco, Cal......Apr. 15

BUILDINGS.

May 8. New York, N. Y......Apr. 29
May 8. School, Stevens Point, Wis......Apr. 29
May 8. Hospital, Evansville, Ind......Apr. 29
May 8. Schools, New York, N. Y......Apr. 29
May 8. School, San Carlos, A. T......Apr. 22
May 9. Htg. court-house, Hallock, Minn......Apr. 8
May 10. School, Brown City, Mich......May 6
May 10. Asylum, Blackwood, N. J......May 6
May 10. School, Schenectady, N. Y......May 6
May 11. Plumbing, etc., Prison, New York, N. Y......Apr. 22
May 11. School, Sandy, Utah......Apr. 29
May 11. School, Oskaloosa, Ia......Apr. 29
May 11. School, Mauch Chunk, Ia......May 6
May 12. School, Portland, Ore......May 6
May 13. School, Langdon, N. D......May 6
May 13. Engine house, Pittsburg, Pa......May 6
May 13. School, Bloomfield, Ia......May 6
May 15 School, Geneva, O......Apr. 29
May 15. School, Colfax, N. D......Apr. 29
May 15. School, Watkins, Minn......Apr. 29
May 15. Schools, New York, N. Y......May 6
May 15. School, Franklin, Minn......May 6
May 15. School, Wakefield, Neb......May 6
May 15. Court house, Piggott, Ark......May 6
May 15. City hall, Elwood, Ind......May 6
May 17. Infirmary, Norristown, Pa......Apr. 22
May 17. Htg. Plant, Columbus, O......Apr. 22
May 17. Vent. and htg. school, West Burlington, Ia......Apr. 29
May 18. School, Des Moines, Ia......Apr. 29
May 20. School, Huntington, W. Va......Apr. 29
May 20. School, Centerville, Ia......Apr. 29
May 23 Dormitory, Washington, D. C......Apr. 29
May 24. School, Des Moines, Ia......Apr. 29
May 27. School, Hinton, Ia......Apr. 29
June 1. School, Beattyville, Ky......Apr. 22
June 1. Town hall, Utica, Ia......Apr. 29
June 6. Hospital, Auburn, Cal......Apr. 29
June 12. Htg. asylum, New Albany, Ind......Apr. 29
June 15. Plans, school, Madison, Wis......Apr. 26
May 15. School, Stevens Point, Wis......May 6
May 15 Home, Vineland, N. J......May 6
May 15. Lake Park, Minn......May 6
May 16. Jail, Stillwater, Minn......May 6
May 17. Plans, school, Trenton, N. J......May 6
May 17. Jail, Kingston, N. Y......May 6
May 18 School, Syracuse, Utah......May 6
May 18. Boilers, Athens, O......May 6
May 20. School, Newton, Ia......May 6
May 20. School, Dazey, N. D......May 6
May 20. School, Martins Ferry, O......May 6
May 20. School, Cleveland, O......May 6
May 20. School, Wyocena, Wis......May 6
May 20. Schools, Montgomery, Ala......May 6
May 22. Schools, Bottineau, N. D......May 6
May 22. School, Oskaloosa, Ia......May 6
May 23. School, Arkansas City, Kan......May 6
May 24. Hospital, Ft. Steilacoom, Wash......May 6
May 24. Dormitory, Grand Forks, N. D......May 6
May 27. School, Pleasant City, O......May 6
June 1. Htg. school, Ellendale, N. D......May 6

MISCELLANEOUS

May 6. Washington, D. C......Apr. 22
Adv., Eng. Record, Apr. 22.
May 8. Bulkheads, Boston, Mass......May 6
May 10. Oil tanks, Montreal, Que......Apr. 15
May 10 Dredging, Providence, R. I......May 6
May 11. Excavating, Brooklyn, N. Y......May 6
May 11. Boston, Mass......May 6
May 13. Park work, Toledo, O......Apr. 29
May 15. Railroads, Santiago, Chile......Apr. 15
May 15. Engineers' supplies, New York, N. Y. May 6
May 15. Grading, etc., Parral, Mexico......May 6
May 16. R. R. work, Richmond, Va......Apr. 29
Adv., Eng Record, Apr. 29.
May 18. Subway, Morristown, N. J......May 6
Adv., Eng. Record, May 6.
May 23. El. Ry. franchise, Riverside, Cal......May 6
May 24. Rails, Santiago, Chile......Apr. 22
May 26. Garbage disposal, Binghamton, N. Y. May 6
June 30. El. Ry., Shanghai, China......Mar. 4
Oct. 1. Railroad, Moscow, Russia......Feb. 25
—— Garbage plant, Savannah, Ga......Apr. 29
Adv., Eng. Record, Apr. 29, May 6.

SCHOOLS.

Detroit, Mich.—The Senate is stated to have passed a bill appropriating $95,-000 for the construction of a woman's building at the Agricultural College.

Blooming Prairie, Minn.—Orff & Gilbert of Minneapolis are said to be preparing plans for a $12,000 school.

Baltimore, Md.—It is stated that the Holy Cross German Catholic Society will build a $25,000 school. Address Rev. Chas. Dammer.

Winsted, Conn.—The Fourth School District is stated to have voted to erect a $22,000 school.

Lancaster, N. H.—It is stated that a $15,000 school will be erected.

Bement, Ill.—The School Board is said to be arranging to build a $25,000 school.

Hastings, Minn.—An election will be held May 18 to vote on issuing $30,000 bonds for a school.

Northfield, N. H.—The School Board is stated to have decided to erect a $20,-000 school.

Brownsville, Tenn.—See "Water."

Scranton, Pa.—E. H. Davis, Commonwealth Bldg., has prepared plans for the 12-room school to be built in the 10th ward. Cost, $30,000.

Wm. Feeney, 415 Spruce St., has prepared plans for a $20,000 school to be built in the 7th Ward.

Montgomery, Ala.—Bids are wanted May 20 for 2 schools. R. H. Somerville, City Treas.

Portland, Ore.—Local press reports state that bids are wanted May 12 by the Board of Regents for a wing to the Monmouth State Normal School, to cost $10,000.

Schenectady, N. Y.—Bids are wanted May 10 for an addition to Clinton St. school; also for plumbing. John A. Vedder, Chmn. Com. Bd. Educ.

Bloomfield, Ia.—Bids are wanted May 13 for a school. E. S. Stockham, Secy. Independent Dist. of Newman.

Wyocena, Wis.—Bids are wanted May 20 for a school. John W. Smith, Chmn. Bldg. Com. Dist. No. 1.

Oskaloosa, Ia.—Bids are wanted May 22 for an addition to the 3d ward school. I. W. Cook, Secy., 214 1st Ave. East.

Trenton, N. J.—Plans are wanted May 17 for a building for the Industrial School for Girls, to cost $15,000. E. Rezean Cook, Chmn. Bldg. Com.

Kenosha, Wis.—It is stated that a $20,000 school will be erected.

Cleveland, O.—Bids are wanted May 20 for a high school. H. Q. Sargent, School Dir.

Dazey, N. D.—Bids are wanted May 20 for a school. O. S. Olson, Clk. Bd.

Mauch Chunk, Ia.—Bids are wanted May 11 for a school in sub-district No. 1. E. Brewster, Secy.

Pleasant City, O.—Bids are wanted May 27 for a school in Valley Township. O. R. Taylor, City Clk.

Stevens Point, Wis.—Separate bids are wanted May 15 for an addition to the State Normal School, remodeling the heating apparatus and for plumbing. A. E. Thompson, Chmn. Executive Com., Madison, Wis.

Brown City, Mich.—Bids are wanted May 10 for a school. J. B. Sherk, Dir.

Lansing, Kan.—Wm. P. Feth of Leavenworth has prepared plans for a $15,000 school.

Martins Ferry, O.—Bids are wanted May 20 for a school in Peace Township. W. G. Morgan, Township Clk.

Arkansas City, Kan.—Bids are wanted May 23 for a dormitory at Chilocco school. W. A. Jones, Commr. Indian Affairs, Dept. of Interior, Washington, D. C.

Bryn Mawr, Pa.—The School Board of Lower Merion Township has selected Shermerhorn & Reinhold, 432 Walnut St., Philadelphia, to prepare plans for a $25,000 school.

Des Moines, Ia.—The Trustees of the Drake University are said to be considering the matter of erecting a new law and medical building.

Bottineau, N. D.—Bids are wanted May 22 for 2 schools. George Michie, Clk. School Bd.

Syracuse, Utah.—Bids are wanted May 18 by E. H. Williams for a school.

Glendale, O.—The citizens are stated to have voted to issue $25,000 bonds for a school.

Chicopee, Mass.—The Council is stated to have decided to erect a $23,000 school at Chicopee Falls.

Wakefield, Neb.—It is stated that bids are wanted May 15 for a school. C. E. Hunter, Secy. Bd. Educ.

Newton, Ia.—Bids are wanted May 20 for a school in Clear Creek Township. C. W. Berry, Chmn. Bldg. Com.

Ellendale, N. D.—Bids are wanted June 1 for furnishing a boiler and installing a steam heating plant in the North Dakota Industrial and Manual Training School. T. H. Faus, Secy. Bd. Trustees, Ludden, N. D.

Langdon, N. D.—Bids are wanted May 13 for a school. O. B. Aldrich, Clk. Billing's School Dist.

Franklin, Minn.—It is stated that bids are wanted May 15 for a school. E. S. Johnson, Clk.

St. Joseph, Mo.—The City Clerk writes that it was voted April 29 to issue $50,-000 school bonds. H. H. Smith, Secy. School Bd.

New York City.—The following bids were opened April 24: *a*, heating and ventilating apparatus and electric light plant for public school No. 173, Borough of Bronx; *b*, heating and ventilating apparatus and electric lighting plant for public school No. 98, Borough of Bronx: Frank Dobson, 218 E 42 St., *a*, $21,000; *b*, $13,500. Walker & Chambers, 50 E. 20 St., *a*, $22,721; *b*, $11,688. The Armstrong & Bolton Co., 62 Grand St., *a*, $27,766; *b*, $15,419. The Baldwin Engineering Co., 106 Beekman St., *a*, $25,-990; *b*, $14,990. The Wells & Newton Co., 231 Eldridge St., *a*, $28,755; *b*, $14,-485. E. Rutzler, 178 Center St., *a*, $25,-841; *b*, $13,575. John Neal's Sons, 218 Center St., *a*, $28,000; *b*, $15,500. Blake & Williams, 362 W. B'way, *a*, $26,212; *b*, $11,441. Francis Bros. & Jellett, Inc., 70 Trinity Pl., *a*, $26,999; *b*, $14,500; Evans, Almirall & Co., 44 Dey St., *b*, $12,-350.

The following bids were opened April 24 for the erection of a school on Butler St., between 4th and 5th Aves., Boro. of Brooklyn. The second figures are the amounts deducted if terra cotta is used: Mapes-Reeve Construction Co., 150 Nassau St., N. Y., $138,857; Kenney & Hennigham, 5 Court Sq., Brooklyn, $121,061—$1,905; Thos. Cockerill & Son, 550 W. 51st St., N. Y., $153,333; F. J. Kelley & Sons, $135,139—$400; Collier-Weeks Co., 163 W. 23d St., N. Y., $124,600—$3,400; K. A. Murphy, 96 Linwood St., Brooklyn, $122,000—$3,000; W. & T. Lamb, $128,000—$4,000; John Thatcher, 54 Park Ave., $132,315—$4,650; Thos. B. Rutan, 5 Court Sq., Brooklyn, $123,700—$3,553.

Bids are wanted May 15 for a ventilating and heating apparatus and electric light plant in the addition to School No. 46, Borough of Manhattan; also for alterations, repairs, etc., to several schools in Manhattan and Brooklyn Boroughs. Richard H. Adams, Chmn. Com. on Bldgs.

STREET CLEANING AND GARBAGE DISPOSAL.

Cohoes, N. Y.—A committee has been appointed to consider the matter of garbage disposal.

Lexington, Ky.—The contract for street cleaning has been awarded to the Home Construction Co. for $9,650 for a period of one year.

Wellsville, N. Y.—A committee will probably be appointed by the Council to confer with the Board of Health on the matter of establishing a garbage plant.

Binghamton, N. Y.—Bids are wanted May 26 for the collection and disposal of garbage. S. D. Kane, City Clk.

GOVERNMENT WORK.

San Francisco, Cal.—Bids are wanted May 29 for dredging in Humboldt Bay. Maj. W. H. Heur, Corps Engrs., U. S. A.

Detroit, Mich.—The following bids were opened April 27 by the Superv. Archt., Treas. Dept., Washington, D. C., for changes, alterations and repairs to the U. S. Custom House at Detroit: W. H. Wares, Detroit, $26,000; Vinton & Co., Detroit, $28,980.

New York, N. Y.—Bids are wanted June 3, at the U. S. Engineer Office, for excavating and removal of Man-o'-War Rock, East River, N. Y. Harbor, as advertised in "The Engineering Record."

New York, N. Y.—Bids are wanted June 3, at the U. S. Engineer Office, for dredging in Shoal Harbor and Compton Creek, Mattawan Creek and Keyport Harbor, N. J., as advertised in "The Engineering Record."

St. Augustine, Fla.—Bids are wanted May 31, at the U. S. Engineer Office, for delivering 60,000 tons of stone, in place, in jetties at mouth of St. Johns River, Fla., as advertised in the "Engineering Record."

Chicago, Ill.—Bids are wanted May 25, by the Superv. Archt., Treas. Dept., Washington, D. C., for constructing, except heating apparatus and laundry machinery, a boiler house, isolation ward, etc., for the U. S. Marine Hospital, as advertised in "The Engineering Record."

St. Paul, Minn.—The following bids were opened May 1 by the Superv. Archt., Treas. Dept., Washington, D. C., for the interior finish, plumbing and gas piping at the U. S. Post Office, Court House and Custom House at St. Paul, as advertised in "The Engineering Record": Angus McLeod, Minneapolis, $148,737; L. L. Leach & Son, Chicago, $152,000; E. F. Gobel, Chicago, $198,556; Hennessey & Cox, St. Paul, $154,000; Jno. A. Serges, St. Paul, $164,928; Butler Ryan Co., St. Paul, $146,950; The Barnett & Record Co., Minneapolis, $157,213; W. H. Ellis, Cincinnati, $159,-209.

Washington, D. C.—The following bids were opened April 27 by Lieut. Col. Chas. J. Allen, Corps of Engrs., U. S. A., for reconstructing pier No. 4 of Aqueduct bridge across the Potomac River at Georgetown, as advertised in "The Engineering Record": Central Contracting Co., 49 Cedar St., N. Y. City, $37,747; George C. Esher, Washington, $44,300; Engineering Contract Co., 71 B'way, N. Y. City, $45,112; Albert Weber, Baltimore, Md., $54,623.

New London, Conn.—Bids are wanted June 8 for dredging in New Haven harbor, also until June 9 for dredging and stone work in Bridgeport harbor. Maj. Smith S. Leach, Corps Engrs., U. S. A.

Raleigh, N. C.—The following bids were opened April 27 by the Superv. Archt., Treas. Dept., Washington, D. C., for heating and ventilating apparatus for the Court House and Post Office: E. Rutzler, New York City, $5,008; Zellers & Eitapence, Binghamton, N. Y., $4,273; Dalton, Savannah, Ga., $5,270; Gaylord & Eitagenee, Binghamton, N. Y., $4,273; Peter Shomohe, Savannah, Ga., $5,400; Chafer & Beckers, Cleveland, O., $5,250; Young & Hensher, Raleigh, N. C., $4,-850.

Fort Myer, Va.—Bids are wanted May 15 for 4 buildings; also for plumbing and steam heating for same. Maj. T. E. True, Corps Engrs., U. S. A., Depot Q. M., Washington, D. C.

Louisville, Ky.—Bids are wanted May 29 for steel, iron and wood work for movable dam. Capt. Geo. A. Zinn, Corps Engrs., U. S. A.

Duluth, Minn.—The following bids were opened May 1 by Major Clinton B. Sears, Corps of Engrs., U. S. A., for riprap embankment at Agate Bay, Two Harbors, Minn., as advertised in "The Engineering Record": King & Steele, Duluth, $37,247; Porter Bros., Duluth, $36,379.99; Frank Campbell, Duluth, $34,-242.20; Engle & Osman, Duluth, *$26,-520.49; Butler-Ryan Co., St. Paul, Minn., $61,974; Alexander Sang, Duluth, $40,-768.25; Chas. Stone, St. Paul, Minn., $60,-722.

*Recommended for acceptance.

New Orleans, La.—Bids are wanted June 8 for improving Bayou Plaquemine. Maj. James B. Quinn, Corps Egrs., U. S. A.

Bremerton, Wash.—Bids are wanted June 10 for a steam engineering shop and boiler house at the Puget Sound Naval Station. Mordecai T. Endicott, Ch. Bureau Yards & Docks, Navy Dept., Washington, D. C.

Tacoma, Wash.—Bids are wanted May 25 for buildings and for a water and sewer system at Puyallup Agency. W. A. Jones, Commrs. Indian Affairs, Dept. of Interior, Washington, D. C.

New York, N. Y.—The following bids for the removal of 235,000 cu. yds. of limestone stored near Spuyten Duyvil, N. Y., were opened April 29 by Major H. M. Adams, Corps of Engrs., U. S. A. Price per cu. yd.: V. P. Sheridan, 22 State St., 68 cts., 18 mos. F. W. McNeal Co., 80 Reade St., 34.97 cts., 300 w'k'g days. John C. Rodgers, 536 W. 152nd St., 35 cts., 2 yrs. John P. Conkling, 44 Bway, 38 cts., 300 wkg days. Chas. Frey, Jr., 411 4th Ave., 49.5 cts., 600 w'k'g days. Farrell & Hopper, 215 W. 125th St., *50 cts., 1 yr. Manhattan Contracting Co., 49 East 42nd St., 60 cts., 700 w'k'g days. John A. Bouker, 110 Wall St., 30 cts., 500 w'k'g days. R. G. Packard Co., 39.17 cts., 4¼ yrs. Jas. C. Smith, 1,080 Bway, 36 cts., 2 yrs.

*Bid for 200,000 cu. yds.

New York, N. Y.—The following bids were opened May 2 by Major H. M. Adams, Corps of Engrs., U. S. A., for about 183,000 cu. yds. of dredging in Wallabout Channel, as advertised in "The Engineering Record." Prices given per cu. yd.: R. G. Packard & Co., 130 Pearl St., N. Y., 19 cts.; Atlantic Dredging Co., 33 Pine St., N. Y., 15 cts.; Henry DuBois Sons & Co., 119 South St., N. Y., 12 9/10 cts.; James R. Steers, 1 Bway, N. Y., 14⅝ cts.; Morris & Cummings Dredging Co., 22 State St., N. Y., 19 9/10 cts.; P. Sanford Ross Inc., Jersey City, 19½ cts.; Wm. H. Taylor, Jr., Jersey City, 14¼ cts.; Frank H. Brainard, 17 State St., N. Y., 19⅞ cts.; John H. Fenner, Jersey City, 9⅝ cts.; Thos. H. Benton, Elizabeth, N. J., 20 cts.

New York, N. Y.—The following bids were opened May 3 by Major H. M. Adams, Corps of Engrs., U. S. A., for dredging in Gowanus Creek Channel, N. Y., as advertised in "The Engineering Record"; appropriation, $23,000; prices given per cu. yd.: W. H. Beard Dredging Co., 11 William St., 23 cts. for 100,000 cu. yds., scow measure; Morris & Cummings Dredging Co., 22 State St., 25 cts. for 92,000 cu. yds.; Atlantic Dredging Co., 33 Pine St., 25 cts. for 92,000 cu. yds.; International Contracting Co., 95 Broad St., 27 cts. for 85,185 cu. yds.

MISCELLANEOUS.

Providence, R. I.—Bids are wanted May 10 for dredging in the Providence River and harbor for the season of 1899. Appropriation, $12,500. Joseph D. Grinnell, Chmn. Com. on Harbor.

Morristown, N. J.—Bids are wanted May 18 (extension of date) for constructing a tunnel or subway to connect the new buildings of the State Hospital at Morris Plains with the old building, as advertised in "The Engineering Record."

Verona, N. J.—The Essex County Board of Freeholders has decided that the grade crossing at Bloomfield Ave., in Verona, must be abolished. The railroad tracks are to be depressed and spanned by a bridge.

Brooklyn, N. Y.—Bids are wanted May 11 for 11,000 cu. yds. of excavation at Red Hook Park. George C. Clausen, Chmn. Commrs. of Parks, New York City.

Boston, Mass.—Bids are wanted May 8 for timber bulkheads on Summer St. extension. William Jackson, City Engr.

Boston, Mass.—Bids are wanted May 11 for strengthening with granite quarry grout the jetties at the entrance to Nenamsha Inlet, Martha's Vineyard; appropriation $5,000. Woodward Emery, Chmn. Harbor & Land Commrs.

Parral, Mexico.—Bids are wanted May 15 for about 550,000 cu. yds. of grading, masonry, timber trestling and tracklaying. Address Jolly Bros. & Co.

New York, N. Y.—Bids are wanted May 15 for engineers' supplies. John W. Keller, Pres. Dept. Pub. Charities.

New York, N. Y.—The following bids were opened April 27 for the removal of the Forty-second street reservoir and other work and for building foundations for the new Library:

Bidder.	Lump Sum for Removing Reservoir. Sec. 1 *	Sec 2 †	Sec. 3 §	Section No. 4. Earth Excavation: Cellars, to av'ge D'pth 10 ft. blw Grd. 97, 38,000 cu. yds.	For F'ndat'ns, D'pth 5 ft. blw. Grd. 87, 5,800 cu yds.	Sheet Piling to D'pth 5 ft. blw Grd. 82, 5,800 cu. yds.	Rock Excavation, 1,800 cu yds.	Concrete Foot'gs 95,000 cu ft.	Rubble Masonry, Foundation, Walls, 500,000 cu. ft.	Brick Work, 500,000 cu. ft.	Back Filling, 2,100 cu. ft.	Test B'rings, 1,000 ft.
United Company, Park Row Bldg., New York	$198,891	$196,000	$198,000	$0.95	$1.00	$1.10	$2.75	$0.18	$0.15	$0.37	$0 23	$0.12
Prescott, Buckley & Callanan, Albany N. Y.	108,000	108,000	115,000	.90	1.10	1.25	3 40	.38	.22	.30	.60	2.00
Crimmins & O'Rourke, 50 E. 59th St., New York.	163,000	165,000	167,000	1.25	1.35	1.50	3.00	.25	.15	.30	1.50	1.00
Sturgis & Hill Co	196,325	209,680	211,490	1 05	1.05	1.05	1.75	.25	.12	.29	.05	.30
Farrell & Hopper, 215 W. 125th St., New York	117,742	109,728	110,250	.96	1.02	1.14	4.08	.35	.15	.43	.01	1.20
P. J. Carlin & Co., 26 Court St., Brooklyn, N. Y.	274,000	264,000	267,000	1.09	1.65	1.80	3.00	.22	.10	.345	.25	7.00
Norton & Dalton, 125th St and Lexington Ave., New York	95,000	89,000	89,000	.75	.85	.85	2.50	.30	.15	.36	.01	1.00
Bart Dunn, 28 Chambers St., New York	116,000	104,000	106,000	1.00	1.40	1.40	1.00	.21	.145	.30	.30	.50
Eugene Lentilhon, 11 Broadway, New York	115,500	103,500	107,000	1.20	1.97	1.97	.30	.22	.0975	.2699	.005	1.60
Frawley & Rooney, New York	172,639	169,889	175,389	1.35	1.75	1.75	.50	.25	.10	.2725	.02‡	1.00
Alger C. Gildersleeve, 39 Cortlandt St., New York	178,970	160,970	162,300	1.84	2.04	2.20	3.00	.28	.15	.34	.35	.30
J. A. Hopper, 219 W. 125th St., New York	235,250	18,000	7,500	1.05	1.55	1.55	1.50	.30	.10	.30	.50	.50

* Practically entire removal. † Same as Sec. 1, except 18,000 cu. yds. of stone walls to be stacked on site. § Same as Sec. 1, except 7,200 sq. ft. of face stone, 1,050 yds. of face stone from main walls, 600 cu. yds. of stone for rubble and 5,500 sq. ft. coping shall be cleaned and delivered at Riker's Island. From the best of the remaining masonry in Secs. 2 and 3 a certain portion shall be cleaned and stacked. ‡ Bid per cu. yd.; other figures in col. are per cu. ft.

PROPOSALS.

Fire Alarm System.

Comptroller's Office
City of New Orleans,
NEW ORLEANS, LA., April 28, 1899.

Pursuant to Ordinance No. 15,194, sealed proposals will be received at this office until the hour of 2.30 p. m., Monday, May 29th, 1899, for the furnishing of a fire alarm system for the City of New Orleans, in accordance with specifications in the office of the City Electrician. Deposit of $300. Bond with surety company in the sum of $20,000. Bidders must have paid their city license in order that their bids may be accepted. The city reserves the right to reject any and all bids.

W. S. DOUGLAS,
Comptroller.

Proposal for Paving.

Bids will be received by the undersigned up to 8 o'clock P. M., Monday, May 15, 1899, for the paving with vitrified brick of Main street, Union City, Pa. Plans and specifications on file at the office of the Secretary. A certified check of $400 must accompany each bid. Council reserves the right to reject any or all bids.

J. E. GILLETT,
City Clerk.

Pumping Engine.

ALLENTOWN, Pa.

Sealed proposals will be received by the Board of Water Commissioners of the City of Allentown until 2 o'clock P. M., May 29, 1899, at their office, City Building, Allentown, Pa., for One 8,000,000-Gallon Pumping Engine. Bidders will be expected to examine location, submit drawings and specifications showing engine in position, also giving boiler capacity required and specific information as to foundation. Each bid must be accompanied by a certified check for $1,000, as a guarantee that bidders will enter into contract. The Board of Water Commissioners reserves the right to reject any or all bids.

Allentown, Pa., April 28, 1899.

U. S. ENGINEER OFFICE, ARMY Building, New York, May 3, 1899.—Sealed proposals for dredging in Shoal Harbor and Compton Creek, Mattawan Creek and Keyport Harbor, N. J., will be received here until 12 M., June 3, 1899, and then publicly opened. Information furnished on application. J. W. BARLOW, Col., Engrs.

U. S. ENGINEER OFFICE, ARMY Building, New York, N. Y., May 3, 1899.—Sealed proposals for excavation and removal of Man-o'-War Rock, East River, N. Y. Harbor, will be received here until 12 M., June 3, 1899, and then publicly opened. Information furnished on application. H. M. ADAMS, Major, Engrs.

TREASURY DEPARTMENT, OFFICE, Supervising Architect, Washington, D. C., April 20th, 1899.—Sealed proposals will be received at this office until 2 oclock P. M. on the 25th day of May, 1899, and then opened, for the construction (except heating apparatus and laundry machinery), of the Boiler House, Isolation Ward, etc., for the U. S. Marine Hospital at Chicago, Ill., in accordance with the drawings and specification, copies of which may be had on application at this office or the office of the Custodian at Chicago, Ill. JAMES KNOX TAYLOR, Supervising Architect.

U. S. ENGINEER OFFICE, ARMY Building, New York, April 17, 1899.—Sealed proposals for dredging and rock excavation in channel of Port Chester Harbor, N. Y., will be received here until 12 o'clock noon, May 17, 1899, and then publicly opened. Information furnished on application. H. M. ADAMS, Major, Engrs.

U. S. ENGINEER OFFICE, MILWAUKEE, Wis., April 10, 1899.—Sealed proposals for dredging at Menominee River, Oconto, Green Bay, Two Rivers, and Milwaukee harbors, will be received here until 12 o'clock noon, standard time, May 17, 1899, and then publicly opened. Information furnished on application. J. G. WARREN, Capt., Engrs.

PROPOSALS.

Notice to Contractors.

PAVING.

Sealed proposals for paving with asphalt blocks, Main street, from the west end of pavement already laid, near South street, westerly as far as Mill River Bridge, will be received at the office of the Common Council of the City of Stamford, Conn., Room 4, Town Hall, until 8:00 P. M., on the 15th day of May, 1899, at which hour the bids will be publicly opened and read.

Bidders are required to state in their proposals, their names and places of residence.

Each proposal shall be signed by the bidder, and accompanied by a certified check for $500 as a guarantee that the bidder will execute the contract within the time specified in this notice, in case the bid be accepted.

The person or persons to whom the contract may be awarded will be required to attend at this office with the surety offered by him or them, and execute the contract within ten (10) days from the date of the award, and in case of failure or neglect so to do, he or they will be considered to have abandoned it, and as in default to the City of Stamford. The surety on the contract bond must be some Surety Company authorized by law to act as bondsman in the State of Connecticut.

Bidders must state in their proposals the kind of asphalt blocks which they propose to use, and must deposit ten (10) samples of the same in the office of the City Engineer on or before the 11th day of May, 1899.

The right to decline any or all the proposals is reserved if deemed for the interest of the city.

The Engineer's estimate of the principal item of work is as follows, viz.:—

3,657 square yds. of asphalt block paving.

These quantities are to be considered as only approximate. The Common Council expressly reserves the right of increasing or diminishing the same as may be deemed necessary by the Engineer.

Specifications, forms, and all available information may be obtained by applying in person or in writing to the City Engineer.

The proposals must be made upon blank forms, furnished by the Common Council, and all proposals will be considered as informal, which are not in all respects in conformity with this notice.

PAUL NASH,
City Engineer,
Room 2, Town Hall.

Dated at Stamford, Conn., May 3d, 1899.

PROPOSALS FOR ICE-MAKING APparatus and a system of Cold Storage.—Office of the Quartermaster, U. S. M. A., West Point, N. Y., April 11, 1899.—Sealed proposals in triplicate, will be received at this office until 12 M., May 11, 1899, for Ice-Making Apparatus and a system of Cold Storage. The right is reserved to reject any or all proposals. Blanks and instructions can be obtained at this office. WM. F. SPURGIN, Maj., Q. M., U. S. M. A.

U. S. ENGINEER OFFICE, 1637 INdiana Ave., Chicago, Ill., March 31, 1899.—Sealed proposals for constructing thirteen miles, or less, of feeder of Illinois and Mississippi Canal, from Mile 17 to Mile 29, south of Tampico, Ill., will be received here until 12 noon, central time, May 9, 1899, and then publicly opened. Information furnished on application here, or to Assistant Engineer L. L. WHEELER, Sterling, Ill. W. L. MARSHALL, Major, Engrs.

U. S. ENGINEER OFFICE, MILWAUkee, Wis., April 20, 1899.—Sealed proposals for Harbor of Refuge, Milwaukee Bay, Wis., breakwater construction; Racine Harbor, Wis., crib pier, breakwater, removal of old pier and dredging; Kenoasha harbor, Wis., pile and crib piers, crib breakwater, removal of old pier and dredging; will be received here until 12 o'clock noon, standard time, May 25, 1899, and then publicly opened. Information furnished on application. J. G WARREN, Capt. Engrs.

PROPOSALS.

New York State Canals.

Notice to Contractors.—Sealed proposals will be received by the Superintendent of Public Works at his office in Albany, New York, until twelve o'clock noon, Tuesday, May 16th, 1899, at which place and hour they will be publicly opened and read:

For building and completing by April 1st, 1900, a steel lift bridge over the Erie canal, at Washington street, Utica, pursuant to Chapter 397, Laws of 1898; and

For repairing and completing, by August 1st, 1899, the bridge at the foot of Liberty street, Penn Yan, pursuant to Chapter 190, Laws of 1898; and

For building and completing, by February 1st, 1900, a wrought iron bridge over Tonawanda creek, between Pendleton and Pickard's bridge, in the counties of Erie and Niagara, pursuant to Chapter 630, Laws of 1898; and

For building and completing, by April 1st, 1900, a lift bridge over the Erie canal, at Catharine street, Syracuse, pursuant to Chapter 424, Laws of 1898; and

For building and completing, by April 1st, 1900, a lift bridge over the Erie canal, at South avenue, Brighton, pursuant to Chapter 618, Laws of 1898; and

For building and completing, by April 1st, 1900, a lift bridge across the Erie canal, at Peterboro street, Canastota, pursuant to Chapter 626, Laws of 1898; and

For building and completing, by April 1st, 1900, a lift bridge over the Erie canal, at Church street, Canajoharie, New York, pursuant to Chapter 562, Laws of 1897, and Chapter 552, Laws of 1898.

For building and completing, by November 1st, 1899, the approaches to the bridge over Otisco inlet, Onondaga county, pursuant to Chapter 615, Laws of 1898; and

For correcting and completing, by November 1st, 1899, the channels of Bashas Kill and Pine Kill, at their junction in Mamakating, Sullivan county, pursuant to Chapter 621, Laws of 1898.

Plans may be seen and general instructions for bidders, blank forms for proposals, specifications and contract forms may be obtained at the office of the Superintendent of Public Works, Albany; at the office of Thomas Wheeler, Assistant Superintendent of Public Works, Syracuse; and at the office of Albert H. Porter, Assistant Superintendent of Public Works, Rochester, New York.

Monthly estimates will be paid of eighty-five per cent. of the amount of work done or materials furnished at the contract price. Every proposal for said work must be accompanied by a draft or certified check upon some good banking institution in the city of New York or Albany, issued by a National or State Bank in good credit within the State, and payable at sight to the Superintendent of Public Works, for ten per cent. of the amount of the proposal, which draft or check will be retained as part of the security until the completion of the work. The amount of bond for faithful performance of the contract will be forty per cent. and the amount of labor bond required on execution of contract will be thirty-five per cent. of the proposal. Each proposal must be addressed to the Superintendent of Public Works, at Albany, N. Y., and must be endorsed on the envelope with the name of the construction for which the proposal is made. The right is reserved to reject any or all bids.

JOHN N. PARTRIDGE,
Superintendent of Public Works.

U. S. ENGINEER OFFICE, D. S. MORgan Building, Buffalo, N. Y., March 29, 1899.—Sealed proposals for Construction of Concrete Superstructure on Breakwater at Buffalo Harbor, N. Y., will be received here until 11 o'clock A. M., May 10, 1899, and then opened. Information furnished on application. T. W. SYMONS, Major Engrs.

U. S. ENGINEER OFFICE, LOUISville, Ky., April 21, 1899.—Sealed proposals for furnishing and delivering Portland cement at Lock No. 5, Green River, Ky., will be received here until 12 o'clock noon, standard time, May 22, 1899, and then publicly opened. Full information furnished on application. GEO. A. ZINN, Capt. Engrs.

U. S. ENGINEER OFFICE, MOBILE, Ala., April 25, 1899.—Proposals for dredging in Ship Island Pass, Miss., at mouth of Pearl River, Miss., in Pascagoula River and Horn Island Harbor, Miss., received here until 12 M., May 25, 1899. Information on application. WM. T. ROSSELL, Maj. Engrs.

PROPOSALS.

Notice to Contractors.

Sealed proposals for constructing a tun nel or subway at the State Hospital Morris Plains, New Jersey, will be receive by the Board of Managers of the State Ho pital at Morris Plains, N. J., at their offi in said Hospital, on THURSDAY, MAY 1899, at twelve o'clock, noon, immediate after which time the said proposals will opened and publicly announced in the pre ence of such bidders as may desire to present. No bids will be received previo to the hour above designated, nor ther after.

Proposals must state the earliest date which the completion of the work will guaranteed. The successful bidder will required to furnish bonds satisfactory the Board of Managers, guaranteeing t faithful performance of the contract.

ALSO, at the same time and place, a under the same general conditions as t foregoing, but entirely separate and di tinct therefrom,

SEALED PROPOSALS

will be received for putting a water-tig lining into the New Reservoir of said Ho pital.

For further information apply to Geor W. Howell, Engineer, Iron Bank Buildi Morristown, N. J.

The right is reserved to reject any all bids.

GEORGE W. HOWELL,
Engineer

Morristown, N. J., May 5, 1899.

TREASURY DEPARTMENT, OFFIC Supervising Architect, Washington, D. April 22, 1899.—Sealed proposals will be ceived at this office until 2 o'clock P. M. the 22d day of May, 1899, and then open for the plumbing, marble and slate wo for the main buildings at the U. S. Imm grant Station, Ellis Island, New York Ha bor, in accordance with drawings and spe fication, copies of which may be had at t office or the office of Boring & Tilton, Arc itects, 32 Broadway, New York Ci JAMES KNOX TAYLOR, Supervis Architect.

PROPOSALS FOR DAMS, ETC., Upper Mississippi River.—U. S. Engin Office, Rock Island, Ill., April 24, 189 Sealed proposals, in duplicate, will be ceived here until 11 a. m., May 31, 1899, then publicly opened, for construction dams and shore protections between Wi na, Minn., and LaCrosse, Wis.; Lansing, and Cassville, Wis.; Cassville, Wis., Dubuque, Ia.; Dubuque and LeClaire, Rock Island and New Boston, Ill.; N Boston, Ill., and Burlington, Ia.; Burling and Montrose, Ia.; Keokuk, Ia., and Quin Ill.; Quincy, Ill., and Saverton, Mo.; Ha burg, Ill., and mouth of Illinois River; construction of levees between Flint Cr and Iowa River, Ia.; and for dredging Quincy Bay, Ill. For information apply C. McD. TOWNSEND, Capt., Engrs.

U. S. ENGINEER OFFICE, AR Building, New York, April 8, 1899.—Sea proposals for dredging in Peekskill Harb N. Y., will be received here until 12 M., 8, 1899, and then publicly opened. Infor tion furnished on application. J. W. BA LOW, Col. Engrs.

QUARTERMASTER'S OFFICE, FO Trumbull, Conn., April 28, 1899.—Sealed posals in triplicate for construction of pital, hospital steward's quarters and h ing hospitals, Plum Island, N. Y., will received here until 12 o'clock M., May 1899, and then opened. United States serves right to reject or accept any or proposals or any part thereof. Infor tion furnished on application. Envelo containing proposals will be endor "Proposals for Hospital, etc." GEOR A. NUGENT, Q. M.

U. S. ENGINEER OFFICE, OSWE N. Y., April 19, 1899.—Sealed propsals excavating rock in Saint Lawrence Ri N. Y., will be received here until noon 22, 1899, and then publicly opened. Infor tion furnished upon application. GRAH D. FITCH, Capt. Engrs.

U. S. ENGINEER OFFICE, MOBI Ala., April 12, 1899.—Proposals for dred in Mobile Bay, received here until 12 May 12, 1899. Information on applicat WM. T. ROSSELL, Maj. Engrs.

U. S. ENGINEER OFFICE, 1637 IN ana ave., Chicago, Ill., April 25, 1899.—Se proposals for dredging in Calumet R will be received until noon (central t May 25, 1899, and then publicly opened. formation furnished on application. W MARSHALL, Maj., Engrs.

U. S. ENGINEER OFFICE, 812 ST. P St., Baltimore, Md., April 8, 1899.—Propo for dredging ship channel leading to bor at Baltimore will be received until May 18, 1899, and then opened. For in mation apply to PETER C. HAINS, Engrs.

U. S. ENGINEER OFFICE, CHAT nooga, Tenn., April 13, 1899.—Sealed posals for constructing two Dipper Dre will be received here until noon, Satu May 13, 1899, and then publicly opened. formation furnished on application. C. KINGMAN, Major Engrs.

Proposals continued on pages xi and

THE ENGINEERING RECORD.
Volume XXXIX. Number 24

TABLE OF LEADING ARTICLES.

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THE INDIANAPOLIS STREET RAILWAY FRANCHISE.

The recent solution of the street railway difficulties in Indianapolis affords an interesting instance of the present tendency to place semi-public undertakings under the supervision of municipal authorities and to demand for valuable franchises some more direct return than the indirect benefits to the citizens which result from improved gas, water, lighting and transit facilities. This subject is all the more important to the city engineer, because the control, or perhaps supervision is a better word, is usually vested wholly or partly in him. In the city of Indianapolis there has been a street railway system, such as it was, for many years. Early in 1864 the Citizens' Street Railway Company obtained a 30-year franchise, which the Common Council extended in 1880 seven years longer, or until January 18, 1901. In 1893 the City Attorney decided that this extension was invalid and the franchise would expire early in 1894. On the strength of this decision a contract was made with a new company, the City Railway Company, which was granted a franchise for 30 years from 1894. The old company brought an injunction suit against the City Railway Company and the result, in the Federal courts, was a decision that the expiration of the old franchise would not take place until 1901.

Meanwhile the State Legislature undertook to straighten out affairs in 1897 by passing an act providing, in effect, that the franchise of the old company would terminate in 1901, in accordance with the decision of the Supreme Court of the United States. The same Legislature also passed another act providing that street railways in cities having a population of over 100,000, according to the census of 1890, should not be permitted to receive a greater fare than three cents per passenger, which sum should entitle each passenger to universal transfer privileges. The Central Trust Company of New York, representing the bondholders of the old company, immediately sought an injunction against the enforcement of such savage and destructive legislation. The result of the suit was the declaration by the Federal courts that both acts were invalid because they were special legislation, which is in conflict with the State Constitution. A little while later the Supreme Court of Indiana was brought into action by the city authorities and it promptly declared that the two acts were constitutional. It was claimed that as the State Supreme Court was the sole judge of the meaning of the State Constitution, the opinion of the Federal courts in such matters was of no importance whatever. This complication was then taken to the Federal courts, where it was held that the State Supreme Court was mistaken.

By this time the situation was becoming too difficult for the lawyers even, and to clear up all the legal complications by one grand suit, the City Attorney commenced an action against both railway companies, which brought them into court to answer to their respective interests, if any, in the streets of the city. This action has continued through several courts and is not yet settled. Any one at all familiar with the cost of conducting important legal battles in the higher courts of the States and in the Federal courts will recognize that the old street railway company had fallen into parlous times. It had been demonstrated clearly in the litigation that the property and franchises of the company were mortgaged to secure bonds to the amount of $4,000,000. The operating expenses and the interest charges for the year ending April 30, 1897, were nearly $844,630. The entire number of fares collected during this period was 19,239,795, which at three cents each, would have amounted to but $577,104, far less than the expenses. It was but natural that during the six years of litigation the service had constantly deteriorated and was constantly growing worse. The legal profession alone was enjoying any benefits from the situation, which finally became so bad that a new company was formed and a new arrangement was made.

The Legislature of the present year passed two emergency acts, which became laws soon after. It repealed all previous conflicting legislation concerning fares and the termination of the old company's franchise, and authorized the city to enter into a contract with any company which might be able to procure and surrender all outstanding street railway franchises of every description. Such a contract would be a franchise for thirty-four years. The maximum rates of fare were fixed at five cents per single passenger with universal transfer privileges and tickets must be sold at no greater rate than six for twenty-five cents and twenty-five for one dollar. The provision concerning the surrender of franchises is important, because the old company had numerous fifty-year franchises in suburbs, which, after the granting of these rights, had been incorporated with the main city, and it also held perpetual franchises on parts of several main streets, which had been granted by the county prior to the annexation of the territory through which they extended.

The new contract is between the city of Indianapolis and a corporation styled the Indianapolis Street Railway Company, which assumes all the obligations of both older corporations.

Certain features of the contract or franchise stand out very distinctly. The most striking is that the company binds itself to pay $1,160,000 to the city as part payment for the grant of the right to the street. Another is that the company will spend as rapidly as the requirements of the plant and service demand at least $1,000,000 for new machinery, cars and tracks. Another is that it shall give any suburban or interurban street railway company free access over its tracks to the heart of the city, on payment of reasonable compensation, if notified to do so by the Board of Public Works. It is also agreed that any time within two years and not later than one year before the expiration of the franchise the city may purchase from the company all its property. But it is definitely stated, and here the idea of municipal ownership finds expression, that no value shall be attached to the franchise in determining the price to be paid by the city for the property. Provision is made for the usual arbitration in case the representatives of the city and the company are unable to come to an agreement. Before the franchise can go into effect the new company must give to the city a discharge in full from every claim whatever of both old companies against the city and from all their rights, actual or alleged, in the streets in Indianapolis. It also stipulates that the new company must agree to operate all its lines in the portions of the present suburbs which may be annexed to the city in the same manner as provided for the lines within the present limits of the city.

The contract is particularly interesting to city engineers and boards of public works, because of the clauses stipulating that the operation of the railways must be satisfactory in all respects to these officials in Indianapolis. The franchise reads: "It is agreed by and between said parties that the Board of Public Works of said city shall have the power at all times to fix and provide such reasonable rules and regulations for the transfer of passengers on the lines of said company within said city as are necessary to secure the comfort and convenience of the public." The overhead trolley system of operation must be used, unless the Board of Public Works and Common Council order some other system which has been "adopted generally in other cities of substantially the same size as the city of Indianapolis." The company is required to furnish to the Department of Public Safety, as often as requested, a statement of the electromotive force and current used. The usual stipulations concerning pavement are made, and the cars must conform to standards which are partly specified and partly left to the discretion of the Board of Public Works. This board also has the right to regulate the running of the cars in order to obtain an adequate service. In many other ways, which it is unnecessary to review here, the Board of Public Works and the City Engineer are given the power to enforce regulations for reasonable and adequate service and for the protection of the public. Of course, in case of a conflict between these officials and the company as to what reasonable and adequate service may be, the matter must be carried to the courts, but it is to be hoped that no such recourse will be necessary in carrying out the terms of the contract.

THE FUTURE OF THE NEW YORK STATE CANALS.

One of the first acts of Governor Roosevelt after his inauguration was to appoint a committee to study the condition of the State canals of New York and advise him what is the best course to be followed with them. Up to the end of 1882, when tolls were abolished, the net balance of the income of the canals over the outgo was $8,333,457. The Erie Canal had been far more profitable than the others, most of which, in fact, showed a loss; the balance to the good of the Erie Canal was over $42,000,000, in addition to all the indirect benefits it had given the State. Since the tolls were abolished in 1882 the expenses of all the canals have amounted to about $29,000,000.

The problem before the committee resolves itself into two main questions; shall the canals be abandoned entirely, as has been done in some other states, or shall they be improved as proposed by the Constitutional Conventiion or in some other manner? This total abandonment of the canals, which have done so much for the prosperity of the State and for all portions of the country tributary to the Great Lakes, will hardly meet the approval of the citizens of the State. They will have a rejoinder to any argument that the railways afford better facilities than the canals; they will point out that when the canal was constructed the capacity of a canal boat was very large compared with the capacity of a railway train, and if the facilities for canal boat traffic had been improved at the same rate as those for railway traffic, there would not be the present disparity between the amount of freight which can be transported in a boat and by a railway train. This argument, aside from any question as to its soundness, will prove strong in influencing voters against the abandonment of the canal. Any measure to abandon the canals will require strong arguments to overcome a readily-aroused

popular belief that the State officials, including the Legislature, have not shown the business sagacity of the managers of private railway corporations, and that other methods of canal management will greatly increase the serviceability of these waterways.

The committee states in a circular of enquiry sent to all parties interested in the State canals that their total tonnage has steadily diminished from 6,673,370 tons in 1872 to 3,360,063 tons in 1898. Until within the last few years the diminution has been chiefly on the smaller canals. The Erie Canal carried 3,500,000 tons in 1871 and 3,235,000 tons in 1893; the Champlain Canal carried 1,100,000 tons in 1871 and 1,020,000 tons in 1892. Since 1893 the tonnage on these main canals has also diminished, amounting in 1898 to 2,300,000 tons on the Erie Canal and about 800,000 tons on the Champlain Canal.

The committee reports that there are four methods of enlarging the capacities of the canals, but it is unfortunate that the statements in its circular concerning the cost of making some of these improvements are somewhat misleading. The first plan mentioned is the completion of the scheme recommended by the Constitutional Convention and authorized by the Legislature and a popular vote. The commission states that 36 per cent. of the work of this improvement is completed, that $9,000,000 has been spent, and that $15,000,000 will be needed to complete the work. It is important to notice that the estimate of $15,000,000 is the decision of two experienced engineers, who spent four months of careful personal examination of the country and the plans, and provided in this figure for every contingency which seemed possible, which figure apparently provides for completing the work under average state management. It is important to notice, also, what the committee has failed to do in its circular, that work on the Erie Canal is much farther advanced than on the others, and the improvement of that waterway can be completed for very much less than $15,000,000. This is an important fact to bear in mind in considering the other figures advanced in the committee's circular.

The second plan which is referred to is apparently that presented by Mr. John N. Scatcherd, one of the present committee, at a meeting of the American Society of Civil Engineers, a number of months ago, but unfortunately never printed in its "Transactions" because of some rule barring out of that publication material previously published elsewhere—in this case one of the Buffalo journals, which had obtained a copy of the address. The plan provides for an enlargement of the present locks on the Erie Canal to a length of 260 feet, a width of 26 feet and a depth of 11 feet. In connection with this improvement two alternative suggestions are made; increasing the size of the canal prism on the scale already partly completed, or increasing the prism to make it available for boats of 10 feet draught, 25 feet width and 125 feet length. The total cost of improving the locks and the canal by the first suggestion is estimated at $20,000,000, and by the second suggestion at $30,000,000. No statement whatever is made as to the manner in which these figures were obtained, or who made them; they differ so widely from the figures of Messrs. North and Cooley that grave suspicion will attach to their accuracy until further information is afforded concerning them. It is very important to notice that both this plan and the first, that which has already been partly executed, involve the transfer of freight at Buffalo from lake vessels to canal boats. The transfer charges at Buffalo have long been regarded as one of the serious drawbacks to shipping freight by way of the canal. Major Thomas W. Symons, in his elaborate report on this subject, states: "The transfer charges at Buffalo are the source of complaint and dissatisfaction, and there is little doubt that they can be materially reduced and the business still transacted at a profit." In this same report he states that the average freight charge from Chicago to New York in 1896 was 6.059 cents per bushel of wheat, of which item 1.3 cents per bushel was paid for transfer at Buffalo. During the same year the charge per bushel of wheat from Chicago to New York by lake and rail was 7.128 cents, including the transfer at Buffalo; the all-rail charge was 12 cents.

The two remaining plans do away with these transfer charges. The first is Major Symons' barge canal descending continuously from Lake Erie to the Hudson River, and designed to accommodate lake-going fleets of barges. This is estimated to cost $50,000,000 and to reduce the present cost of freightage from 1.8 mills per ton mile to 0.6 mill. This canal could not follow the present Erie route in many places; in fact, it is the belief of many of the most experienced engineers acquainted with the canal that any enlargement of the prism beyond that contemplated by the improvements partially completed is entirely out of the question. The fourth plan is a ship canal, having a depth of 20 to 30 feet, and suitable for lake and ocean vessels of 5,000 to 10,000 tons capacity. The cost of such a ship canal is stated to be from $200,000,000 to $500,000,000. How the latter estimate is reached it is difficult to see. In the project of Major Symons the canal prism has a cross-section of approximately 1,200 square feet, and an approximate prism for a ship canal would be about 4,200 square feet. The two would necessarily follow about the same route and the cost would be somewhat proportional to the relative cross-sections. This would give $165,000,000; Major Symons' estimate was $250,000,000. Any higher figure must be backed by ample engineering evidence before it can be accepted. At present the United States Government is investigating this subject by means of a Deep Waterway Commission, and partial information concerning the cost of such a ship canal is to be expected when its labors are finished. Unfortunately this survey will not give knowledge of the cost through the richest portion of the state, because the Commission is not empowered even to look out of a car window at any part of the route between Lockport and Syracuse. The route some engineers consider the most advantageous has apparently been carefully shut out of its field of investigation.

It will be seen from what has been stated that the only estimate of the cost of improving the canals, which has been carefully worked out, is that of Messrs. North and Cooley. They reported that about $10,700,000 would be required to put the Erie Canal alone in the condition proposed by the plan now partly finished. Major Symons distinctly stated that his figures were merely rough estimates, and definite authority for the others does not seem to be forthcoming.

In every business undertaking it is essential to determine whether the profits which will follow a given expenditure will warrant making it. Any of these improvements will furnish a canal of far greater capacity than any traffic which has ever passed over the existing system. The assertion is frequently made that a reduction in terminal charges would result in a marked increase in the traffic over the present canal, and, if this is true, it will be seen that the whole subject of the future of the Erie Canal is as much a business proposition as a technical problem. Any of the projects for improving the canal can be executed if enough money is provided, for they present no insurmountable engineering difficulties. The business interests must decide whether the transfer restrictions in handling freight by way of the canal, either in its present state or enlarged, are so severe that an expenditure of $50,000,000 for a barge canal or four times that amount for a ship canal is warranted to overcome them. This necessitates very careful estimates of the future business over routes which make rapid handling of freight impossible.

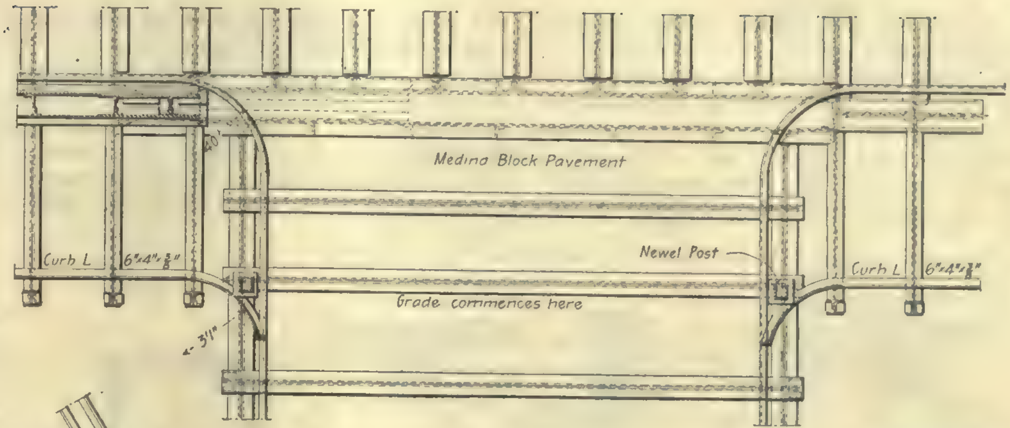
The Chicago Drainage Canal will be allowed to fulfill its purpose, in spite of the protest of the St. Louis commission which was reviewed last week. Secretary Alger and General Wilson have viewed the work, and on Monday the permission of the War Department was given the trustees of the sanitary district to allow the Chicago River to flow backward into the canal. The permission is only temporary, however, until Congress has reached a decision on the subject; and the sanitary district must assume entire responsibility for all damages due to the current in the river. Moreover, the War Department reserves the right to modify or stop the flow in the river due to the canal if the current becomes unreasonably obstructive to navigation or injurious to property.

Sewage Disposal in the United States and Canada is the subject of the twenty-second number of the water-supply and irrigation papers published, under the editorial management of Dr. F. H. Newell, by the U. S. Geological Survey. It was written by Mr. George W. Rafter, M. Am. Soc. C. E., and presents in the small compass of the 100 pages allowed by law the important facts which the author has obtained concerning every disposal plant built in the two countries. The author's success in gathering such information is well known, and his long study of the subject has enabled him to prepare a work as unique as it is valuable. Like all the previous issues of the series, it is liberally illustrated. Comments on the various plants are made freely, and there are introductory chapters on various aspects of the sewage disposal problem which furnish material for careful consideration. Unfortunately the edition is a small one, so engineers who desire copies are advised to apply immediately to the members of Congress from their districts or to the director of the Geological Survey.

The Importance of Steam Engineering in architectural work was strongly shown by three of the papers presented this week at the meeting of the American Society of Mechanical Engineers, and reprinted in abstract elsewhere in this issue. Mr. Bolton's statement of the magnitude of the power plant of a modern office building probably surprised many members of the society, for even among mechanical engineers there is not any general understanding of the amount of power and the diversity of apparatus needed to meet the demands of the tenants of these little worlds. Some of the largest office buildings contain more people during business hours than many towns, and the men in them require for the expedition of their affairs mechanical aids whose cost exceeds the expense of all the sewers, pavements and water-works for communities of the same population. Mr. Darling's description of the power plant of the Columbia University is a revelation of a part of the business of higher education as now conducted. It is interesting to picture mentally the astonishment with which the college trustees of the early days of unventilated class rooms and oil lamps would view the construction of such a large power plant by an educational institution. Prof. Storm Bull's description of the heating plant of the University of Wisconsin affords an interesting companion paper to that by Mr. Darling, as it shows how the mechanical equipment of that institution had to be enlarged from time to time to meet the increasing demands. The two papers together illustrate clearly the importance of business methods in universities; machine made education, in a certain sense, is the rule of today, the college is a factory where the raw material is matriculated and passed out graduated, and though good workmen may get along with poor tools, good tools and good workmen are both necessary in such an institution if it is to be permanently successful.

STREET BRIDGES OVER RAILROAD TRACKS IN BUFFALO.

In May, 1887, the Common Council of Buffalo, N. Y., invited the State Railroad Commissioners to recommend a comprehensive plan of abolishing grade crossings. An examination was made and a grade Crossing Commission was appointed with power to design structures and contract for their construction. This commission developed an extensive plan, built some of the structures required, has others under contract, and still others designed and proposed. Certain requirements of grade, headway, strength, etc., were specified by law, and in conformity to them bridges have been designed which present



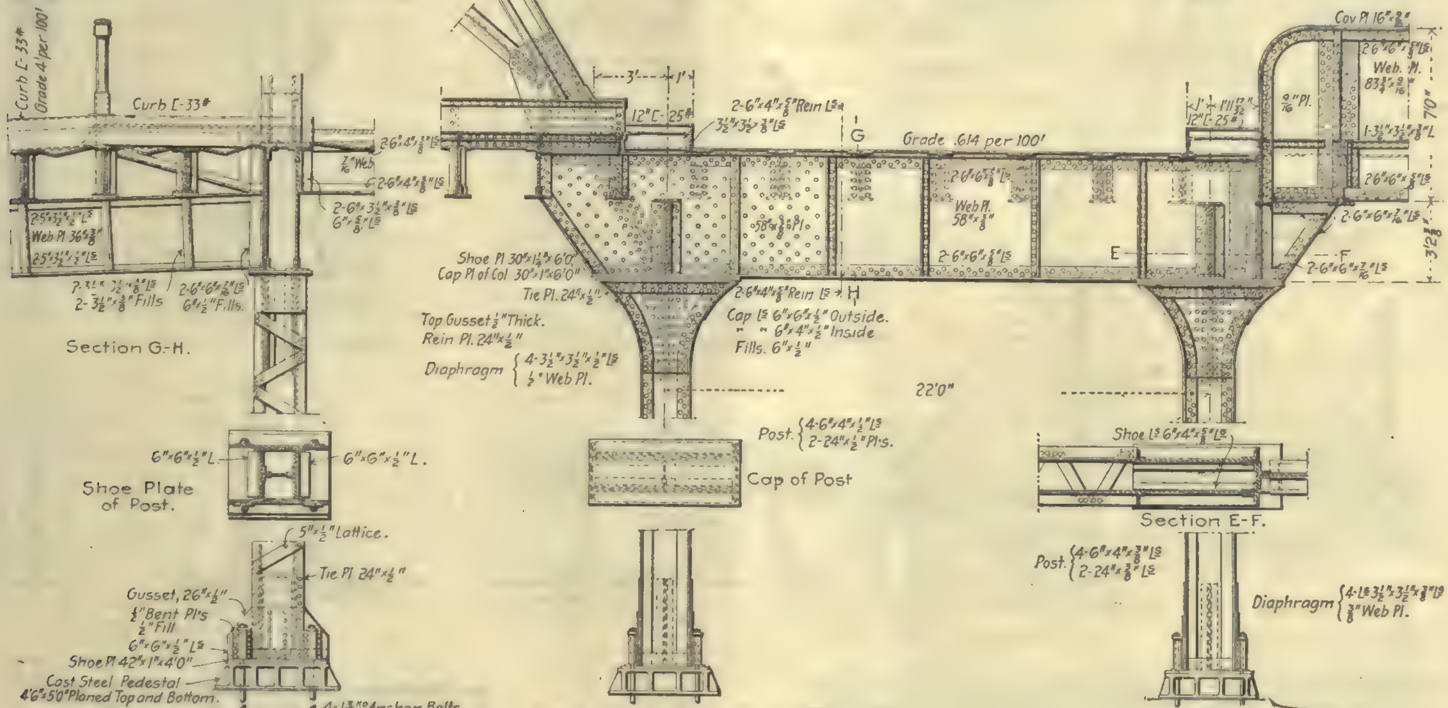


Fig. 4 Details of Girder and Posts

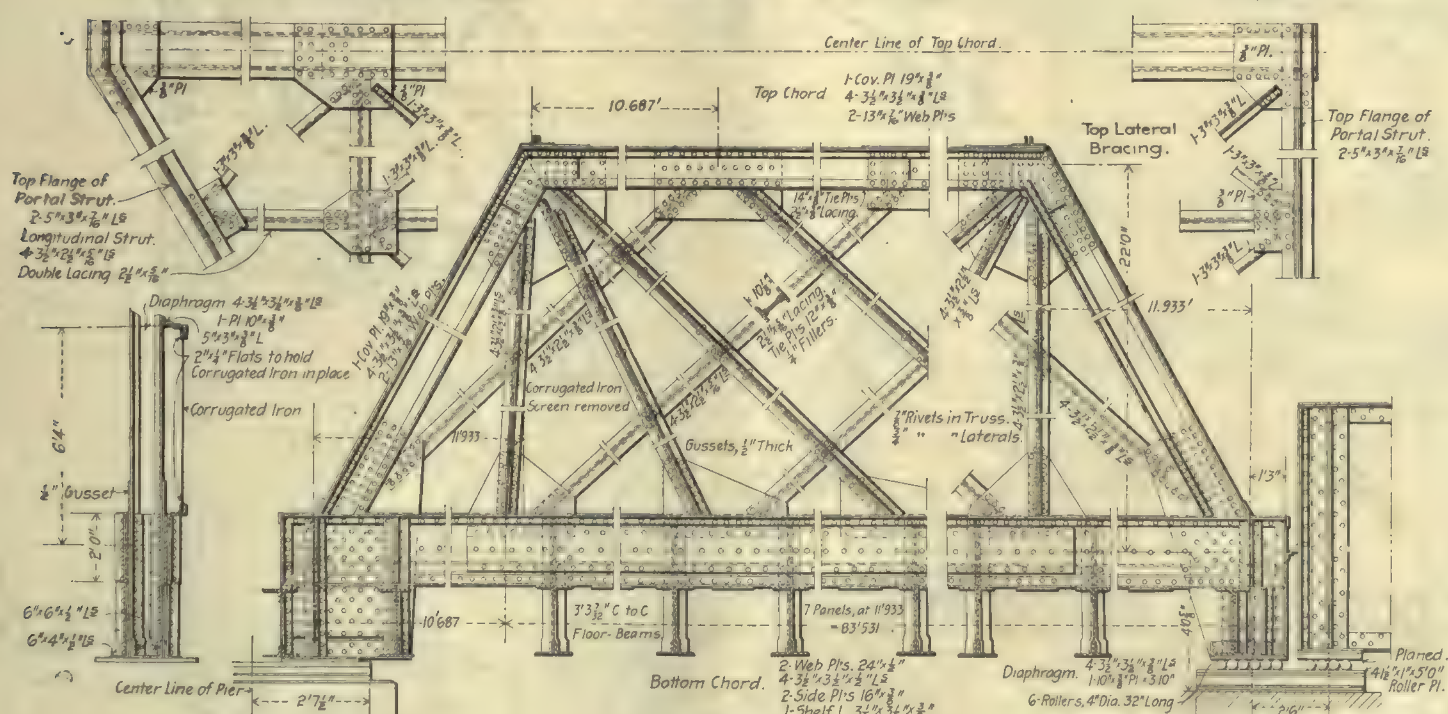


Fig. 2 Truss A.

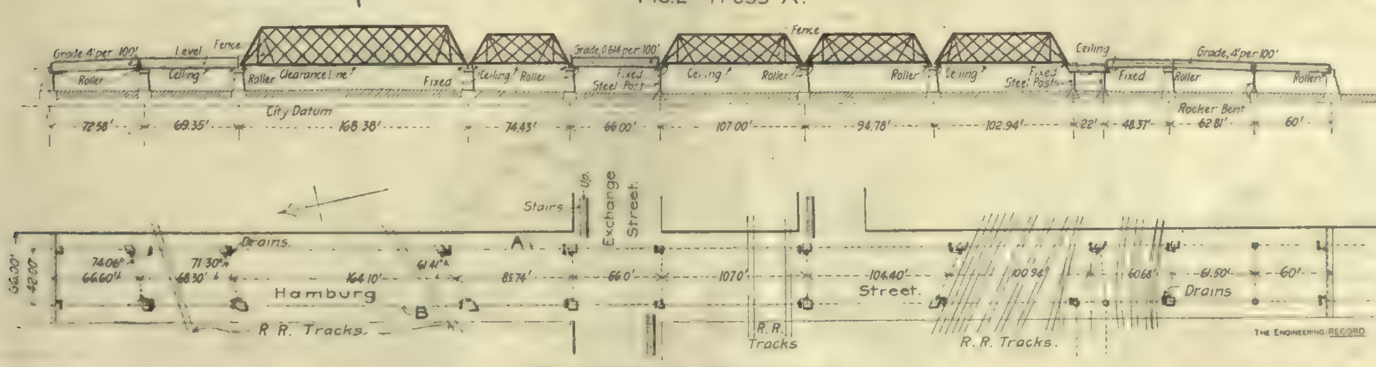


Fig. 1 General Plan and Elevation.

THE HAMBURG STREET VIADUCT, BUFFALO, N Y.

special features and embody recent standard practice or new details.

The plans provided for the abolition of 63 grade crossings, 26 being effected by closing the streets and 37 by the construction of viaducts, subways and foot bridges. The tracks of nine railroads were involved in the changes and the work was estimated to cost from five to six million dollars, of which more than one million dollars had already been spent. In general, the city pays one-third of the cost of the approaches, land awards and damages, and the railroads pay the rest. Usually the street widths are maintained and the grade only is changed, the adjacent houses being left in their original positions above or below the new grade. Most of the streets cross below the railroad tracks north of Seneca Street and over them south of it.

All elevated and depressed approaches and lateral ramps have a maximum grade of four per cent. and have stone side walls up to a height of 12 feet, beyond which there are columns or piers and steel bridges, paved with asphalt on brick arches or iron buckle plates and designed to carry a live load of 100 pounds per square foot. All railroad bridges over subways have solid trough floors and a clearance of 12 feet above the pavement. Street bridges have

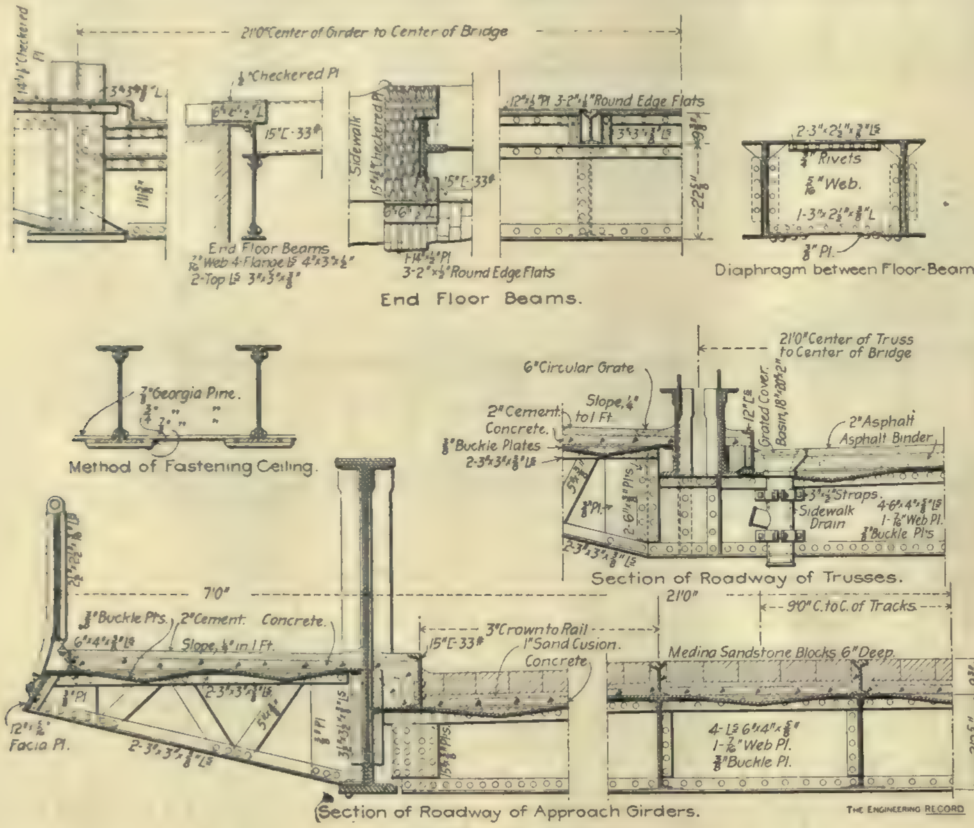


Fig. 6 Floor-Beam Details.

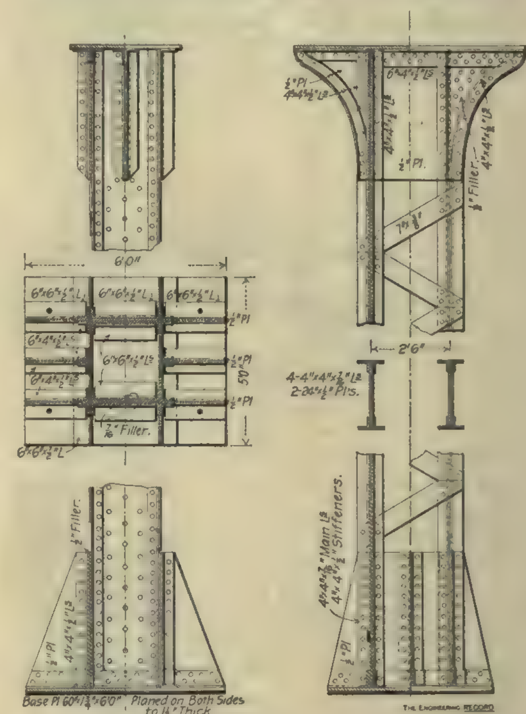


Fig. 7 Column Details.

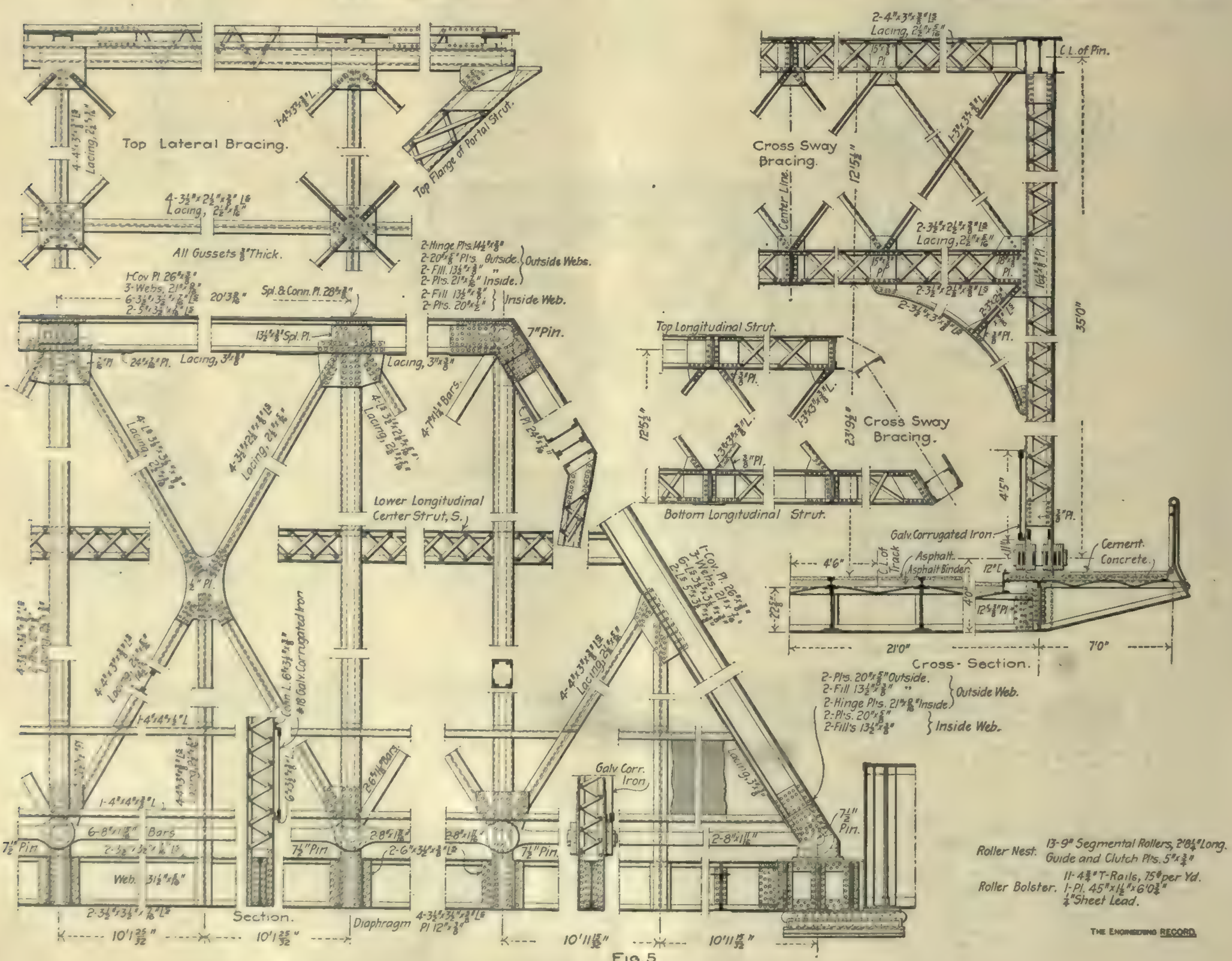


Fig. 5

THE HAMBURG AND SENECA STREETS VIADUCTS, BUFFALO, N. Y.

clearances of 15, 16 and 18 feet above different lines of railroads. Some of the recent contracts have been for the viaducts on Hamburg and Seneca Streets, which were estimated to cost about $470,000. In both these structures the street is raised at both ends on solid embankments and carried over the railroads and intersecting streets by plate girder viaducts and trussed spans.

A plan and elevation of one side of the Hamburg Street crossings is shown in Figure 1. At Seneca Street the structure is shorter and contains only one truss span.

The Hamburg Street truss spans are triple-intersection triangular riveted girders of the general type shown in Figure 2, which is a side elevation of the 97-foot truss A. All connections and intersections are riveted, the chords are of box section and the web members are I shaped, each built up of two pairs of angles. Those inclined in one direction (tension members) have the vertical legs of their angles turned inward so as to point toward each other, and those inclined in the other direction (compression members) have them turned away from each other so that the distance between the horizontal flanges is the same in both cases, allowing them to just clear each other at intersections where the backs of the horizontal flanges are in contact and are riveted together. The top lateral system consists of transverse struts, having the center points united by a line of longitudinal struts and with diagonal angles in all the panels. The connection plates at the bottoms of the end posts are riveted across the lower chord webs and extend continuously below them as far as the bottom of the floor beams. They are reinforced by vertical stiffener angles and form pedestals which rest on the roller beds or fixed shoes. The bottom chords are essentially box girders with pairs of vertical angles riveted to their webs by rivets through their opposite flanges which form connections for the floor-beams, about four of which are spaced in every panel. Six feet above the center line of the bottom chord a continuous horizontal 4x4-inch angle is riveted to the outside of each truss to receive the upper edge of a vertical screen of No. 18 galvanized corrugated iron, which is riveted to it, and to a 5x3-inch angle on the lower chord with 2x2½-inch binder strips, as indicated in the end view. The screen and its connections are omitted in the side elevation to avoid confusion. Both ends of the bridge rest on rail beds, distributing the pressure on the pier masonry. At the fixed end the pedestal sets directly on the rails and at the expansion end there is a nest of 4-inch rollers intervening. The trusses are designed to have, under their own weight, a camber of one-fourth of one per cent. of their length. The floor beams in the two end panels are hung vertical and elsewhere have their suspenders riveted at right angles to the bottom chord. After the web members were connected all openings in the upper side of the bottom chords were closed by riveting on a continuous 19.25x0.31-inch plate.

The 164.1 foot truss B, Figure 1, is substantially similar to truss A in most respects, the points of difference being indicated in Figure 3. It has rockers instead of rollers. Instead of a portal composed of two pairs of angles latticed, as in truss A, truss B has a deeper one with curved knee braces, which is divided into two panels by a middle vertical strut. This is braced by an inclined longitudinal member reaching from its bottom and curved at the top to a tangent connection with the I-shaped center top longitudinal strut. This brace is connected to the portal center piece by lattice angles and is virtually a continuation of the longitudinal strut.

The main platform of the Hamburg Street structure is intersected by a transverse approach viaduct on one side. Here all but one of the adjacent spans are plate girders and are supported on steel columns instead of masonry piers as elsewhere, and their arrangement is shown in Figure 4.

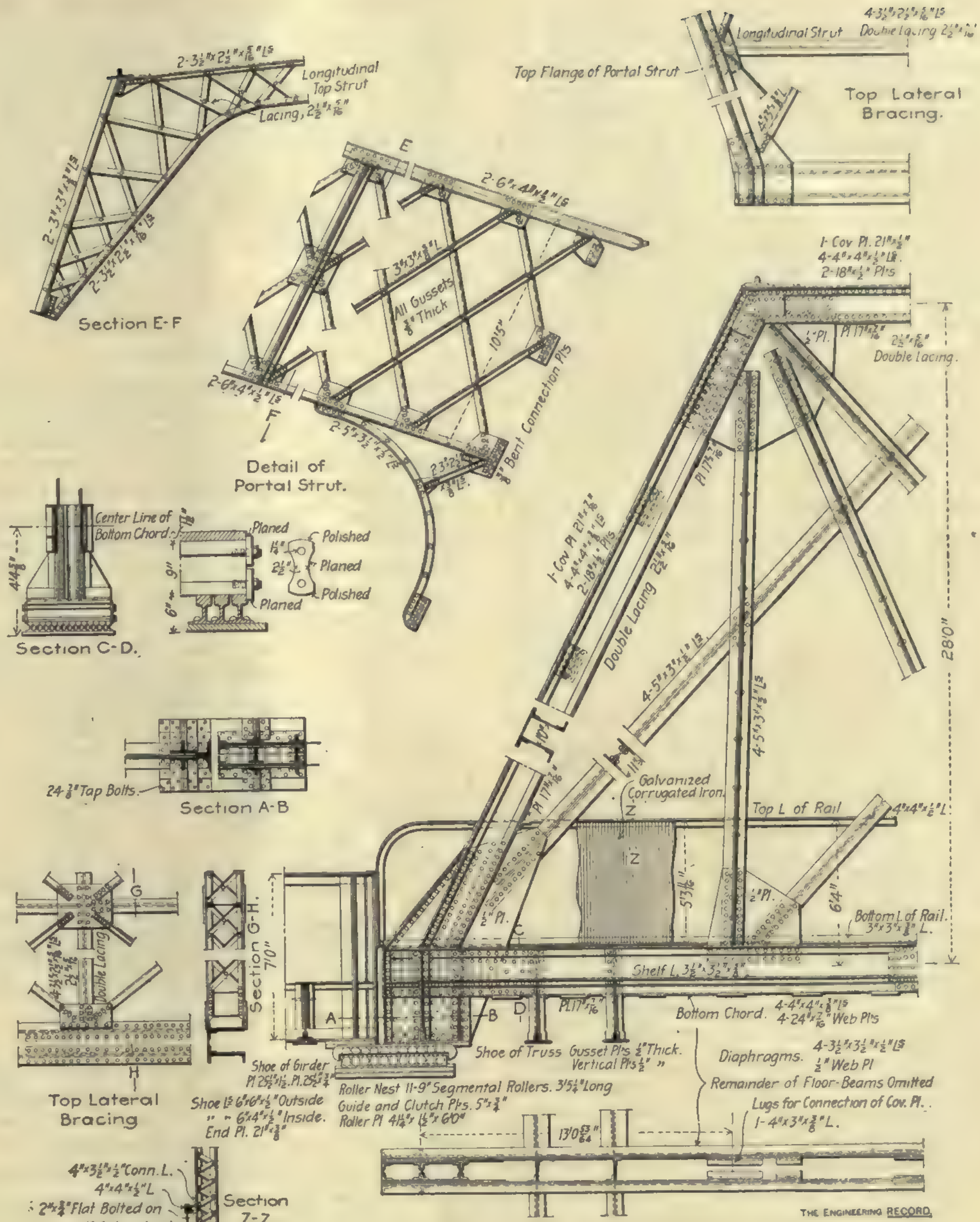


FIG. 3 TRUSS B.

In the 194.36-foot span of the Seneca Street bridge the trusses have eye-bar bottom chords and eye-bar diagonals except in the center panel, where each counter is composed of two pairs of latticed angles, as shown in Figure 5. All the eyebars necessarily have pin connections, but all other members have riveted connections. Longitudinal stringers are web connected to the lower ends of the vertical posts continued below the lower chord pins, and to them the transverse floor beams are web connected. Otherwise the details are of ordinary design or are similar to those already described.

Partial cross-sections of the roadways of truss and plate girder spans are shown in Figure 6. In both cases there is a solid platform of steel buckleplates, which, on the approaches, are covered with concrete and paved with 6-inch Medina blocks set on a 1-inch sand cushion. In the truss spans an asphalt binder is laid over the buckle-plates and covered with a 2-inch asphalt pavement. Vertical cast-iron drain pipes with flaring tops and gratings are set in the sides of the roadway, as indicated in Figure 1, and discharge through waste pipes carried down the columns and piers to the sewers. The pavements all crown 3 inches in the center and have 15-inch channel iron curbs. The sidewalks all have a 7-foot center width and are carried on lattice girder cantilevers, which support a buckleplate floor. On it is a concrete foundation and a 2-inch cement wearing surface, which slopes transversely one in forty-eight from the outside angle-iron curb to the roadway channel curb. The ends of the floorbeam cantilevers have a face plate inclined inwards about 30 degrees from the vertical, so as to be tangent to the curved lower ends of the hand-rail post braces, which are secured to them by nut clamps on angle clips. The end floorbeams have vertical guard plates riveted to them, with their webs extended upward to retain and protect the pavement. They also have a sliding apron plate forming a connection between spans, as shown in the detail.

Where trains pass under the bridge the ironwork is protected from the smoke by a wooden ceiling, which covers the lower flanges of the floor beams and the spaces between them. The viaduct columns are made with two heavy web plates and eight angles and have flaring tops and extended and reinforced base, as shown in Figure 7, and their caps and bases are both planed. All stairways are made with steel stringers and oak treads and are roofed with matched boards covered with 16-ounce copper.

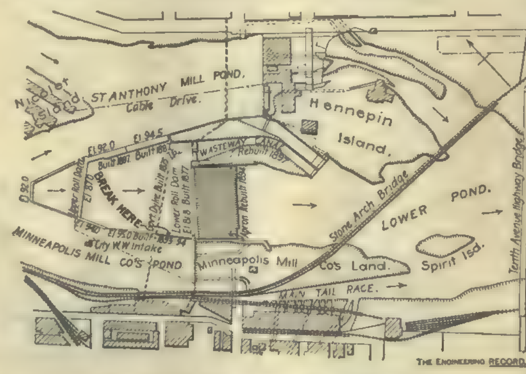
The drawings for these structures are signed by Mr. F. V. E. Bardol, chief engineer of the Bureau of Engineering of Buffalo; Mr. E. A. Handy, M. Am. Soc. C. E., chief engineer of the Lake Shore & Michigan Southern Railway Company; Mr. Walter Katté, M. Am. Soc. C. E., chief engineer of the New York Central & Hudson River and the West Shore Railroad Companies; Mr. R. D. McCreary, chief engineer of the Western New York & Pennsylvania Railway Company; Mr. C. W. Buchholz, M. Am. Soc. C. E., chief engineer of the Erie Railroad Company; Mr. Edward Guthrie, M. Am. Soc. C. E., chief engineer of the Grade Crossing Commission, and Mr. R. B. Adam, chairman of the Grade Crossing Commission. The contractors for the superstructure were the Edge Moor Bridge Works, Wilmington, Del., and the masonry and approach work was built by Mr. A. P. Kehr of Buffalo, the stone coming from the local quarries of the Barber Asphalt Company.

The American Water-Works Association will hold its nineteenth annual convention in Columbus on May 16 to 19 inclusive, and the program which has been arranged is a very attractive one. The hard work of the Secretary, Mr. Peter Milne, has resulted in the promise of a series of papers which has probably never been equalled at any gathering of water-works officials. The water-works of the convention city, which are unusually interesting, are to be described by Chief Engineer Julian Griggs of the Board of Public Improvements. There are to be several papers on subjects of practical application; Mr. W. R. Hill will tell how the water supply of Syracuse is kept free from unpleasant tastes; Mr. John B. Heim will explain the method of thawing frozen pipes by electricity, which was first practiced on the works at Madison, Wis., under his direction, and Mr. D. W. French will describe a method employed in repairing a 30-inch main belonging to the Hackensack Water Company. Wooden water pipes will be discussed by Mr. C. P. Allen, chief engineer of the Union Water Company of Denver, who has done more than any other one man to develop their capabilities for water-works purposes. There are several papers on the subject of pure water, all by recognized specialists; Prof. W. P. Mason will define good, pure and wholesome water, and explain the method of measuring turbidity; Prof. A. H. Bleile will tell what is the practical value of bacteriological examinations; Mr. George W. Fuller will discuss filtration; Dr. C. O. Probst will present some notes on sanitation in connection wich water-works administration; and Mr. Allen Hazen will give a lantern lecture on the construction of the many filter plants he has visited here and abroad. Major W. J. Milner is scheduled for an account of some difficulties in obtaining a water supply, and Mr. Chas. E. Bolling will present an object lesson; just what these two papers will contain has not been announced, but no superintendent acquainted with the authors needs Secretary Milne's assurance that they are valuable. Mr. John W. Hill is also expected to present a paper on the valuation of franchises, or, possibly, an even more important topic.

The Fight for a Water Shed which is being made by three English cities at the present time affords a good object lesson of the value of unpolluted surface water supplies in countries which are thickly peopled. According to the Journal of Gas Lighting it seems that the catchment area of the Derwent River in Derbyshire is regarded with covetous eyes by the corporations of Derby, Leicester and Sheffield. The Derbyshire County Council has decided to lend the whole of its influence to the city of Derby, considering that the interests of the county will be best served by allowing the city to take possession of the coveted drainage area. On the other hand, the district councils of Derbyshire are largely of the opinion they will obtain a better supply of water for themselves by treating directly with Sheffield or Leicester, and on this ground many of them may support one or the other of the schemes emanating from these cities. The estimated cost of getting the water is highest in the case of Derby and lowest in that of Sheffield.

FAILURE OF A MINNEAPOLIS DAM BY ICE PRESSURE.

Early on the morning of April 30 a section of the upper dam in the extensive works of the St. Anthony Falls Water Power Company at Minneapolis gave way, causing a considerable loss to the owners and some temporary inconvenience to the milling interests depending upon the water power. The causes of this failure being quite unusual and the power being one of the largest developed powers in the country, special interest attaches to the accident.



PLAN OF MINNEAPOLIS DAMS.

The main falls at Minneapolis were, in 1877, protected by a roll dam and apron, from either end of which there extended up the river a series of dams serving to divert the current towards the east and west sides of the stream forming two mill ponds, locally known as the Minneapolis Mill Co.'s pond and the St. Anthony pond. In ordinary stages of the river, practically all the water in the Mississippi is utilized and the apron is dry, but in flood stages there have been as much as nine feet depth on the crest of the dam. To assist in the discharge of these flood waters two additional spillways were constructed at the east end of the apron in recent years. The upper dam maintains the level of the water in the mill ponds from 10 to 12 feet above the crest of the apron. The main current of the Mississippi is towards the westerly shore, and much the larger part of the power afforded by the works is utilized by the flour mills on the west side.

In 1893-4 a section of the upper dam extending from the west end of the apron for 530 feet up stream, and nearly parallel with the west bank, was rebuilt in a most substantial manner from plans by William De la Barre, engineer of the St. Anthony Falls Water Power Co. The material was Kettle River sandstone and the specifications called for first-class coursed ashlar masonry. Much of the stone was in blocks weighing over 8,000 pounds. The dimensions were; height 18 feet, width at base 12 feet, top 5 feet 1½ inches. A spillway about 50 feet in length, and the same distance from the apron, afforded a means of removing logs and debris and of relieving the surrounding structure in times of high water. This dam was not expected to carry water over the crest, but in the unprecedented flood of 1897 2 feet of water flowed over it for a considerable time without causing the slightest injury.

But the dam was destined to be subjected to an entirely unexpected strain. The winter of 1898-9 was the most severe which the Northwest has experienced, probably, since the earliest settlement. For the first time in the recollection of those who have had to do with the works about the falls the ice formed in the mill pond to the thickness of 6 feet. In fact, the cold was so intense that ice formed on the inside of this stone dam to the bottom of the river. Ordinarily the pond is open—owing to the brisk current—or only lightly frozen.

The ice alone would have caused no injury had it not been for the fact that the level of the water in the pond is frequently changed. When all the mills using power are running, the level drops to the stage which the volume of water then in the river can afford; when the mills shut down, as on Saturday night for the Sunday rest, the water rises until it flows over the spillways. A difference of level of several feet thus occurs at not infrequent intervals.

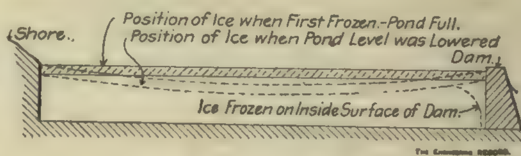


DIAGRAM OF ICE ACTION ON DAM.

It follows, of course, that when the pond is frozen over at the highest stage, a lowering of the water gradually would cause the ice to sag in the middle while adhering to the sides. Continued cold would solidify the ice anew in this position, filling any cracks and adding to the thickness. When the water rises again the concaved mass of ice must crush or extend itself laterally, and one end of the mass being against the solid shore, the whole force would

THE BREAK IN THE UPPER DAM AT MINNEAPOLIS; VIEW FROM EAST END OF APRON.

[The opening is about 170 feet wide. At the left and close to the end of the apron is shown the 30-foot section of the dam which was moved bodily, like a gate swinging on its hinges. The railway bridge seen directly above the break is about 300 feet from the dam and over the entrance to the power canal.]

be exerted against the dam on the outer side of the pond. As the pond is some 300 feet in width, every rise of water produced an enormous thrust. Under ordinary conditions the thin ice would crush under the strain; but ice from 4 to 6 feet thick proved stronger than the dam.

During the very coldest weather it was discovered that the dam was slightly out of position, but owing to the temperature it was impossible to examine the foundation and determine the extent of the injury. However, as much ice as was possible was removed, the dam settled back to its proper position and at frequent intervals 3-inch steel rods were sunk through the masonry and from 2 to 3 feet into the limestone ledge underneath. These were thoroughly set with cement. With the disappearance of the ice the dam seemed in good condition, and, at the time of the failure, was carrying only a few inches greater head of water than had been sustained without injury during the few weeks preceding. The break came without warning. A mass of masonry 170 feet long was tumbled into the basin in a few seconds, while a section 30 feet long, next the apron, was swung bodily like a gate on its hinges so that the outer end stands about 5 feet out of line. The steel rods which had been inserted were snapped off like straws.

Until a coffer dam can be constructed and the foundations at the break be examined, the exact conditions and causes cannot be determined, but it is evident that the action of the ice, forcing the top of the dam outward, opened a seam somewhere near the base on the inner side. The presence of water in such a crack would, of course, greatly weaken the structure. That the steel rods failed to compensate for this weakening is now evident.

The water power company has already commenced the construction of a coffer dam about 900 feet in length, shown by the dotted line in the diagram, which, when finished, will allow of draining that part of the pond adjacent to the stone dam. Until this dam is completed the flour mills will be obliged to depend in part on their auxiliary steam power, as a large part of the available water is lost through the gap. It is estimated that the loss occasioned by the failure will amount to $25,000 in round numbers.

COUNTY ROAD CONSTRUCTION IN IRELAND.

The construction of country roads in localities with inadequate railroad facilities for the cheap transportation of materials affords a number of problems calling for the exercise of much business sagacity as well as engineering skill. There are many sections of the United States where the construction of good roads is hampered by this lack of local material and the inability to secure it from other places at a reasonable expense, and it is believed in consequence that the account of the method of constructing roads under like conditions in Ireland, prepared by Mr. Richard Barnsley Sanders and printed in a recent issue of the "Proceedings" of the Institution of Civil Engineers, will be of general interest to American engineers. The method of carrying on the Irish road work is, of course, different from that in this country. Each Irish county is divided into a number of districts, known as baronies, which vary widely in area. Each barony has a representative in the grand jury of the county. Formerly the grand juries exercised practically complete supervision over the roadways, but to-day their power has been delegated to a considerable extent to the district boards, called the Baronial Presentment Sessions. These boards are composed of the magistrates of the district and a certain number of the largest taxpayers. All applications for works and expenditures must be made to the boards, which are advised by the county surveyor. The Baronial Sessions then decide, first, to approve or reject the applications, and, second, if the works are approved, the sums to be granted for them. The works which are sanctioned in this manner are then advertised and subsequently sent up to the grand jury for approval. All public works must be submitted for contract and the lowest tender must be accepted if it is considered bona fide and the sureties are sufficient. In case no tender is received the grand jury may entrust the execution of the work to the county surveyor, provided it does not cost more than the appropriation made by the Baronial Sessions. Formerly this latter power did not exist, and, in the absence of tenders, no work could be carried out under grand juries, a fact which was the cause of great inconvenience. Thus, in Kings County, more than 400 miles of important roads were at one time almost impassable, as no contractors could be induced to tender for their repair and maintenance except at fabulous prices fixed by themselves. An energetic county surveyor, with the assistance of a number of public officials, succeeded in remedying this state of affairs in the manner mentioned. In case of a sudden accident to roads or bridges the local magistrates have special power to provide sums up to $250 for repairs, and in case larger sums are necessary the Lord Lieutenant can order special Baronial Sessions held for the purpose of making an appropriation.

Under this system the county surveyor is an officer with very responsible duties. He obtains his appointment by an open competition conducted by civil service commissioners for each vacancy. The assistant surveyors are appointed by the county surveyors, who are allowed as many as the grand juries may consider necessary; but before an assistant can be appointed he must have a certificate of qualification from the Board of Public Works in Ireland. As a matter of general interest the regulation relating to the county surveyor's examination is reprinted:

"The subjects for county surveyors' examinations are grouped into two parts, viz.: Part 1, theoretical, and Part 2, practical. The subjects comprised in Part 1 are mathematics, including geometry, trigonometry, algebra, differential and integral calculus and geometrical optics; mechanical philosophy, including statics and dynamics, hydrostatics and hydraulics, pneumatics and heat regarded as a source of power; experimental science, including inorganic chemistry, heat, electricity and magnetism, geology and mineralogy. Part 2 comprises railway and canal engineering; marine engineering, including harbors, docks and reclamation works; hydraulic engineering, including water supply, sewerage and irrigation; county works, including architecture, roads, drainage and river works. Each of the subjects in Part 2 includes the drawing of designs, estimates and specifications, and mechanical contrivances connected therewith, for works required as described in the examination papers. The successful candidates must, after the examination, show that they have been engaged in the actual practice of their profession for an adequate time on important works, either of their own design or as responsible engineers in carrying out such works."

The contracts for the repair and maintenance of roads may be made for as long as seven years, but the average length is three to five years. Payments on such contracts are made twice a year. The work is usually let to local farmers or to persons engaged in business in the district. The roads are divided for contract purposes into sections from half a mile to six miles long. The materials are procured under special provisions which give large powers to enter upon private property for this purpose, if it is proved to the satisfaction of the magistrates that suitable materials cannot be conveniently obtained elsewhere.

The manner in which road construction is carried out under the direction of Mr. Sanders is as follows: For a main road, running through sound upland districts, as soon as the work of making the open side drains, cuts, embankments, culverts, fences, etc., has been finished and the subgrade well consolidated, it is thoroughly drained by miter and covered longitudinal side-drains, made with stones and discharging by small cross-drains or pipes under the sides, foot-paths and fences into the open back-drains. A stone foundation of a sufficient depth for the traffic the road is intended to carry is laid carefully on the subgrade, closely packed and formed to a convex cross-section, and joined into the tops of the longitudinal covered side-drains. For roads carrying very heavy traffic, and town streets, this under pavement generally consists of well-rammed stones about 9 inches in depth. In country districts the paving consists of one or two layers of 6-inch to 4-inch and 3-inch to 2½-inch stones. When the foundation has been well rammed and leveled, 2-inch macadam metal is spread in layers not more than 3 inches deep at a time, and blinded over with fine screenings, gravel or other suitable material, and the road is opened for light traffic; its succeeding layers of metal are applied in a similar manner until the proper depth is obtained, which varies between 6 and 9 inches, according to the class of road or street. The surface is finished with a transverse fall from the center to the sides of 1 inch in 4 feet. In towns and villages the side channels are paved with good pebbles, and in country districts they are formed in the surface, where the latter joins with the edge or curb of the footpath. The surface water is discharged through 9x6-inch outlets built under the footpaths and fences into the open back-drains.

In making roads across peat bogs, their nature and depth is first definitely ascertained. If the bog is sound and rests on a clay or firm bottom, the road can be made without brushwood or timber. The side-drains are first cut for such a depth into the solid, sound peat as will not lower the water more than about 18 inches or 2 feet below the surface of the intended road. Outside parallel drains are then cut at distances and depths calculated according to the nature of the bog and the depth to which it may eventually be cut for fuel. The side-drains are connected with the outside parallel drains by a small cross-drain. The whole is then allowed to stand for a few months to drain and settle. When the water has assumed its altered level, the space to be occupied by the roadway is cleared by removing all the light portions of the bog down to the sound peat. On this is placed a layer of tough grass sods with the grass side down, and over these clay or good stiff soil is laid in thin courses for a depth of 6 to 9 inches and carefully pounded. If fine gravel or coarse sand is obtainable, it is then spread as a support for the broken stone, which is laid as described for upland roads. Mr. Sanders does not use heavy stones for a solid foundation in making bog roads.

If a floating or shaking bog has to be crossed, the side and parallel drains are made as described, but each as shallow as possible, so as to avoid weakening the floating peat crust. After the drains are cut on such bogs the site usually sinks materially and must be allowed to stand until it attains a somewhat permanent level. The top is then cleared over the site for the roadway, and a bed of gorse, heather or very fine bushes is carefully laid over the wet peat and layers of fascines or strong brushwood, well crossed, are placed over it, the size and depth depending on the weight of the traffic to be carried. All the brushwood is filled in with moist peat, the whole being brought up in this way to the proper level, on which grass sods are placed and the roadway is constructed as already described for firm bogs. It is essential that all the brushwood should be laid below the line of saturation so as to keep it constantly wet, together with the peat packing, for, peat being a powerful antiseptic, all

parts are preserved from decay if kept in a wet state.

When the present system of maintenance went into effect in 1836, there were 13,191 miles of road repaired under the direction of the grand juries of Ireland, at an annual cost of about \$83 per mile. In 1895 there were 53,064 miles of road maintained by them at an average annual expense of a little less than \$60 per mile. Had the old system remained in vogue it is probable that the extra expense of maintenance to the present day would have been over a million dollars. This reduction in cost is all the more noteworthy because the usual pay of a laborer in 1836 was but 12 cents a day, while at present from 36 to 60 cents per day is the average rate. The total cost of supervision by county surveyors, together with their assistants, is at the rate of about 4½ per cent. on the expenditure. The tax for the repair and maintenance of the public roads amounts to about 5 per cent. on the valuation.

The principal materials available for repairing and maintaining roads over the greater part of Ireland are different kinds of limestone, which vary considerably in character and hardness, from the light, friable and indurated chalk to the hardest blue limestone. In some districts, trap, basalt, granite, syenite, whinstone and clay-slate are, however, in use. In all parts of the country it is necessary to employ the nearest available materials, for means of transit are wanting to bring stone from a distance. Limestone, though good enough for roads of light traffic, is, as is well known, not well adapted for those carrying heavy traffic. The author of the paper has about 1,000 miles of public roads under maintenance and repair, and the only local stone available is blue or gray limestone, either in the rock or in drifts of gravel and boulders. In certain of the mountain districts it is possible to make use of the local clay-slate or sand-stone grit, but these materials are of inferior quality and can only be employed for mountain roads where the traffic is very light.

The system employed by Mr. Sanders in improving roads has been; first, to pick out any large stones making their appearance on the surface, and to replace them with broken metal; second, to increase the thickness of the crust of the roads, and to bring them to a better formation; and third, to improve the drainage as far as possible. In the case of old roads which were never properly constructed, this was the only suitable method, since many of them were originally merely lanes or private roads. These were subsequently presented for repairs by the grand jury, though they should really in many cases have been presented for reconstruction, as they have since become important thoroughfares. It is often surprising to find how much has been accomplished by these methods of improving imperfect roads at a nominal cost, but they are not, of course, adapted for continuous heavy traffic.

A large number of Irish roads traverse great stretches of peat bogs, and in such cases the management of the longitudinal side-drains is of the greatest importance. If the subsoil is drained too much the peat, when it becomes dry, loses all its glutinous matter, rots away and crumbles under the crust of the road, and the latter is then liable to drop into the holes. The soundest bog roads are those in which the level of the water in the longitudinal side-drains is kept about 18 inches below the surface of the road. This can best be managed by making small shallow side-drains with cross-drains to discharge the flood water into larger parallel drains, cut into the bog at a considerable distance from the road and made deeper than the adjacent side-drains. Under such circumstances the peat beneath the road always retains sufficient moisture to keep it in a sound condition, and it does not part with its adhesive qualities; in the case of roads crossing peat bogs, which have been cut for a considerable depth below the level of the road and too close to it, the roads are always in an unsound condition and appear to expand or contract according to the state of the weather. The crust of the road is broken up in very dry weather, though it becomes firm again when the weather is damp. Mr. Sanders has observed that roads over peat bogs are not so much injured by frost as are the upland roads.

The system of repair generally adopted in Ireland is patching. The author's specifications provide that the parts to be repaired are to be picked and loosened to a depth of half an inch, somewhat more at the edges, and the new materials are then to be spread over the old surface and consolidated with a pounder. In very wet weather and after frost, in roads of heavy traffic, the picking and pounding are omitted, for the stones bind at once. The metal for districts where the traffic is light is broken to 1 to 1½ inches in size, and for roads for heavy traffic to about 2 inches. Gravel is also extensively used for light traffic roads and summer repairs in those districts where it is procurable. It is considered advisable to apply the patches of new material alternately at each side of the road, extending therefrom to a little beyond the center and at distances of 25 to 30 yards. A clear footway is thus obtained for the use of horses without treading on the fresh patches in which the wheels roll, and ease and comfort are experienced in driving when only one wheel crosses a patch at a time. If the roads are systematically repaired in this way, taking up alternate portions and not applying too much material at any one operation, they may be brought into very good condition without rolling.

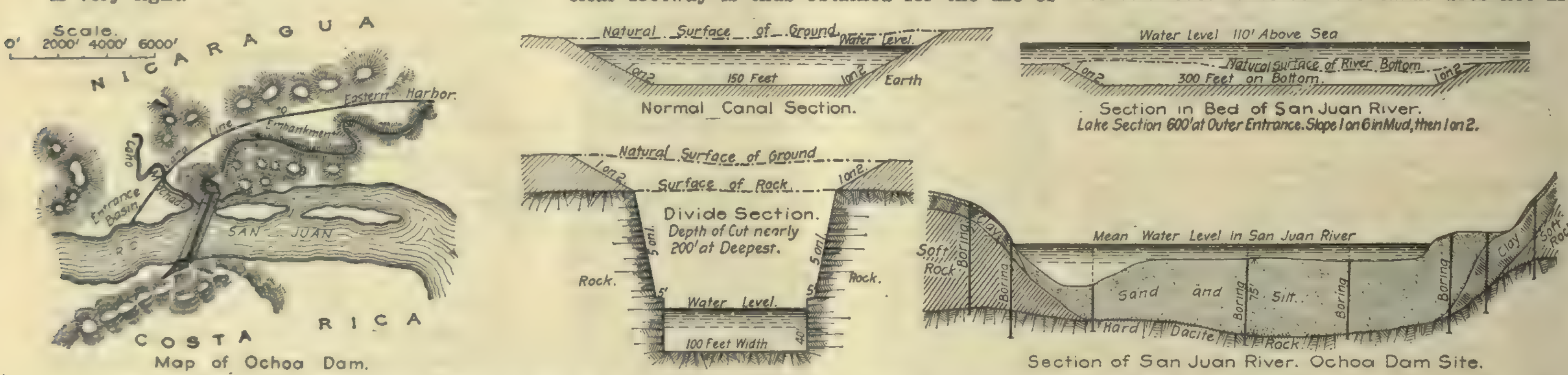
The footpaths along certain of the public roads are made mainly with a surface of gravel or fine screenings from the road metal. In a few cases, near towns, concrete, asphalt and tar paving have been used for this purpose; but concrete in situ has not been recommended where gas and water pipes exist, owing to the difficulties of opening and repairing it.

The system of letting contracts for repairs to the local farmers, though it is attended with some advantages, is fraught with drawbacks. As the contractors with the aid of their sons and friends themselves execute the work, it is difficult to secure regular and systematic attention to it, and the plan is open to considerable jobbery and certain dishonest practices, which can only be kept in check by the utmost vigilance on the part of the engineers. If honest local contractors should be secured to undertake contracts for considerable stretches of road, the system might answer well, but it is impossible in most places to find substantial men willing to accept such work. Moreover, skilled workmen are really needed for the repair and maintenance of roads, but they cannot be procured except by training, and most people at present consider that no skill is necessary for this class of work. Mr. Sanders has adopted a plan of giving short lectures, illustrated by chalk sketches, to the road contractors for each district, and he also supplies printed directions in the specifications for the work, instructions as to the methods of procuring materials and other necessary advice. By such means as these, accompanied by frequent inspections and by stoppage of payments for imperfect work, he has succeeded in obtaining excellent work in all cases when he was well supported locally. Wherever he has been able to group the roads into neighboring sections of 8 to 10 miles, he has appointed staffs of trained men on each section, and in this way he has formed districts of about 35 to 50 miles with an overseer in each district to superintend the work and make out the pay rolls. Where the amount of money placed at his disposal was often very much less than the contractors' prices, it has been possible to keep the roads in excellent order and pay the increased staff, cost of tools and all expense of works, out of the money saved under this system; but the plan has met with considerable opposition from parties whose interests were certainly not identical with those of the taxpayers.

THE OCHOA DAM.

It will be recalled by readers of the preliminary report of the Nicaragua Canal Commission, which was printed in these columns on December 31, 1898, that the question of a high-level or low-level route for the canal does not affect in any material way the necessity for a great dam at Ochoa, the most troublesome feature of the project. On the high-level route it will be necessary to have a dam about 3 feet higher than on the other, and in either case the elevation to be overcome by lockage is about the same as that proposed by the present plans of the Panama Canal Company, in which the water surface on the summit level is fixed at 102.5 feet.

In the Nicaragua project, the Lull or low-level route follows the San Juan River, and the Maritime, or high-level route, crosses the Great Divide in a more direct but no less sinuous line to the Ochoa dam. The distance from Greytown Harbor by the first line is 36 miles, and by the second line is 34 miles. The location of the dam is understood to have been determined by General Hains and Professor Haupt alone, Admiral Walker, the head of the commission, not voting on account of his unfamiliarity with the engineering problems presented. There were no accurate surveys of the site previous to those under the direction of General Hains. The borings he made indicate



TYPICAL SECTIONS OF THE LATEST NICARAGUA CANAL PROJECT AND DETAILS OF THE OCHOA DAM-SITE.

that the strata at this place have the form shown in one of the accompanying diagrams. It will be seen that some 75 feet of sand and silt must be removed before a foundation firm enough for the dam can be secured. The river is about 1,600 feet wide at this place and is bordered by high hills on both sides. The plans for the dam call for a masonry structure with a back having a reversed curve, a total height above the foundations of about 150 feet, and a length on the crest of about 2,000 feet; it is estimated to cost nearly $6,500,000, including the necessary excavation and the incidental work to control the water. It will be recalled that previous studies of this canal have been based to a greater or less extent on the use of a rock-fill dam instead of the masonry structure now proposed. As the site is in the belt of active volcanic disturbance there has been a great deal of speculation in regard to the advisability of the Nicaragua route because it involves such a great dam. Even though the torrential streams can be controlled, there arises the question of the effect of earthquakes on the structure. The entire 64 miles of canal from the Caribbean Sea to the Lake of Nicaragua will be dependent on the stability of this dam, and its failure might cause incalculable damage.

To build the structure it will be necessary to divert both the San Carlos and San Juan rivers from their beds. This will be done by a cut through the San Carlos ridge a few miles above the dam-site, letting the enormous volume of water through to the basin of the Caño Cureño, where it will flow eastward until it again empties into its natural bed 5 miles below. The magnitude of this task is evident from the fact that the discharge of the San Juan during the rainy season is 90,000 cubic feet per second, and that of the San Carlos is about half as much.

It is understood that the result of a personal examination of the site of the dam by the present commissioners has convinced them of the feasibility of constructing a dam at the site indicated on the accompanying sketch, which will maintain a water level of 112 feet in Lake Nicaragua, allowing a slope of 1/16 foot to the mile for the 64 miles of intervening river navigation. The free river and lake navigation which these plans propose reduce the actual canal cutting, having a normal bottom width of 150 feet, to less than 50 miles. The typical cross-sections used in the preparation of the recent estimates are, as will be seen from the accompanying sketches, much larger than those heretofore used, and probably explain the reason for General Hains' large preliminary figures for the cost of this great undertaking. The final estimates may be made lower.

THE HISTORY OF AN AMATEUR WATER-WORKS PLANT.

The importance of engineering advice for even small water-works is well shown by the history of a system built without further expert advice than that furnished by the agent of a gasoline motor firm. It is told by Mr. E. R. Scales in a recent number of the "Transit," and is reprinted on account of the good lesson it teaches, although it should be said in passing that the fact this particular plant failed to work properly should not be held to reflect in any way on the merits of the reliable gasoline engines now on the market. These are showing by their daily records under conditions varying widely that they are suitable for service of just the character of the particular plant of which the following account is told.

"It was the writer's fortune to witness the experience of a small town which installed a gasoline-engine water supply plant. To one not having property in the town or interest in the plant a retrospective view is not without an amusing vein. The necessity of fire protection having been impressed upon the minds of the good people of the town referred to by a conflagration in a neighboring town, a meeting was held to perfect plans for a system of water-works. The town being too poor to undertake the work, a local stock company was formed. The holders of the stock were to receive 6 per cent. interest on the money invested, this interest to be paid by the town as rental for the plant, the city reserving the right to buy the plant after a term of years.

"The company organized and elected its officers; the man who furnished the most capital, as is usually the case, being the man who was most engineer. Not a man among them could tell a gasoline from a steam engine, or distinguish between a dynamo and motor, but each and every one advanced some new and startling theories on the matter of water supply. The contract for laying the mains, erecting a steel tower, and building the tank and pumping station was let to the lowest bidder. The tower was a substantial steel tower, 60 feet high and carried a wooden tank of 50,000 gallons capacity. The pump house was a square brick structure of no particular style of architecture, and the man who planned it forgot to specify a chimney, so the bidder, not wishing to alter his contract, put none on. The genial agent of a sham engine firm was early on the ground and stormed the directors with illustrated catalogues and arguments all pointing to the necessity of using a gasoline engine. His wonderful display of facts and figures could not help but convince the management that such a machine as he had to sell was the one for the place and they congratulated each other heartily as they thought how masterfully they had avoided the great expense of an engineer's salary.

"At last the engine arrived and the expert proceeded to install it. It was a wonderful machine, everything about it was cheap, except, possibly, the price. It looked as though the inventor had decided that the more rods and valves and moving parts he could use the better would be the engine, and he then proceeded to work all into it possible. It was belted to a line shaft, which, in turn, drove two deep-well pumps of uncertain pattern by means of a chain and sprocket; and a rotary fire pump by means of tight and loose pulleys. The exhaust was muffled by being led through a large wooden box filled with broken brick and elevated on timbers in one corner of the pump room. The box acted like a sounding board and greatly intensified the report. The violence of the exhaust and the explosions soon disintegrated the brick, and after the first run the electric light globes and everything in the vicinity wore a coating of red brick dust. It was immediately evident this experiment would not work, and the box and remaining pieces of brick were removed, the exhaust pipe being run outside and buried. This was the first of a long series of changes which finally resulted in the downfall of this automatic gasoline engine pumping plant.

"The first real test of the system came on a bright winter's morning; when the fire alarm was sounded the marshal hastened to the pumping plant to start the fire pump. He carefully read the printed directions tacked upon the wall, turned the screw marked A, poured some gasoline in the hole marked B, turned screw marked C, waited the required number of minutes and gave the wheel a turn. But the engine refused to start. For two hours the local engineer wrestled with that obstinate gasoline engine, but all efforts were futile. Meanwhile the citizens rallied to the rescue and extinguished the fire in the good old way before it had done extensive damage. But dissatisfaction was general, and the engine company finally replaced the engine with a new one, which differed from the former chiefly in having more valves, rods, moving parts and adjustments. Each day some piece of faulty construction revealed itself and some impromptu remedy was applied. The sprocket chains driving the pumps were continually being broken by the jerking motion of the pump. One director argued that flywheels on the line shafts would help matters, and accordingly two were purchased. Now arose a difference of opinion; one said the flywheels should be placed on the shaft that revolved the faster; another that they should be placed on the shaft that revolved the slower; so a compromise was made, and one wheel placed on each shaft. Then gearing was substituted for the chain and sprocket, and many other changes were made which might be enumerated. Meanwhile the plant passed under many hands; each week or two saw a new official try his hand and a disgusted one step down and out. The marshal was now elected upon his mechanical ability, and success in wrestling with the gasoline engine was the first and highest qualification for office. The town found itself obliged to pay large gasoline and repair bills and water was often noticeably scarce around the pumping plant. The expenses of operating far exceeded the income, and the venture proved itself a failure.

"Then the lectric light company came to the rescue with a proposition to pump the water by electricity, the town to purchase a standard pump and the company to furnish motor and power and keep the plant in repair. The proposition being accepted, a motor and pump was installed in a good mechanical manner. The major part of the pumping is done when the lighting load is least, thus helping to bring the working load nearer to the point of maximum economy. The motor is started at the pump house by an employee of the light company, who also oils the machinery, i. e., fills the oilers and sees that they are set to feed properly. The plant is then locked and left to its own care, no further attention being required beyond an occasional overhauling by the company's engineer. The motor is thrown out of circuit by the engineer at the lighting station when an electric signal shows the tank to be full. This signal consists of a lamp on the switch board, which lights when the water in the tank reaches the required level. The gasoline engine still remains belted to the fire pump for emergency, but its glory has departed."

NOTES ON SUCTION PIPES.

An elaborate paper on the mechanics of suction and suction pipes was read before the Western Society of Engineers recently by Mr. Daniel W. Mead, M. Am. Soc. C. E., and is printed in the February number of the "Journal" of the association, together with the important discussion which it elicited It is too long and accompanied by too many tables to be presented even in abstract in these columns, but attention is called to certain portions of the discussion of Prof. Arthur N. Talbot, M. Am. Soc. C. E., which are reproduced slightly condensed below:

Vacuum chambers are used for two purposes: First, to act as reservoirs to receive and discharge water under the varying velocity of the stroke and thus to avoid shock and slip; second, to serve as traps to collect air from leaky suction pipes or from supersaturated waters. For the first purpose the chamber should be placed as near the pump as possible and in a direct line with the motion of the water before reaching it. Generally this will place it immediately above a vertical suction pipe and beyond a horizontal one or beyond the pump suction chamber. It should have the same diameter as the suction main and extend vertically as high as the regular velocity of the water would carry it in the interval between the closing and the opening of the suction valves, and should have a space above this point sufficient to prevent shock. It should not contain much water at the time of the full velocity of stroke, for this would leave a mass to be started and stopped at every acceleration. For the second purpose, an auxiliary air pump should be used to avoid the

loss of energy and of discharge by pumping air through the main pump and to avoid the shock due to sudden releases or gulps of accumulated air. Much care has to be taken in the use of such apparatus to make it effective.

It is not strange that the head lost in pump valves and water passages is quite high, when the velocity head, entrance head and friction head through the valve openings are considered. Take the case where the area of valve openings is one-third of that of the plunger, and consider a plunger speed of 2½ feet per second. This requires an average velocity of 7½ feet through the valve openings, giving a velocity head of 0.85 foot. The entrance head will probably be nearly as much, and the resistance through the valves even more. As practically all the velocity head is lost, this would make at least 2.5 feet and the same amount through the discharge valves would bring the total loss to 5 feet. With stiff valves and passages arranged to require a reversal of current, the resistance through the pump may become very large. It may be doubted if it often comes as low as 5 feet. Some pumps tested here gave 11 feet. The new Aurora pumps, having a capacity of 6,000,000 gallons per 24 hours and giving a duty of 124,000,000 foot-pounds, in a test by Prof. L. P. Breckenridge of the University of Illinois, gave a loss through valves and pump passages of 14 feet. More attention should be given to the designing of these parts.

The actual effect on the suction of the confined gases will depend upon whether their amount is in excess of the point of saturation at the pressure or vacuum to which the water is subjected, and the point of duration or time element during which the water is at a considerable suction height. It is likely, also, that the amount of free surface exposed, similar to evaporation surface, will govern the amount of the discharge. While most waters are well within the limit of saturation for atmospheric pressure, many ground waters contain large quantities of gas, which become troublesome at medium or high suction lifts. Likewise, the usual condition of vertical suction mains gives only two or three seconds of time for the water to remain at reduced pressure, a time too short to permit of the escape of much gas; but a gang system of driven wells may have a considerable length of connecting suction pipe at or near the level of the pumps, thus giving much more time for the release of the gases.

That the quantity of gas given off under ordinary conditions cannot be large is shown from a determination of air accumulation made incidentally in some experiments with 2-inch syphons by Messrs. Ketchum and Seastone, under the direction of Professor Talbot three years ago. The inlet leg of the syphon rose vertically for the full lift. At this level 162 feet of horizontal pipe was placed, and at the end of this the outlet leg descended vertically to the outlet tank. Near the outleg leg a connection with the horizontal run of pipe was made to an air chamber. The amount of air accumulating was measured after stopping the experiment by metering the water required to fill the apparatus. While the apparatus was fairly tight it was known there was some leakage. The water used was from the city waterworks. Part of it was pumped over again, but was subject to aeration in passing over a weir and through four tanks. The vacuum at the summit was measured with a carefully calibrated vacuum gauge and checked closely with the sum of the lift or rise, the velocity head, the entrance head and the friction head. The highest vacuum used, 30.1 feet of water, is within about 2.5 feet of the probable highest vacuum obtainable with the atmospheric conditions existing. The limitations of the apparatus and its location would not permit experiments under a higher head. It will be seen that the time the water was under the vacuum ranged from one to two minutes, a much longer time to exposure than is usual in suction pipes. It may be said that the construction of the syphon was not such as to allow the liberation and reabsorption of the air before reaching the outer leg. In the table the amount of rarified air at the vacuum of the high point of the syphon is given as a percentage of the quantity of air passing through the syphon. The head, lift and vacuum are given in feet of water, the velocity in feet per second.

Head on syph.	8.4	8.4	8.4	8.4	2 75	4.3	1.9
Lift	21.5	21.5	21.5	21.5	21.5	27.5	27.5
Loss to outlet leg	6.6	6.6	6.6	6.6	2 7	2.6	1.1
Ind. vacuum..	28.1	28.1	28.1	28.1	23.7	30.1	28.6
Time	1:50h.	1:45h.	9:30h.	8:55h.	8:15h.	27:40h.	1:20h.
Velocity	3.4	3 4	3.4	3.4	2.5	2 2	1.4
Rar air, % .	0.05	0.05	0.025	0.01	0.015	1.02	0.02

No relation can be deduced with reference to the release of air at different pressures, since it is known that in some cases a considerable part of the accumulated air is due to air confined in the syphon during the process of filling. At New Rochelle, N. Y., a 12-inch syphon 925 feet long, constructed by Mr. J. N. Chester, Assoc. M. Am. Soc. C. E., and described in "The Engineering Record" of August 12, 1893, under lifts of 18 to 23 feet, accumulated air at a rate of 125 cubic feet of rarified air in 12 hours, which was at the rate of 0.1 per cent. of the volume of the water flowing or 0.04 per cent. of free air. This was surface water from an impounding reservoir. It was known that there was considerable air leakage in this syphon.

While the accumulation of air given in these experiments is small, it must be borne in mind that many ground waters are heavily supersaturated with gases and offer quite different conditions. The experience of Professor Talbot with gang-driven wells in the drift indicates that such waters may give considerable trouble even at low lifts. However, it is believed that the greatest source of trouble with air accumulation lies in leaky suction pipes. This is augmented by the great difficulty in making joints air-tight, as compared with water-tight joints, and by the fact that at high lifts the pressure of the outside air is many times that on the inside. There is special danger in the gang system of wells where the casing of each well extends above the surface and has several joints above the connecting suction pipe, which, of course, are not covered with water. In this connection it may be said that a water jacket offers a good protection against leaky suction pipes.

Where long suctions at high lifts are to be used, the pipe should never be horizontal nor have a summit before reaching the pump, but should be laid on a sharp ascending grade. This will allow air to escape to the pump as fast as liberated and will prevent the accumulation of bubbles or masses of air, which may have serious consequences in finally passing off. The use of a bell-shaped mouth for suction pipes with high velocities is to be commended, but in general a conical mouthpiece with a diameter double that of the suction pipe will give sufficiently good results.

A rather unusual case of a pump being used under a considerable head on the suction side may be noted here. At Decatur, Ill., the water is pumped from the Sangamon River to filters and reservoir on the hill above the station. From the reservoir the water passes to pressure pumps under a head of 70 feet, and is pumped into the distributing mains. A chamber 5 feet in diameter and 12 feet high is placed on the suction side and another of the same size on the discharge side of the pump. Air is kept at the proper height in these by means of an air pump. Cards taken from the pump showed satisfactory working both with the usual discharge pressure of 90 pounds and ordinary consumption of 2,000,000 gallons per 24 hours, and also with the fire pressure of 140 pounds and four large fire streams as additional discharge. Until May, 1898, the water from the reservoir was permitted to flow down hill to a pump well below the pumps, thus losing all the energy in the 70 feet of head.

THE POWER PLANT OF COLUMBIA UNIVERSITY.

The power plant of the new portion of Columbia University, which has recently been completed in the upper west side of New York City, was described in a paper presented by Mr. Edward A. Darling, its designer, before the convention of the American Society of Mechanical Engineers in Washington this week. Part of the paper related to the power plant in the buildings of the College of Physicians and Surgeons, which has already been described in "The Engineering Record." Messrs. McKim, Mead & White were the architects of the new buildings, Mr. Alfred R. Wolff the consulting heating and ventilating engineer, and Mr. C. O. Mailloux was called upon to design the electric plants, exclusive of the generating equipment. Mr. F. A. Goetze, the author's assistant, is credited with the design of details of the plant and for efficient superintendence.

The design of the buildings called for the creation of a great platform, 750x575 feet in area. The Library was to stand on the center line of the platform. Directly back of the Library, which faced south, the university hall, containing the refectory, academic theatre, gymnasium and power plant was to be placed; and flanking the Library on the east and west were four groups of educational buildings, forming as many quadrangles. The author realized that a power house would be at best a disturbing element and proposed at the outset that it be built on the bank of the Hudson River, 1,500 feet west, sinking a shaft from the center of the university site and running a tunnel from its bottom under Riverside Park and the New York Central tracks to the power house built out over the water on piers. Pipes and cables for the supply of steam and electricity, and a light railway and elevator to carry freight were to run through the tunnel and shaft. This scheme which would make possible the transfer of coal directly from boats to bins over the boilers, and the use of condensing engines, received the sanction of the trustees and the consent of the city and the railroad authorities, but it was blocked by legislation introduced at Albany by an organization of adjacent property owners, and the plan for a power house in the center of the site had to be adopted.

Continuing, Mr. Darling said in part: It was agreed that a steam pressure of 110 pounds should be maintained throughout the distributing mains to the point where it met the reducing valves of the several heating systems, this pressure being taken as the limit for the single-expansion engines which were to be used in the generating plant. The ventilation throughout was to be on the plenum system, the blowers overbalancing the exhausters with that end in view. The heating was to be on what is known as the direct-indirect system, and electric motors were to be used for all power purposes excepting drip and return pumps, which were arranged to exhaust directly into the heating stacks, and the temperature-regulating system, which used compressed air in common with the book and message dispatch system for the Library building, the exhaust steam from the power-house to be used for heating the Library and university hall. Direct current on the two-wire system was to be used for both power and light, with an initial potential of 120 volts.

The entire group would, when completed, require at least 4,000 nominal boiler horse-power and 1,500 electrical horse-power, requiring a coal consumption of 15,000 tons per annum.

The service furnished by the power-house covered a period of eight months, when the university is in full operation, and a period of four months of vacation, when only the library building is in use, and the demand for light and power would be reduced to a minimum. The varying conditions of weather, as well as the intermittent use of the buildings during term time, on Saturdays and holidays, called for a

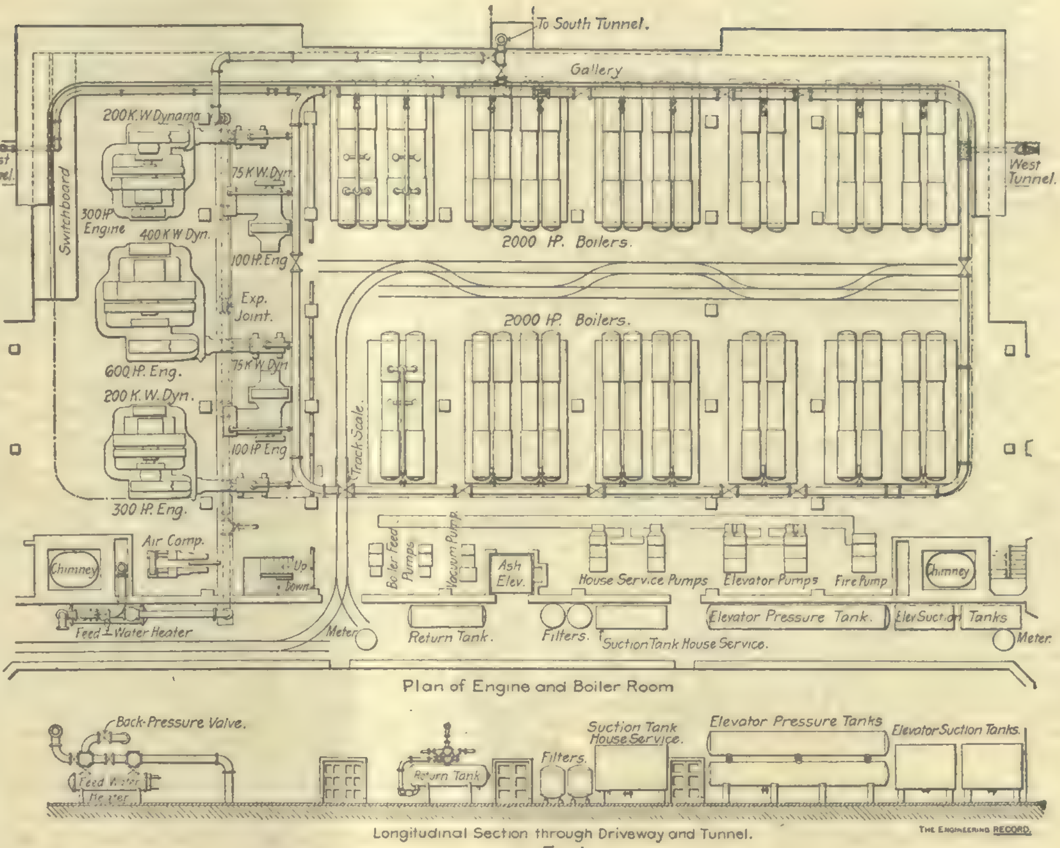
wide range in boiler power and engine units, in order to attain economical operation.

Figure 1 shows a plan of the power-house. Sections of the boiler room and engine room are shown by Figures 2 and 3 respectively.

An upper tunnel leads south from the floor above the power-house to the Library. Two on a lower level run east and west to vaults on the level with the basements of the outer line of buildings, and open into a gallery that runs entirely around the room 19 feet above the floor, and opening out on the transverse roadway, which runs through university hall and separates the power-house from the gymnasium.

The coal vaults have a capacity of 4,000 tons, sufficient to supply the boilers during the ten weeks of severe winter weather, when the river is practically closed to navigation. Coal is dumped down through holes that occur at regular intervals along the driveway. No trimming is necessary, and it is served to the boilers as required on a system of Hunt tracks, that are given a slight down grade all the way to the boiler room. Water and gas mains are run in from the street on either side, and are hung up in the upper corners of the vaults, where they are always open to inspection, as the flow of coal leaves the corners unoccupied.

The boilers are in two rows facing each other, with just sufficient room in the alley to draw a tube. North of the boilers and in the same compartment with them stand all the pumps in a row, and in the alley north of the boiler room,



Longitudinal Section through Driveway and Tunnel.
FIG. 1

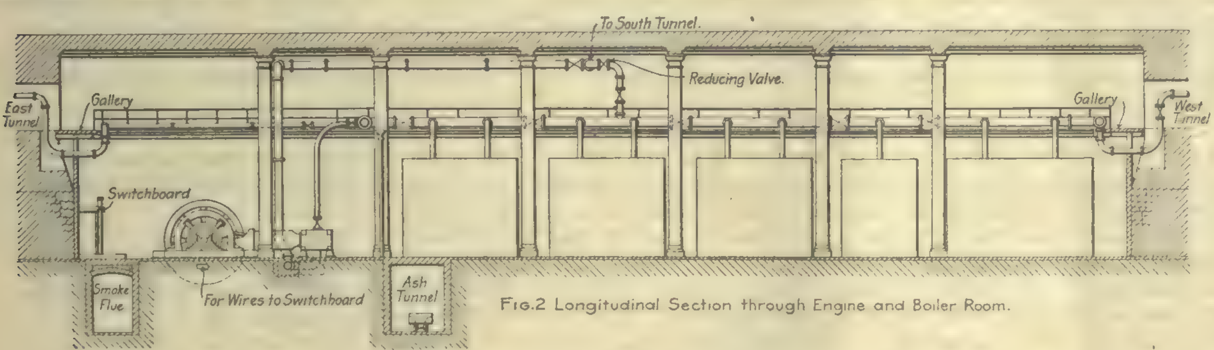


FIG. 2 Longitudinal Section through Engine and Boiler Room.

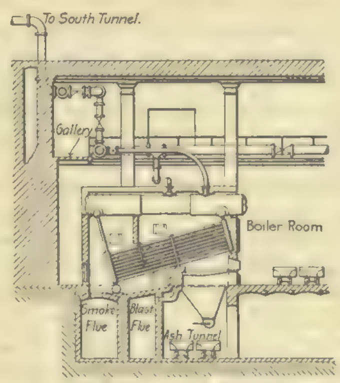


FIG. 3 Transverse Section

THE POWER PLANT OF COLUMBIA UNIVERSITY, NEW YORK CITY.

which connects the coal vaults together, stand all the tanks, filters, feed-heaters, etc., each of these units being as close as possible to the pump.

The engine compartment is separated from the boiler room by a glass and iron screen which only runs up to the level of the gallery, making the entire room open overhead.

The five generating engines stand on a common foundation, which is simply a mass of rock and concrete of 1,000 tons weight. A 25-ton traveling-crane runs north and south directly over the flywheels of the large engines. The entire framework of the windows, which are 12 feet wide and extend the full height of the room, may be removed to take out any part of the plant, as it is of iron, bolted together in sections. Part of the area in the engine-room side is covered at a height of 10 feet with a skylight, and forms the engineers' toilet room.

The boiler room is paved with brick all around the boilers and with tiles around the pumps. The engine room is paved with the same buff-colored tiles, strong enough to permit the dropping of a wrench without cracking. Trench covers are of thick slabs of slate, with hook-holes in each end for lifting. The walls are of Keene cement painted and enamelled, and there is a wainscot around the entire room on the main floor, and again on the gallery level, 6 feet 6 inches in height, of white enameled brick, all corners being rounded. The wheel-pits are lined with enameled brick, and the boiler settings are faced all around with moulded enameled brick to their full height and capped with dressed blue-stone.

There are in all 17 Babcock & Wilcox all-wrought steel boilers, having a total grate area of 825 square feet and a total heating service of 37,000 square feet, built for a working pressure of 150 pounds to the inch; at the present time 110 pounds is the working pressure. All exposed parts of the steam drums are clothed with magnesia covering, to keep down radiation.

Coal is brought from the vaults in charging cars, which pass over a track scale to give the tally, and line up within easy firing distance of the furnace doors. McClave shaking grates are used, and the ashes fall into hoppers underneath.

To prevent the warping and rusting from the water column blow-offs and the ash-pit sprays, the hoppers are made of ¼-inch steel plates riveted to angle-iron corners and lined throughout with firebrick laid in Portland cement mortar. The ashes are dumped into ash cars, which are then run around to the engine room elevator and lifted up to the level of the ash-chute, which in turn empties the ashes into carts that pass through the driveway. The bodies of the ash cars are made to raise, tilt and discharge over the truck wheels into the chute by the turning of a hand-wheel at the side of the truck.

Anthracite coal is used, but the plant is prepared to handle the lowest and most refractory grades of coal that come to market, by a system of forced draft. The air chambers run along between the smoke-flues and ash tunnels, and are divided from the smoke-flues by as thin a wall as practicable, to the end that the incoming air may borrow as much heat as possible from the outgoing gases. A direct-driven Sturtevant blower is set in one end of the air tunnels, and the air is admitted through gates opening directly into the top of the ash hoppers under the center of the bridge wall.

The gases of combustion escape down back of the rear headers, which are protected from them by a removable sheet-iron screen, through dampers set in holes in the roof of the flue. The smoke-flues are 10 feet in height by 6 feet in width, arched and cross-arched with an air space between to avoid overheating the floor of the engine and boiler room under which they pass on the way to the chimneys. The two chimneys measure 6 feet one way and 8 feet the other, and have a height of 135 feet above the grates. A lining of thin cast-iron plates for the first 25 feet in height protects the chimney shell at the uptake.

The chimneys have an area of 40 square feet; the smoke-flues, which are tapered by giving the floor of the flue a pitch toward the stack, have an area at their greatest section of 60 square feet. This excess of area was given to allow for the deposit of flue ashes on the floor of the flue, and for drifts of ashes which were liable to form at the turns. As a matter of fact, during the first season's run a drift 3 feet in height formed, and had thus cut down the area at that point to 42 feet.

There is a large pipe-chase built clear to the roof next each chimney shaft; that on the east side being for the free-exhaust riser and its return drip, and that on the west side to contain the twin standpipes for the water system. The chases are of sufficient size to allow for lowering a man to make or unmake the flange joints in these lines.

The feedwater and blow-off mains run through the ash tunnels, and are visible and accessible throughout their length. The blow-off line and its connections are of heavy cast iron, and the feed line of drawn brass. During the

winter season the boiler feed is served from the return and low-pressure drip-tanks, and is sent through a horizontal Wainwright heater. When the weather is warm and the exhaust is being wasted, the boiler feed is taken from the swimming-pool under the gymnasium directly through the feed heater. The pool contains 250,000 gallons of water that has been first run through two tandem filters to cleanse it, and then brought to a temperature of 70 degrees Fahr. in a heater. The feed losses during the winter season are made up from the same source. This scheme prevents the waste of either heat or water, and secures not only a constant change of water in the pool, but clear water for the boilers.

The engines and generators are divided into six units as follows: One 24 by 48-inch, 600 horse-power, simple Corliss engine, driving a 400-kilowatt generator at 90 revolutions per minute; two 20 by 42-inch 300 horse-power simple Corliss engines, driving 200-kilowatt generators at 100 revolutions per minute; two 11½ by 16½ by 12-inch cross-compound, high-speed engines, driving 75-kilowatt generators at 260 revolutions per minute; one 50 horse-power gas engine, driving a 30-kilowatt generator. All engines to be direct connected to their generators.

The larger engines were intended to bear the heat and burden of the day during term from eight in the morning until seven at night, the high-speed cross-compounds to take care of the light loads in the early morning and after seven at night, and the gas engine was to be put in to furnish the comparatively small amount of current called for during the summer vacation, and allow for shutting down the boilers entirely for three months in the year.

The Corliss engines were designed by Mr. Edwin Reynolds, of the E. P. Allis Company. Each flywheel is 12 feet in diameter and weighs 15 tons; the body of the wheel was cast in one piece with the hub parted to allow for shrinkage in the arms. After the rim had been faced off on both sides, four layers of mild steel segmental plates having a total thickness of 3¼ inches were laid up on each side, with joints staggered, two inch holes drilled through and countersunk, and turned soft-steel pins driven through and riveted cold. When this operation was completed the wheel was placed on the boring mill, the rim finished all over and the hub bored to gauge.

An additional safeguard against the danger from a racing engine, in the form of automatic stop-valves above the throttles of the engines, was provided.

The high-speed cross-compounds were built by the Armington & Sims Company.

At the solicitation of the writer, Prof. F. B. Croker, past president of the American Institute of Electrical Engineers, consented to write specifications for generators that would stall the engines before they could burn out the armatures or cause a sputter at the commutator. After securing competitive bids from some of the leading makers, the contract was awarded to the lowest bidders, the Crocker-Wheeler Company.

One of the most troublesome problems encountered in putting heavy machinery under a building that is devoted to uses entirely foreign to the generation of power, is to get rid of the annoyance caused through the transmission of vibration by the bearing walls and piping. This becomes especially difficult where the foundation rests on bedrock, as in the present instance.

It seemed to us that the best way to avoid giving annoyance was to unite all the engine foundations on a single block of masonry, cut clear of the building foundations, of sufficient mass to absorb the vibrations before they reached the level on which the building foundations stood.

In order to baffle the vibrations that might travel across the arches over the smoke-flue, we laid up soft pine planking on edge against the wall to the depth of the arching, and finished the floor up against it. While this lasts it forms a deadener, and when it rots it will leave an air-space.

To prepare the foundation block for the engines, the entire area was cleaned of all loose or rotten rock, the wheel pits and exhaust trenches were laid up in brick to the working level, and the iron conduits set in place for the feeder mains from the generators to the switchboard. The whole area was then brought up to the working level with Portland cement concrete, and the surface floated off.

After the mass had hardened sufficiently to admit of drilling, the templates for the different engines were laid down and the holes for the anchor-bolts marked out. The holes were cut with a steam rock-drill, and were made an inch larger than the bolts they were to receive. Those for the larger engines were sent down 10 feet, and for the smaller engines 4 feet.

The bolts, which had been roughed by the blacksmith all the way down the shank, were then dropped into the holes, and the engines were set up without any of the usual cramping and fidgeting caused by set anchor-bolts, as the bolts were free to wobble about and accommodate themselves to the inevitable variations from template that occur in a rough bedplate. After getting the engines to fair and true level by means of stake wedges the bolts were given a full nut, the holes grouted to the brim with Dyckerhoff cement, and the joints finally rusted.

A 16-inch header, in the form of a flattened ring, runs around the outside of the boilers, and rests on roller bearings that are carried by the gallery. The boilers feed into the inside of the ring, and the engines and distributing lines connect directly to the outside of it, the connections to both engines and boilers being single, straight-away, long-turn bends. The angles at the turns of the header are formed of steel castings.

A 14-inch exhaust main runs in a trench straight across the engine room floor. To allow for movement in the rigid connection which this forms between the engines, an expansion joint is placed in the center of the line and a screw joint was made to the exhaust nozzle of the Corlisses on the end. Just outside the engine to the south the main rises to the level of the library tunnel and continues along it, full size, to the heating stacks of that building.

There are separate systems for the high-pressure and low-pressure drips; the high-pressure being sent back directly to the boilers, and the low-pressure returned through the return tank and feed heater with the regular feed. The high-pressure lines were to be dripped at every fitting on horizontal runs.

Our specifications and drawing called for flanged connections on all pipe over 3-inch; for outside screw and yoke Chapman gate valves on all sizes over 3-inch; for long-turn elbows whatever possible; galvanized pipe and fittings for cold-water lines, drawn brass (iron-pipe sizes) for feed lines, and cast-iron for blow-off lines. A choice between John's asbestos and Keasbey's magnesia was allowed for pipe-covering.

Two 9 by 5¼ by 10-inch duplex pumps alternate in the service of the boiler feed. Two 8 and 12-inch by 10¼ by 10-inch compound duplexes controlled by pressure regulators take care of all the water supply, with the exception of the fountains in the south court, which are to be operated by a 300-gallons-per-minute electric pump placed in the basement of the Library building. A 6-inch Croton line was run across through the coal vaults, and connected on the one end to the city main in Amsterdam avenue, and to the main in Broadway on the other end, both ends being kept open to prevent stagnation. The water flows through the filters, under street pressure, into the suction tanks of the house pumps. Next in line are two 14 and 20-inch by 10¼ by 10-inch elevator pumps, which operate three elevators in university hall. The elevators in all the other buildings are electric, with the exception of the Otis experimental elevator in the engineering building.

A 20 by 12 by 10-inch fire pump, figured to throw 1,000 gallons per minute, delivers directly into the house mains and risers of the inside buildings, these lines being made unusually large on this account. The suction tank for the fire pump is the swimming-pool aforementioned. This pump is used for emptying the pool into the sewer every two weeks.

Compressed air is distributed to the buildings where it is needed from a Rand compound compressor, with steam cylinders 9 and 13 inches, a stroke of 13 inches and air cylinders 12 inches in diameter. A 9 by 12 by 10-inch wet vacuum pump runs all day long to serve the requirements in that line of the chemists and physicists in their lecture-rooms and laboratories. In Havemeyer Hall alone there are over 6,000 outlets and connections for water, compressed air, gas and vacuum.

The switchboard is divided into three panels; the central panel carrying the generator switches, circuit breakers, and instruments, one of the side panels carrying the power connections for the buildings, and the other the light connections.

The whole board is forty feet in length, and was designed by Mr. Mailloux, to cover the entire group of twenty buildings, without disturbing the bus-bars and switches for the buildings first erected, as buildings are added from time to time.

Although the generators ordinarily carry the light and power load together, the circuits are kept separate throughout, and, with the steady load furnished by the ventilator motors, the throwing on and off of elevator and shop motors does not interfere with the regulation to any appreciable extent.

Whenever there is a tendency to jump big loads on and off the circuit we have put circuit breakers in the power lines, where they will localize the annoyances.

The feeder mains terminate at local switchboards in the basement of each of the buildings, which divide the circuits by floors, and panel boards in the hallway on each floor subdivide the service to the separate rooms. This method of distribution gives local control of the circuit in so far as it is practicable and makes the operation of lines a comparatively simple matter. Every switch or cut-out is lettered or numbered to correspond with a schedule or diagram posted beside each board. From the main switchboard to the branch boards the feeder-main cables are carried by segmental porcelain blocks, fitted into steel trellis frames which are hung under the power-house gallery or bolted to the side walls of the tunnels. Over 65 tons of copper were put into the mains for the buildings now in use.

In addition to the wiring for light and power, there are complete interconnecting systems for telephone, electric clock, and signal bells, and for the watchmen's patrol record within the buildings. These wires are run in iron conduits like the light and power circuits, and connect in the tunnels to lead-covered cables.

A log is kept covering every day in the year, giving for each week the total hours' run of each unit, and the output, together with averages and the consumption of coal, water, and supplies and the cost of labor and repairs charged against the power-house. To operate the plant as it stands to-day, during the winter months we employ the following force:

A chief engineer, two assistant engineers, two oilers, one dynamo tender, three heating-service men, one electrician, one machinist, four firemen, two coal passers, and one helper. The heating-service men patrol the heating and ventilating plant in the different buildings at regular intervals day and night during cold weather; and considering the fact that there are in all, so far, 22 motors and fans ranging

from 10 to 50 horse-power each, 21 return pumps, and an aggregate of 80,000 square feet of heating coils and radiators scattered throughout the building, it will be seen that they are kept pretty busy. The electrician attends to keeping all electric conduits and fixtures in order, and is allowed extra help as occasion demands.

The power-house force stands two 12-hour watches during the winter months, when steam is kept on day and night.

During the season when light and power alone are required and the force is reduced, the day men report at 7 and leave at 6, and the night men report at 12.30 and leave at 11.30 when the Library has closed for the night. By this arrangement the entire force is on duty during the afternoon when the load is heaviest.

We estimate that when our ventilating system is in full operation we use 50 per cent. more fuel than when we are simply heating the buildings and allowing the heated air to escape by natural draught though the flues and doors. In no part of any building do we give less than six changes of air per hour, and in some lecture-rooms and laboratories as many as twelve changes per hour. More current is used for driving the ventilation fans than is used for light, and the ventilating apparatus is run continuously during the time when the lecture-rooms and laboratories are in use. When all the fans are running they will move 1,250,000 cubic feet of air through the buildings every minute.

For all purposes, we burn at the present time about $13,000 worth of fuel per annum with a labor account chargeable to heat, light and power of $10,000 per annum, or at the ratio of 1 to 1.3. Ultimately we expect to have to spend not less than $25,000 a year for fuel and to increase our labor account to $15,000 a year, which will then give a ratio of labor to fuel of 1 to 1.66.

The complete power plant and its connections, exclusive of structural work or excavations, represents an investment of $200,000, or at the rate of $50 per horse-power. That part of university hall occupied by the power-house, including the coal vaults and tunnels, cost $350,000. The heating and ventilating equipment and the electric wiring of the entire group will foot up to $550,000. This makes a total of $1,100,000 for the complete engineering equipment, exclusive of drainage and plumbing. The entire improvement is estimated to cost $12,000,000, including the cost of the land. From the figures given above it will be noted that the engineering equipment represents about 10 per cent. of the total investment.

COMPARATIVE TESTS ON BITUMINOUS STEAM COALS.

A number of tests of the relative evaporative power of different grades of certain West Virginia, Pittsburg, Ohio and Kentucky coals, the results of which will be of very great value to steam users in the eastern section of the United States, were described in a paper presented last week before the American Society of Civil Engineers by Mr. John W. Hill of Cincinnati, Ohio. The tests were made by the author for the Cincinnati water-works and comprised an evaporative trial, a determination of the heat value by a Carpenter calorimeter, and the proximate analysis, that is, the percentage of fixed carbon, volatile matter, moisture and ash, of each coal.

It is greatly to be regretted that the demand for steam at the Cincinnati water-works was such that the boilers could not be operated under more economical conditions. Although the author's results show the relative value of the coals under the conditions of the tests, they do not show what might have been expected from each coal had the evaporation per unit of boiler surface been best suited to obtain the highest economy. In all probability the results obtained are about in the same relative proportion to what they would have been had the rate of evaporation been more favorable. The evaporation per square foot of heating surface, about 5¼ pounds on an average, almost double what it should have been to secure the best economy, resulted in the passage of a large percentage of the heat in the fuel up the chimney. The flue temperature, it should be said, serves to show in a measure what might have been expected from each coal, had it been tested under the best conditions. It has been found that the best economy with the grade of coals tested by the author is secured when the flue temperature is about 450 degrees Fahr., and that each rise of 100 degrees in temperature above this temperature represents a loss of about 6 per cent. If, therefore, the flue temperature in any test, and they are given in a subsequent table, should be 650 degrees, it would be safe to say that the coal used in that test could have given a better result by 12 per cent. had the conditions been more favorable. A low flue temperature does not always mean high economy, however, as air leakage through the setting of the boilers or through improperly covered grates, may bring this about.

The boilers in which the tests were made were of the Galloway type and were built by the Edge Moor Iron Company. The shell was 7 feet in diameter and 28 feet long and contained a nearly round flue about 3 feet in diameter and of the same length as the boiler. The heating surface in each boiler was 995.3 square feet, the grate surface 36.2 square feet and their ratio 27.5 to 1. The chimney was 48 inches in diameter and 70 feet high.

Previous to each test the boilers were fired with the coal to be tested for two hours; the test was then commenced and lasted 16 hours. The grates were cleaned at regular intervals and the firemen were required to be attentive, without exceeding the care which should prevail at all times. The water was supplied to the boilers through a pair of 3-inch hot-water Worthington meters, made for the purpose, which were calibrated at short intervals. The tests were made with the boilers in ordinary condition, and at the end of each series of three or four tests, the boilers were opened and all loose material washed out. A feed-water heater intercepted the mud. To determine the effect of cleaning, the boilers were opened after one of the tests and the small amount of scale found was carefully scraped off of the surface of the metal. Upon testing the boilers again with the same coal the difference between the boiler performance with carefully cleaned surfaces and with the boilers in ordinary condition was 2½ per cent.

Fifty-four samples of coal were tested. The Pennsylvania (Pittsburg) coals were as follows: Four samples from the Brown Mines, Nos. 10 and 11, Second Pool, Monongahela River. Four samples from the Catsburg Mine, No. 47, Third Pool, Monongahela River. Two samples from the Cincinnati mines, Third Pool, Monongahela River. Four samples from the Woods Mine, No. 75, Fourth Pool, Monongahela River.

The accompanying table, compiled from several tables given by the author, shows the general results of the evaporative trials.

Economic and Capacity Results.

Kind of coal.	Steam from and at 212° Fahr. Per pound of coal.	Steam from and at 212° Fahr. Per pound of combustible	Steam per square foot of heating surface per hour.	Coal per square foot of grate surface per hour.	Temperature of waste gases.	Efficiency on Coal.	Efficiency on Combustible.
Pennsylvania Coals.	Pounds	Pounds	Pounds	Pounds	Deg. F.		
Pittsburg, Brown, Second Pool, Lump	9.004	9.537	5.397	17.408	645	0.6500	0.6406
" " " Barge Run	9.064	9.642	5.398	17.297	603	0.6542	0.6477
" " " Mine Run	8.424	9.251	5.358	18.484	647	0.6081	0.6214
" " " Nut and Slack.	8.439	9.241	5.413	18.666	609	0.6091	0.6207
Pittsburg, Catsburg, Third Pool, Lump	9.227	9.868	5.317	16.783	675	0.6629	0.6658
" " " Barge Run	8.790	9.459	5.419	17.960	736	0.6315	0.6382
" " " Mine Run.	8.521	9.364	5.391	18.426	733	0.6122	0.6318
" " " Nut and Slack	8.227	9.143	5.334	18.839	707	0.5910	0.6169
Pittsburg, Cincinnati, Third Pool, Mine Run	8.673	9.237	5.362	17.990	654	0.6325	0.6357
" " " Nut and Slack	8.672	9.344	5.391	18.061	631	0.6324	0.6431
Pittsburg, Woods, Fourth Pool, Lump	8.735	9.648	5.375	17.875	682	0.6337	0.6557
" " " Barge Run	8.519	9.426	5.398	18.432	679	0.6180	0.6406
" " " Mine Run	8.933	9.903	5.407	17.593	656	0.6480	0.6731
" " " Nut and Slack	8.452	9.426	5.377	18.468	661	0.6131	0.6406
West Virginia Coals.							
New River, Lump	9.186	9.879	5.400	17.149	622	0.6019	0.6056
" Lump	9.707	10.143	5.333	15.590	606	0.6361	0.6218
" Mine Run	9.834	10.771	5.319	15.794	631	0.6444	0.6603
" Mine Run	9.572	10.005	5.477	16.811	521	0.6272	0.6134
Loup Creek, Lump	10.215	10.633	5.567	15.837	637	0.6589	0.6698
" Mine Run	8.759	9.130	5.434	18.048	718	0.5650	0.5751
" Slack	8.776	9.216	5.216	17.272	637	0.5661	0.5805
Pocahontas, Lump	9.958	10.603	5.353	15.645	625	0.6357	0.6627
" Mine Run	9.423	10.133	5.262	16.247	632	0.6015	0.6333
Kanawha, Steam Lump	9.280	9.943	5.335	16.914	707	0.5912	0.6136
" Gas Lump	8.620	9.854	5.340	18.262	696	0.5519	0.6165
Acme, Mine Run	9.566	10.185	5.454	16.613	545	0.6086	0.6311
" Nut and Slack	9.066	9.935	5.499	17.623	559	0.5768	0.6156
Keystone, Mine Run	8.818	9.688	5.472	18.118	566	0.6162	0.6058
Winifrede, Lump	9.211	9.908	5.398	17.041	541	0.6306	0.6514
" Mine Run	8.591	9.110	5.369	18.181	601	0.5881	0.5989
" Nut and Slack	8.341	9.583	5.486	19.144	575	0.5710	0.6300
Thacker, Lump	9.464	10.011	5.441	16.756	544	0.6294	0.6217
" Mine Run	9.392	10.132	5.599	17.329	567	0.6246	0.6293
" Mine Run	9.521	10.129	5.482	16.677	456	0.6332	0.6291
" Nut and Slack	9.040	10.124	5.460	17.533	589	0.6012	0.6288
Logan Consolidated, Thacker, Mine Run	9.158	9.804	5.341	16.944	590	0.6210	0.6327
Maritime, Thacker, Mine Run	9.264	9.679	5.453	17.137	568	0.6335	0.6230
Campbell's Creek, Mine Run	8.924	9.659	5.466	17.812	589	0.6079	0.6309
" " Nut and Slack	7.899	8.689	5.364	19.744	646	0.5381	0.5676
Monongah, Mine Run	8.939	9.582	5.423	17.679	548	0.6062	0.6162
Eagle, Mine Run	9.044	9.874	5.202	16.667	436	0.6223	0.6522
Cedar Grove, Mine Run	9.365	9.841	5.177	16.052	531	0.6168	0.6164
Mount Carbon, Mine Run	8.920	9.576	5.152	16.802	549	0.6171	0.6267
Chesapeake, Mine Run	8.816	9.326	5.122	16.942	539	0.6370	0.6396
Coalburg, Mine Run	8.742	9.406	5.062	16.839	551	0.6128	0.6187
Belmont Splint, Mine Run	8.730	9.485	5.488	18.278	570	0.6513	0.6909
" " Nut and Slack	8.152	9.273	5.438	19.437	585	0.6081	0.6754
Ohio Coals.							
Luhrig, Washed Egg	7.820	8.404	5.373	20.037	565	0.5829	0.5655
Luhrig, Washed Slack	7.275	7.667	5.304	21.186	612	0.5423	0.5159
Wellston Shaft, Mine Run	8.053	8.301	5.321	19.209	650	0.6220	0.5695
Wellston Shaft, Nut and Slack	7.570	7.943	5.274	20.265	652	0.5847	0.5450
Kentucky Coals.							
Jellico, Mine Run	9.115	9.431	5.485	17.509	613	0.6084	0.6123
Jellico, Nut and Slack	7.779	8.695	5.340	19.991	581	0.5192	0.5645
Tennessee Coal.							
Jellico, Mine Run	8.719	9.001	5.484	18.255	633	0.6083	0.6081

With the Pennsylvania coal it appeared, the author states, that there was no superiority of lump over barge run coal, while mine run and nut and slack were less than 6½ per cent. inferior in economy to lump coal; and nut and slack coal for steam purposes, at the prices usually asked, was superior to lump coal by 26.20 per cent.; or while one dollar's worth of Second Pool lump coal furnished 10,290 pounds of steam, one dollar's worth of nut and slack coal furnished 12,983 pounds of steam, and one dollar's worth of mine run coal furnished 11,232 pounds of steam.

The relative value of the different grades of coal from each mine are as follows:

	Second Pool.	Third Pool.	Fourth Pool.
Lump	100	100	100
Barge Run	100.6	92.3	97.5
Mine Run	93.5	93.1	102.2
Nut and Slack	93.7	92.1	96.7

An examination of the Pennsylvania coals shows two things, continued the author:

First. That the opinion hitherto generally accepted as to Second Pool, Monongahela River coal being markedly superior to the coals obtained from the newer Pittsburg mines farther up the river, is not sustained by the results of these tests.

Second. That the prices usually asked for the higher grades of these coals are not warranted for steam purposes; that mine run and nut and slack coals are by far the most economical coals, and that they can be sold upon narrower discounts from lump coal prices and still be the most profitable to buyers of steam coals.

Referring briefly to the economic results per pound of combustible, it will be noticed that there is greater uniformity among all these coals in the steam per pound of combustible, without regard to the mines or grades, than in the steam per pound of coal, and this naturally is due to the fact that the lower grades contain just as good coal as lump, but carry more waste matter from the slate and stone loosened in mining from the roof and floor of the galleries, which in lump coal is presumed to be removed when it is run over the screen at the mouth of the mine, and by the use of finer screens often goes into the cargoes of low-grade coals, and is purchased as so much coal by the buyer. Assuming no more non-combustible matter in the mine run than in the lump coal, such coal for steam purposes should always be equal to lump, provided the grates upon which it is burned are suitable to retain the smaller and finer particles until coking occurs, or in the non-coking coals, until combustion is completed.

A review of the Pittsburg coals indicates that they should be rated as of equal quality, whether obtained from the older mines in the Second Pool or from the newer mines in the Fourth Pool.

A hasty glance at the table of economic results obtained with the West Virginia coals will show that nearly all the samples should be ranked higher than Pittsburg coals. Thus the average weight of steam per pound of coal for all the Pittsburg coals was 8.69 pounds, an economy which is reached or excelled by all except five samples of West Virginia coals. Heretofore, in the western river markets, Pittsburg coal from the Second Pool has been the accepted standard, and for years prices and guarantees have been based on this coal.

The author groups the West Virginia coals into two classes, the first containing coals distinctly superior to Pittsburg, and the second all the other coals tested. These are:

Samples of Coals.	Steam from and at 212° Fahr. Per pound of coal. Pounds.	Per pound of combustible. Pounds.
Pittsburg coals (average..	8.69	9.46
First-class, West Virginia coals:		
New River, Loup Creek (MacDonald Mine), Pocahontas, Kanawha Steam, Acme, Thacker, and Cedar Grove coals (average)	9.51	10.16
Second-class, West Virginia coals:		
Loup Creek (Dunn Loup Mine), Kanawha Gas, Keystone, Winifrede, Logan Consolidated Thacker, Maritime Thacker, Campbell's Creek, Monongah, Eagle, Mt. Carbon, Chesapeake, Coalburg and Belmont Splint coals (average)	8.76	9.49

The Ohio, Kentucky and Tennessee coals were not equal to the West Virginia and Pittsburg coals, except Jellico, Ky., coal, which compared favorably with the second-class West Virginia coals.

The accompanying table shows the results of tests made to determine the heat values of the

Heating Power of Coals in British Thermal Units, and Proximate Analysis.

Kind of Coal.	Heat units per pound of coal.	Ash by calorimeter.	Specific gravity.	Moisture.	Volatile matter.	Fixed carbon.	Ash
Pennslyvania (Pittsburg) Coals.							
Pittsburg Brown, Second Pool	13 383	5.77	1.317	1.17	26.93	68.15	3.75
" Catsburg, Third Pool	13 446	5.46	1.291	0.76	33.04	60.70	5.50
" Cincinnati, Third Pool	13 247	4.64	1.295	0.98	33.37	61.60	4.05
" Woods, Fourth Pool	13 316	5.66	1.292	0.65	31.95	61.80	5.60
West Virginia Coals.							
New River (old sample)	14 742	1.40	1.270	0.50	17.85	80.20	1.45
" (new sample)	15 163	2.87	1.270	0.90	18.60	78.10	2.40
Loup Creek (old sample)	14 137	4.17	1.275	0.55	19.25	78.05	2.15
" (new sample)	14 975	1.20	1.275	1.15	19.15	78.75	0.95
Pocahontas (old sample)	14 048	4.23	1.277	0.45	14.95	80.60	4.00
" (new sample)	15 133	1.57	1.277	0.52	18.80	79.43	1.25
Kanawha, Steam	15 163	2.33	1.277	0.80	31.28	65.82	2.10
" Gas	15 088	1.33	1.261	0.95	37.35	57.95	3.75
Acme	15 184	1.60	1.273	1.00	31.50	65.40	2.10
Keystone	13 824	9.73	1.306	0.78	28.92	62.00	8.30
Winifrede	14 111	2.91	1.297	1.05	32.40	63.70	2.85
Thacker	14 526	5.88	1.324	0.73	31.32	62.95	5.00
Logan Consolidated Thacker	14 245	4.13	1.309	0.70	32.60	62.85	3.85
Maritime Thacker	14 126	5.20	1.301	0.68	31.67	63.05	4.60
Campbell's Creek	14 180	3.17	1.278	0.95	38.00	58.15	2.90
Monongah	14 245	3.04	1.282	1.05	33.15	62.50	3.30
Eagle	14 040	3.00	1.268	1.00	30.53	65.87	2.60
Cedar Grove	14 668	3.97	1.308	0.92	35.35	60.26	3.47
Mt. Carbon	13 964	4.67	1.266	0.73	31.87	63.07	4.33
Chesapeake	13 370	3.93	1.274	1.15	34.28	61.30	3.27
Coalburg	13 781	5.26	1.289	0.90	38.17	56.00	4.93
Belmont Splint	12 949	1.08	1.269	1.28	34.22	63.30	1.20
Ohio Coals.							
Luhrig, Washed	12 960	6.86	1.306	2.87	33.47	56.76	6.90
Wellston, Shaft	12 506	7.80	1.293	3.38	34.07	55.25	7.30
Kentucky Coal.							
Jellico	14 472	1.06	1.273	1.68	36.62	60.85	0.85
Tennessee Coal.							
Jellico	13 846	1.37	1.275	1.80	36.10	61.00	1.16

coals by the Carpenter Calorimeter, also the proximate analysis of each coal.

THE EQUIPMENT OF TALL OFFICE BUILDINGS IN NEW YORK CITY.

Some interesting observations in regard to the mechanical equipment of tall buildings and the financial problems involved, were made in a paper presented before the American Society of Mechanical Engineers at Washington during the past week, by Mr. Reginald Pelham Bolton. The cost of desirably located sites, he said, has been greatly on the increase during recent years and in certain advantageous positions has reached as high a figure as $300 per square foot in New York. An average value of sites for such buildings as are under discussion would now be $150 per square foot. A recent purchase of 1,736 square feet of ground by the Stock Exchange on Broad Street is at the rate of $244 per square foot, while an extreme was reached by the price of $330 per square foot paid in 1882 for a very desirable corner site in the same neighborhood.

Illustrating the relative increase of value obtained by height, the author said that the four and five-story buildings occupying the site of the present German-American building represented a renting area of not more than 6,000 square feet per floor, which at the old rates of about $3 per square foot per annum may have produced a gross rental of as much as $70,000 per annum when filled, but even this represented only 6 per cent. on the real value of the land alone. The new building has a net renting area of about 7,000 square feet per floor, producing on fourteen upper floors, even at the low average of $1.60 per square foot, $156,000, in addition to which are two large ground-floor banking parlors producing about $17,000 and $12,000 per annum respectively, also a basement restaurant bringing in $3,000, or a gross return of $188,000 per annum, an increase of two and a half times as much as the old buildings. On a cost for building and equipment of $650,000, and of land $937,000, or $1,587,000 in all, a gross return of nearly 12 per cent. is thus attained. The cost of management, operation of equipment and city taxes naturally form a large increase on the same items in the old buildings, but under good management and economy do not exceed 50 per cent. of the gross rental. It will be evident that the economical operation of the equipment forms a decided factor in the net balance available for interest.

As a mortgage can be placed on such a building and land for six-tenths of its value at a rate not exceeding 4 per cent., the net return on the actual capital sunk in such a building may be very high, nevertheless wasteful appliances and accompanying cost of management reduce the return in many instances down to 3 per cent.

Mr. Bolton gives the following details in regard to several buildings equipped in accordance with his plans; all but the last are warmed by the Webster system.

Name of Building.	No of stories.	Cubic feet contents.	Number Elevators.	Car miles per hr.	No. Lights.	H. P. Boilers.
Bowling Green	16	5,000,000	9 Hyd.	14-20	6,200	720
Lords Court		3,000,000	5 Elec.	9½	4,000	420
Central Bank	16	1,980,000	5 Hyd.	11	3,800	[illegible]
German-Amer.	15	1,400,000	5 Elec.	11	2,800	320
Hudson	16	1,500,000	4 Hyd.	8	3,000	[illegible]
R. G. Dun	15	1,200,000	6 Elec.	16	4,500	600

All of the buildings but the last mentioned were stated to be provided with a spare boiler.

The cost of average steel-framed 16-story office buildings, complete with equipment and inclusive of a moderate amount of decorative outside treatment in stone machine mouldings or in terra cotta, without hand stone-carving, is 36 to 40 cents per cubic foot of its gross cubic content, outside measurement. The excessively high buildings cost more, also those with expensive adornments. The relative cost of the mechanical appliances, including power, elevators, heat, light and sanitation, is approximately one-seventh of the above. The total cost of mechanical appliances in a building of 16 stories, basement and sub-basement, say 6,000 square feet renting area per floor, was $82,000.

Or in detail:

	Cost.
Chimney	$1,200 to $2,500
Boiler plant	9,000 to 11,000
Four to six elevator plant	28,000 to 40,000
Heating appliances and piping	14,000 to 17,000
Electric wiring and switchboard	9,000 to 15,000
Engines and generators	8,000 to 10,000
Sanitation and fixtures	12,000 to 15,000

The effect of an increase in the cost of these appliances, if the same be productive of economy and advantage in operation, is very much less in proportion than its importance to the owner. For instance, the difference in the above comparative costs would amount to $26,000, say 4½ per cent. on gross cost of building, which would represent fully 50 per cent. more convenience and the best appliances for economy throughout. It has, however, been difficult at times to induce owners to spend on economical appliances a small fraction of the sum laid out on non-remunerative outside or interior adornment.

The difference between a compound and a triple-expansion pump may be say $1,500, and be begrudged, while the difference between marble trim and other substitutes in the hall will be $15,000 and be freely expended.

These are difficulties met by engineers everywhere, yet in no case do they appear so forcibly. It is satisfactory to relate that such instances have been rather due to the present faulty system of letting general contracts inclusive of machinery than to the owners' shortsightedness as regards the advantage offered.

The value of office buildings to the business

community is based on the improvements they offer, which are chiefly of a mechanical character, and further examination of the requirements will make it evident that the importance of the mechanical equipment considerably outweighs the value of any architectural features.

In laying out the arrangements for form of the buildings mentioned the guiding consideration has been to so locate the boilers that the fire room will have a natural supply of light and air, and shall be readily accessible from the engine room. The author departed in each instance from the practice of placing the boilers under the sidewalk, and has preferred even so long a flue as that in the Bowling Green Building, which is 240 feet in length, to a less advantageous position for the fire room. It must be recorded that the location of the chimney is usually fixed beforehand by the architect.

The disposition of the main engines and pumps is chiefly decided by the position of the foundations of columns, and the necessity of access and repair. The arrangement of auxiliary pumps is such that they shall be so readily reached by the fireman that it shall be unnecessary for the engineer to stand by them at all times. This also enables the engineer, at certain hours of light duty, to attend to the firing.

The relative position of the coal storage to the fireroom is of less consequence than its proportions. The fireman may easily attend to his own coal passing if provided with a track. But unless the coal storage is large, a coal trimmer must be kept to receive the daily supply. Trimming in the store costs, in certain buildings, five to fifteen cents per ton. Such a large storage as the Bowling Green, which can contain 420 tons, has been found of advantage in reducing the price of fuel about ten cents per ton, as it is not required to be delivered at any particular hour.

Buildings on Broadway are not permitted to receive coal or remove ashes and paper during certain hours, and consequently have to pay more for each convenience. The cost of removal of ashes under such conditions is 65 cents per truck load, but where the ash cans can be taken at any time, as on a rear street, the city removes without cost.

A considerable variety and extent of labor is required in office buildings, and may be reduced by carefully planned arrangements and appliances.

The general superintendence is commonly delegated to a renting agent, who is paid by a percentage of 3 to 5 per cent. on the rentals received. The actual duty of superintendence then falls on an employe who has, generally, a number of such buildings in charge, which are therefore largely left to the mercy of the janitors. A better method is followed in some buildings by the addition of the duty to that of the chief engineer, when much closer supervision over details of operation is possible.

The rates of wages per week are as follows in an average 16-story building:

One janitor, without residence	$15
One doorman, or hall porter	$10 to 12
One car starter, with uniform	12 to 14
Four to six elevator boys, with uniform	10 to 12
Three window cleaners	8 to 10
One toilet cleaner	8 to 10
Twenty to thirty scrubwomen (5 to 9 p.m., 6 to 9 a. m.)	6 to 8
One watchman	10

and the following in the engineering department:

One chief engineer	$25 to $31.50
One assistant engineer	20 to 22
One electric-elevator man	20
One electrician	18 to 20
One night engineer	15
One leading fireman	16
One assistant, or night fireman	13 to 14
One coal passer and ashman	12
One oiler	12

The electric supply of the illuminating companies forms the most serious competitor with an independent plant. At present prices for power the nominal rate is 10 cents per horse-power-hour by meter, and users of large quantities can scale this rate down to as low as 4 cents per electrical horse-power-hour on a use of 10,000 horse-power-hours per annum, with a still further reduction of about one-half cent if a storage battery be adopted.

But although the offer is of a temptingly simple and apparently advantageous character, a still further reduction in rates is required before the supply can compete with the results of a really economical independent plant.

At the time of the establishment of the Bowling Green Building a careful computation showed, at the net price for lighting current of 8 cents per kilowatt-hour, including lamp renewals, and at the then price for elevator power of 7 cents per kilowatt-hour, an advantage in favor of an independent plant exceeding $5,000 per annum. The results of operation have shown a still larger advantage, as the plant was debited with the services of an engine room staff of nine men, whereas it is now operated by only five hands.

The item which largely operates in this comparison is the utilization of exhaust steam in house heating for the 100 or 120 days of cold weather.

The cost of a horse-power-hour for power, oil and repairs, generated by an independent plant, may be, with economic arrangements, as low as 2.4 cents, and a fair figure, inclusive of interest and depreciation, is 2.8 cents; adding one-half share of all engineering labor, which is more than its due, a covering figure is 3.8 cents.

THE HEATING PLANT OF THE UNIVERSITY OF WISCONSIN.

A paper was presented to the American Society of Mechanical Engineers at the recent Washington meeting by Prof. Storm Bull, on the central heating plant of the University of Wisconsin, Madison, Wis. Its development with the growth of the University was outlined, and it was shown that various conditions which had from time to time restricted any extended designs for the plant, prevented it being a model one, however interesting otherwise.

The author said in part: "The principal difficulty met with in laying out the central heating plant of the University of Wisconsin was that a boiler house already existed, from which power and heat were furnished for three adjacent buildings. The location of this boiler house was hardly the best one even for these three buildings, but when it was determined by the authorities to heat all the buildings from a central plant, it was at once seen that the location was a bad one for several of the buildings. But so much money had already been expended on the boiler house, together with the chimney, that it was determined by the Regents of the University, in 1894, that the old boiler house should be merged and remodeled so that all the buildings at the University—except those of the agricultural department—could be heated from it. The various buildings are located on the slope of a hill, rising from Lake Mendota, the boiler-house being about one-third way up, so that several of the buildings are on a lower level than it. The proper location for the boiler-house would have been on the lake shore, both because all return water from the several buildings could have been returned by gravity, and also because of the hauling of the coal and the disposal of the ashes."

The original boiler-house was a square building about 50 feet each way, and in order that the three buildings might be heated from it, the floor had been sunk about 13 feet below the surface of the ground. When the change to the larger plant was authorized the boiler-house was already connected by tunnels to four buildings and had five boilers of various types furnishing steam for an engine in the machine shop and for pumps in the pump-house at the lake shore, as well as for heating purposes. The author said that the old boiler-house had to be enlarged to such an extent that there would be room for boilers sufficient to furnish steam for three additional buildings, of which one especially was quite large. In addition it was determined to make the new boiler-house so much larger that it might house several more boilers, so that other buildings might be heated from it in the future. One wall of the building was removed, the roof being carried on columns, and the coal vault was placed on the opposite side of the building to what it was before, because of the greater convenience of hauling coal. For the same reason it was placed below ground, bringing the floor of the coal vault on the same level as the floor of the boiler-house. Two buildings were subsequently added, both times an additional boiler being installed, and at the present time there are eleven boilers, representing 1,160 horse-power, with room for a boiler of 200 horse-power capacity. One of the boilers is used for experimental purposes and all are equipped with Roney stokers.

One of the reasons for determining on the installation of a central heating plant, the author said, was that it would be possible to use bituminous coal instead of anthracite, as was being used in the separate buildings, and without suffering from the smoke and dirt to such an extent at least as would have been the case if bituminous coal had been used for heating the separate buildings. "A thorough investigation of the smoke question soon convinced the writer that several of the mechanical stokers besides the Hawley down-draft and other arrangements, will, if properly taken care of, and if the boilers are not forced much, produce a fire which is reasonably free from smoke. The writer determined on the use of a mechanical stoker; and coal-conveying machinery with coal-storage tanks above the boilers was also made an essential part of the program. As the floor of the boiler-house was some 13 feet below the surface of the ground, an ash elevator was also a necessity. A track with an ash dump-cart was determined upon in the place of a conveyor. In the old plant there had been no feed-water heater, but a Green economizer of 400 horse-power capacity was installed, and in connection with it a fan with short smoke-stack for artificial draught, the latter arrangement mostly for experimental purposes.

"Steam had to be furnished from the central plant both for heating and power purposes, and the question arose whether it would not be best only to carry steam of high enough pressure for power purposes at the central plant, and to reduce the pressure at the various buildings to use the steam for heating. On account of the fact that the boilers were considerably higher than the return in several of the buildings to be heated, and in fact because all of the buildings were situated at such various levels and distances as compared with the boiler-house, it was, of course, impossible to use a common reducing valve at the latter place for all the steam used for heating, and the only other alternative was to use a certain number of boilers for heating purposes of sufficient but moderate pressure that it might be used for running the fan engines at the various buildings and otherwise be reduced in pressure at the buildings to serve for heating.

"Various members of the Board of Regents of the University objected to the use of 'high-pressure' steam in the buildings in which only ordinary janitors had to take care of it; consequently a steam of less pressure than that used for the pumps at the lake shore or for the engines in the laboratories had to be used. At the same time the architects, who had planned the heating systems of several of the buildings, had provided engines for running the ventilating fans, requiring steam of at least 30 pounds pressure, which would be too high for the direct radiation. If, therefore, a common reducing valve had been used at the central plant, it could not reduce the steam to less than 30 pounds pressure, necessitating an additional reducing valve in each of the buildings or a separate pipe for taking the steam for the fan engines. All the boilers in the central plant were connected with two separate headers, one for high-pressure and the other for low-pressure

steam, the first one to carry about 100 pounds and the latter about 40 pounds pressure. The high-pressure steam was carried to such buildings in which steam was used for power purposes exclusive of fan engines, and the low-pressure steam to all buildings to be heated. It is perhaps necessary to add that the writer is of the opinion that it would have been poor economy to have carried in the tunnels leading to the various buildings steam of such low pressure that it could have been used for the direct radiation without being reduced in pressure, because it would have necessitated large pipes, which would have made the loss by radiation in the tunnels greater than it would be with smaller pipes carrying steam of high pressure, although necessarily also of higher temperature. With the system adopted for this plant it is possible to keep the size of the pipes quite small, so small in fact that a considerable loss of pressure must be expected at the end of the main. Experience in this plant has shown that it is preferable to have a separate reducing valve for the indirect tempering and heating coils, in order that a higher pressure may be carried on these than on the direct radiation, to facilitate the circulation in these coils in very cold weather. The sizes of mains in the tunnels were calculated to carry sufficient steam to heat the buildings in the most severe weather. But especially in the fall and spring there is a considerable length of time in which but very little steam is used for heating, but always a certain amount for ventilating the school rooms, etc. At those times the large mains are altogether too large, and the percentage of loss of heat in the tunnels is excessive. In other buildings warm water is a necessity the year around, and this warm water is obtained by steam from the central plant, and for this purpose also the original steam mains were too large. Because of these reasons separate small mains were run from the central plant to the various buildings and were connected at the several buildings with the large mains in such a way that the steam coming through the small pipes could be used for heating the buildings, running the fans or heating water as the special case required. The original cost of these 'summer' mains was quite an item, but the saving in fuel during the past five years has more than paid for them. Another great advantage gained by having these two separate mains to each of the buildings is that in case the large main should absolutely need repairs, the smaller one could be used and will furnish sufficient steam to keep the building from freezing, at any rate.

"Another important question affecting the economy of the plant was that of the return-water from the various buildings. There are several of the buildings which are lower than the central plant. After a thorough investigation it was conclusively proven that it would pay to pump the water back through the tunnels to the central plant, even if the distance was as great as from the Armory, nearly 900 feet. The returns are all connected to closed receivers in the central plant, and the receivers to the hot-well. Because of the two different pressures carried on the boilers, it was necessary to provide for two different feeding systems for each boiler, with a feed pump for each system. The low-pressure feed pump takes its suction from the return-water receivers directly, whereas the high-pressure pump has its suction connected with the hot-well. All water required beyond the return-water is pumped into the well and is then pumped through the Green economizer before it enters the high-pressure boilers. The additional water required is principally obtained from a number of rain-water cisterns located near the various buildings, the capacity of all these together being about 6,000 barrels, most of the water running by gravity to the central plant. Quite frequently, however, water from the lake has to be used, but as this is comparatively soft water, and as it is nearly always heated up to from 250 to 300 degrees Fahr. by the economizer, very little scale can form even in the high-pressure boilers. It is impossible to estimate accurately what portion of the feed-water is return-water; but it is safe to say that it amounts to more than three-fourths during the winter months, when nearly all the exhaust steam from the various engines, etc., is used for heating purposes. During the summer months, when all the steam is used for power purposes, no return-water is obtained. A feed-water heater in the central plant has been installed, utilizing the exhaust steam from the various stoker engines, feed pumps, the conveyor engine, and from the small engine which runs the dynamo, furnishing the light for the building. This feed-water heater discharges into the hot-well. The data of the tests showed that the temperature of the water of the hot-well reaches 170 degrees Fahr., due to the feed-water heater, and to the discharge of a number of steam traps which take care of the condensation in the mains, etc., in the boiler-house.

"All of the return-water from the several buildings is discharged into two closed receivers in the central plant. There are not separate returns from all of the buildings to these receivers, several being connected into one at convenient places. However, it has been deemed best to have separate return pipes from those buildings from which the water has to be pumped back. Because of the fact that each building has a separate reducing valve and that therefore the steam pressure used in each building may be different from that used in every other, it was necessary to discharge all return-water through steam traps into the returns. It might have been possible to avoid these traps if open receivers had been used, but it certainly would have resulted in a great loss of steam from these receivers, and it is probable that the present return pipes would not have been large enough to relieve the various heating systems in several of the buildings from too great a back pressure. As the returns now are arranged the heating apparatus of each building is entirely independent of that of every other building. This is in itself of great advantage, as the heating plants of the various buildings have been designed by several different parties, and because of differences in the design, require steam of different pressures."

The author said that his experience with expansion joints had shown that if the pipes were carefully anchored in every direction at the place where the joint is placed, they were the source of very little annoyance. He made a rule to repack the joints once a year, not because it was certain they needed repacking, but simply as a precautionary measure. His belief was that the good results attained were due to careful anchoring and alignment. His experience with pipe covering was as yet of too short duration to state any positive results as to durability. He had found, however, that pipe covering must be thoroughly protected by paint, on account of the moisture of air in tunnels, and that the best protection was a covering of two coats of heavy asphaltum paint. The total amount of surface supplied with steam by the central plant was 53,800 square feet direct and 28,500 square feet indirect. The coal used is always of Western origin and 4,500 tons were burned during the year.

The tests which have already been mentioned were conducted under the code of rules of the society. Three tests of 24 hours' duration each were made.

The coal used was as follows: Indiana washed nut from Coxville, Ind., in the first; Illinois washed pea coal from Carterville, Ill., in the second; and washed New Kentucky pea coal from Murphysboro, Ill., in the third. The first test was made with two boilers at 89 pounds pressure, and three boilers at 39 pounds. The temperature of the gases before entering the economizer was 484 degrees Fahrenheit, and after leaving 349 degrees. The draught corresponding was 0.177 and 0.43. The temperature of the feedwater for the high-pressure boilers was 171.8 degrees Fahrenheit before entering economizer and 270 degrees after leaving; for the low-pressure boilers it was 183.3 degrees. The results showed that the equivalent evaporation per pound of dry coal from and at 212 degrees Fahrenheit was 8.64 pounds for the high-pressure boilers with economizer, 7.81 pounds without it, and 7.8 for the low-pressure boilers. Per pound of combustible, the figures are 9.27, 8.4 and 8.38. The high-pressure boilers were run at about 32.7 per cent. below rating, and the low-pressure boilers at about 23 per cent. below rating.

Test No. 2 was undertaken with a different connection of boilers and at pressures of 87.6 pounds and 40.26 pounds respectively. The temperature of the gases before and after leaving the economizer were 356 and 295 degrees Fahrenheit respectively, with draught of 0.16 of an inch and 0.354 of an inch respectively. The temperatures of the feed water entering and leaving the economizer were 160 and 237 degrees Fahrenheit respectively. The feed-water temperature for the low-pressure boilers was 196.8 degrees Fahrenheit. The equivalent evaporation realized per pound of dry coal was 8.22 pounds, high-pressure boilers with economizer; 7.87 pounds, high-pressure boilers, without economizer; 7.79 pounds, low-pressure boilers. Per pound of the combustible the figures are 8.95, 8.57 and 8.5 pounds respectively.

In the third test the pressure of the steam on the high-pressure boilers was 101 pounds, on the low-pressure boilers 50 pounds. Average draught was 0.434 of an inch. No economizer was used and the temperature of the gases was 593 degrees Fahrenheit. The feed-water temperature averaged 180 degrees Fahrenheit for the high-pressure boilers, and 179 degrees for the low-pressure boilers. The equivalent evaporation per pound of dry coal for the high and low-pressure boilers was 8.64 and 8.06 pounds respectively; and the same per pound of combustible was 9.56 and 8.92 pounds. The boiler power developed was 4.5 per cent. above the rating for the high-pressure boilers and 14 per cent. below rating for the low-pressure boilers.

HEATING CAPACITY OF HOT-BLAST COILS.

It is with a good deal of pleasure that "The Engineering Record" is able to print some data in regard to the heating power of hot-blast coils, as the general practice seems to be a matter of guessing how much surface is needed on account of the lack of accurate information concerning the rate with which steam condenses in a coil. Mr. W. A. Blessed of the American Blower Company, Detroit, Mich., states that with A. B. C. sections, each of which contains four rows of 1-inch pipes placed 2¾ inches, center to center, and with air at a temperature of 30 degrees Fahr. passing through the coils at a mean velocity of 1,600 feet per minute, the usual velocity with a centrifugal fan, the air will be raised to the temperature shown in the following table, with the steam pressures and number of coils in use as mentioned:

Steam 5 lbs. Pressure		Steam 75 lbs. Pressure.	
No. Sect's.	Final Temp. of Air. Deg. Fah.	No. Sect's.	Final Temp. of Air. Deg. Fah.
4	74	4	92
5	88	5	117
6	100	6	137
7	110	7	143
8	117	8	156

With a mean velocity of air of 900 feet per minute, such as is found with disk fans, the rise in temperature of the air will be:

Steam 5 lbs. Pressure.		Steam 75 lbs. Pressure.	
No. Sect's.	Final Temp. of Air. Deg. Fah.	No. Sect's.	Final Temp. of Air. Deg. Fah.
4	85	4	125
5	110	5	158
6	130	6	186
7	147	7	210
8	160	[illegible]	230

With 5 pounds pressure about 1,720 B. T. U. are given off per minute per square foot of heating surface, and with 70 pounds pressure about 2,520 B. T. U.

PERSONAL AND OBITUARY NOTES.

Mr. Pitt Ross has been elected city engineer of Albuquerque, N. M.

Major J. I. Hudson has been appointed city engineer of Portsmouth, O.

Mr. George Storey has been chosen superintendent of water-works of Laporte, Ind.

Mr. Lawrence E. McGann has been reappointed commissioner of public works, Chicago, Ill.

Mr. Chas. F. Lawton has been re-elected superintendent of public works, New Bedford, Mass.

Mr. Wm. H. Breithaupt, M. Am. Soc. C. E., has removed his offices to 66 Broadway, New York.

Mr. L. C. Fisher has been appointed superintendent of electric lights and water-works engineer of Paris, Ill.

Mr. D. Geo. Shryock has been elected president of the board of commissioners of water and lighting, Meadville, Pa.

Mr. Thomas Ogden has been appointed assistant city engineer and Mr. W. C. Parmley, M. Am. Soc. C. E., superintendent of the sewer system of Cleveland, O.

The following appointments have been made in New Rochelle, N. Y.: Clerk, Mr. Andrew J. Seiz; superintendent of streets, Mr. John P. Kelly; city engineer, Mr. Clarence S. Haskell.

Mr. E. Harper Firth has been appointed engineer of Nassau County, N. Y. He is a graduate of Swarthmore College and for the last three years has been engaged on road and sewer work.

Mr. Samuel Darling has tendered his resignation as superintendent in the water-works department of Pawtucket, R. I., to take effect June 1. He has held his present position for the past 18 years.

Messrs. Rudolph Hering, Samuel M. Gray and Joseph M. Wilson have been selected by the Mayor of Philadelphia as an expert committee to report on the improvement of the water-works of that city.

Mr. Chas. P. Chase has been chosen consulting engineer for Dubuque, Iowa, in its project to purchase a water-works plant. His duty will be to make an appraisement of the value of the water plant to guide the city in its negotiations with the present water company.

Oscar Erlandsen, M. Am. Soc. C. E., has been commissioned captain of the First Signal Corps, N. G., N. Y. This corps, which is a mounted organization attached to National Guard Headquarters, is composed largely of civil and electrical engineers. Many of its members served with credit in the U. S. Vol. Signal Corps during the recent war with Spain.

Mr. August Rauschenbach, office superintendent in the street department, St. Louis, Mo., died May 2, at the age of 69. He was born in Lauterbach, Hesse-Darmstadt, Germany, and was educated in his native country, as a civil engineer. He came to the United States in 1853, settled in St. Louis, and a year later was appointed to a position in the city engineer department, remaining with the city in various capacities for the remainder of his life, 45 years.

A Landmark in Bridge Building has recently passed into the control of the Standard Oil Company. It is a tract of land 219 feet by 830 feet in Baltimore, Md., on which are the buildings where the Bollman bridges were manufactured many years ago. The property was acquired by Bollman, Tegmeyer & Co. in 1859, and they began the construction of their plant in that year. For many years it was known as the Patapsco Bridge & Iron Works and was operated until 1885; later it was leased to a firm of Welsh tin plate makers, who ran the plant for three years and then went out of business. Since then the property has been idle.

CONTRACTING NEWS

OF SPECIAL INTEREST TO

CONTRACTORS, BUILDERS, ENGINEERS, AND MANUFACTURERS

OF ENGINEERING AND BUILDING SUPPLIES.

For Proposals see pages xi, xii and 560.

WATER.

Oshawa, Ont.—The lowest bid received May 5 for water-works is stated to be $76,971, from J. P. McKnight & Co., Toronto. Total appropriation for sewers and water is $110,000. See "Sewers."

Indiana, Pa.—It is stated that the Clymer Water Co. will construct a new plant at a cost of $15,000.

Middletown, Pa.—It is reported that the Middletown Water Co. has contracted with S. W. Cooper of Millersberg, Pa., for a sand filter.

La Salle, Ill.—The Mayor is said to be urging the construction of a new $30,000 pipe line.

Port Arthur, Tex.—It is reported that the City Council has contracted with Ed. Wagner of Berlin, Germany, for 1,000,000 gallons of water per day for 25 years. Local representative is the International Trading Co.

Columbia City, Ind.—It is stated that the Harmon Water Supply Co. of Tiffin, O., has a contract to sink a 10-inch well near the pumping station to a depth not to exceed 300 feet.

McConnellsburg, Pa.—The Borough Council is said to be contemplating the construction of a system of water-works.

Shawville, Can.—Robert Surtees of Ottawa is said to be investigating the question of water supply.

Phoenixville, Pa.—The Town Council has voted to construct a 6,000,000 gal. subsiding basin.

Barre, Vt.—The City Council is said to have voted to purchase the Barre Water Co.'s plant.

Joplin, Mo.—The American Water-Works & Guarantee Co. of Pittsburg, Pa., is said to have purchased the plant of the Joplin Water-Works Co.

Traverse City, Mich.—W. H. Wheeler of Chicago is investigating the question of a water supply.

Columbus, N. J.—A company is said to have been organized to build a system of water-works.

Duluth, Minn.—The Council is said to have voted to replace 1,300 feet of kalomine pipe with cast iron.

Minneapolis, Minn.—The Board of the Minnesota Soldiers' Home is said to be figuring on a new water supply at a cost of about $3,000.

Spartanburg, S. C.—The Home Water Supply Co. is said to have applied for a charter; capital stock, $50,000.

Evansville, Ind.—The Water Board is said to be investigating the question of filtration. See "Sewers."

Rockwood, Tenn.—There is some talk of building works here.

McKees Rocks, Pa.—It is reported that the Monongahela Water Co. will lay a pipe line to McKees Rocks.

Marshall, Minn.—A 12-inch well will probably be sunk.

Oconomowac, Wis.—The Common Council has voted to issue $42,000 of water-works bonds.

Okalont, Miss.—The question of an issue of $6,000 of water bonds will be submitted to the voters.

Darby, Pa.—Geo. H. Orcott is said to be sinking an artesian well to furnish water for the borough.

Durango, Colo.—The Union Mesa Irrigating Ditch Co. is reported as incorporated with a capital stock of $50,000. Directors: Edgar G. Bates, Robert Morrison, Owen F. Boyle and others.

Grand Junction, Colo.—The City Council has authorized a $65,000 issue of bonds for water-works.

Marble Rock, Ia.—Articles of incorporation are said to have been filed by the Calcasian River Irrigation Co. Incorporators: F. E. Gates and O. E. Moore.

Nora Springs, Ia.—Bids are wanted May 25 for $6,540 water bonds. S. G. Blythe, Mayor.

Highlands, Ky.—Bids are wanted May 18 for the privilege of laying water pipes and supplying water. Wm. H. Band, Secy. Bd. Trustees.

Albany, Ore.—N. J. Henton, City Recorder, writes that at a meeting of the Council March 28, J. K. Weatherford of Albany petitioned for a franchise for a water company. It was referred to a special committee consisting of Councilmen J. G. Galbraith, M. Sanders and J. J. Graham. Said committee has not yet reported.

Philadelphia, Pa.—The Worthington Pumping Engine Co., 86 Liberty St., N. Y. City, has received the contract for two 5,000,000 gal. pumps for the Roxborough station at $30,000 each.

Savona, N. Y.—T. C. Wall, Village Clk., writes that J. F. Witmer, Elliott Sq., Buffalo, has prepared plans for water-works to cost $15,000. A vote will soon be taken on question.

Red Lodge, Mont.—Geo. H. Bailey, City Clk., writes that at the election, May 1, it was voted to issue $25,000 bonds for water works.

Ionia, Mich.—Bids will be received about June 1 for 3,600 ft. 6-in. pipe and 2 hydrants.

Walla Walla, Wash.—E. S. Clark, City Surveyor, writes that the City Council, on May 2, passed an ordinance empowering the Mayor and City Clerk to enter into a contract with the Walla Walla Water Co. to buy its entire plant for $250,000, subject to ratification by popular vote. At the same time the question of sewerage will be submitted.

Poughkeepsie, N. Y.—A correspondent writes that about 10 blocks of water main extension will be laid this spring.

Copenhagen, Lewis Co., N. Y.—S. S. Snell, Lowville, N. Y., is preparing plans and estimates for works.

Wheatland, Wyo.—It is said that the Wyoming Development Co. will soon begin work on a large reservoir.

Lancaster, Pa.—The Common Council is considering the erection of a new standpipe.

Red Oak, Ia.—It is stated that the Council has decided that all patrons of the water-works must have meters.

St. Paul, Minn.—Supt. of Parks Nussbaumer recommends the laying of about 10,500 ft. of small size water pipe and has been authorized to purchase a part of the same. He also recommends a 35,000-gal. water tower.

Jersey City, N. J.—Bids are wanted May 16 for 20,000 lbs. pig lead. Geo. T. Bouton, Clk. Bd. St. & Water Commrs.

Berryville, Va.—A committee of the Town Council has been appointed to employ an engineer to estimate the cost of completing the water-works.

Morton, Minn.—It is stated that a vote will be taken May 16 on the question of constructing a water-works system to cost $8,000.

Wonewoc, Wis.—Chicago and Madison parties are said to be contemplating the construction of a water and electric light plant.

Sanford, N. C.—Bids are wanted May 18 for $10,000 water and light bonds. W. J. Edwards, Mayor.

Hartford, Wis.—An election will be held May 27 to vote on issuing $2,500 bonds for constructing water-works. T. Foley, City Clk.

Bay City, Mich.—It is proposed to construct an intake pipe to cost $200,000. John Bloomshield, Engr., West Bay City. Geo. Turner, City Engr.

Chicago, Ill.—Bids are wanted May 18 for one steel discharge pipe at the north pumping station. L. E. McGann, Pres. Bd. Local Improv.

East Grand Forks, Minn.—An ordinance is said to be before the Council providing for the issue of $35,000 water and light bonds.

Denver, Colo.—A resolution has been introduced in the Board of Aldermen providing for a municipal water plant at a cost not to exceed $3,500,000.

Revere, Mass.—At a recent town meeting it was voted that a committee inquire into the feasibility of acquiring the plant of the Revere Water Co.

Fall River, Mass.—An order authorizing the City Treasurer to negotiate a reservoir loan of $50,000 has been adopted.

Jamestown, N. Y.—Bonds to the extent of $7,500 are said to have been voted for artesian wells.

Belgrade, Minn.—Water-works and electric light bonds to the extent of $6,000 have been voted.

Seattle, Wash.—The following bids for building the Cedar River works were opened April 13 by the Bd. of Pub. Wks., Frank Oleson, Sec'y.

	Moran Bros. Co., Seattle.	Smythe, Wakefield & David, Portland, Ore.	Pacific Bridge Co., Portland, Ore.	F. McLellan.	Cawsey, Carney & McWilliams.	Stirret & Goetz.
Section I.—						
Head-works	$77,089.42	$75,270.50	$78,271.85	$78,694.50	....	....
Pressure pipe	874,054.99	827,534.00	774,399.75	783,076.50	....	....
Reservoir connections	13,653.80	11,922.80	10,893.63	11,998.60	....	....
Waste pipe	6,320.00	5,290.00	4,782.50	5,558.00	....	....
River improvements	17,973.20	20,280 00	21,093.00	19,860.00	....	....
Lake improvements	27,774.29	28,868.60	21,566.35	22,345.20	....	....
Total	1,016,865.70	969,165 90	911,007.08*	921,532.80	....	....
Section II.—Reservoirs.						
High-service	125,321.92	106.845.50	144,752.82	122,038.00	$125,993.77	$110,656 20
Low-service	111,518.11	106,563.75	122,473.90	127,202.50	121,894.07	108,929.25
Total	236,840.03	213,409.25*	267,226.72	249,240.50	247,887.84	219,585.45
Section III.—						
Stand-pipe	19,015.01	20,686.20*	22,686.75	....	....	....
Force main	36,539.80	30,795.00*	39,074.00	....	....	....
Section IV	30,949.50	28,014.50*	35,900.00	....	....	....

*Contracts awarded. A brief description of the nature of this large undertaking was printed in the proposal advertisement in THE ENGINEERING RECORD of March 18 and 25. The above official figures do not materially change the approximate totals printed April 22.

Conway, Ark.—The question of a water-works system is being discussed.

Oakland, Cal.—The question of a new water supply and municipal ownership of the same has been referred to the fire and water committee.

Youngstown, O.—It is reported that the water-works trustees will lay about 2,100 ft. of 8 and 12-inch pipe.

Menasha, Wis.—It is reported that negotiations are being held with the city government for the construction of a water-works system. Estimated cost, $90,000.

Lewiston, Me.—John A. Jones, City Engr., writes that a preliminary survey has commenced for the extension of a large water main to Lake Auburn, about 3 miles. E. H. Gowing, 95 Milk St., Boston, Consulting Engr. for the Water Bd.

Republic, Wash.—J. C. Ralston of the Republic Gold Mining Co., is preparing an estimate for water-works, in which Patrick Clark, 41 Zeigler Blk., Spokane, is interested.

Newbern, N. C.—The citizens on May 2 voted to purchase the water-works and electric light plants.

Willimantic, Conn.—The following bids are said to have been received for new pumps, as advertised in "The Engineering Record": The Barr Pumping Engine Co. of Philadelphia, $8,000 for a 14½x18-inch pump, or $6,300 for same pump with cheaper finish; Henry R. Worthington, 86 Liberty St., N. Y. City, a 13x18-inch pump for $8,900 or a 14x18-inch pump for $7,000.

Laurel, Del.—The following bids for water-works and a sewerage system were received by the Town Council May 3. Chas. S. York, Engr., 1526 E. Biddle St., Baltimore, Md.; E. F. Kitson, Pottsville, Pa., *$17,604.94; Wm. H. Rothrock, Baltimore, Md., $18,026.02; E. H. Post, Wilkes-Barre, Pa., $17,814.02; R. W. Brown, $18,900; B. F. Sweeten & Sons, Camden, N. J., $18,512.30; Humphrey & Rowe, Ashland, Pa., $18,513.20; B. R. Burns, Philadelphia, Pa., $18,236; Fred Spalding, Bethlehem, Pa., $17,617.86.
* Contract awarded.

Cincinnati, O.—Bids are wanted June 13 for cast iron pipe and special castings for the settling reservoirs and for the pump mains from the eastern pumping station on the water-works grounds near California, O., as advertised in "The Engineering Record."

Pine Island, Minn.—Bids are wanted May 22 for a system of water-works, as advertised in "The Engineering Record."

Newark, N. J.—The following bids were opened May 11 by Morris R. Sherrerd, Engr. and Supt. Water Dept., for supplying 800 gross tons 4 to 36-in. pipe and 100,000 pounds specials: (*a*) 513 tons 4 to 10-in. pipe, (*b*) 277 tons 12 to 36-in. pipe, (*c*) specials. Warren Foundry & Machine Co., Phillipsburgh, N. J. (*a*), $23.90; (*b*) $23.20; (*c*) 2 cts.; total, $20,687.10. U. S. Cast-Iron Pipe & Foundry Co., Burlington, N. J. (*a*), $23.20; (*b*) $23.20; (*c*) 1.9 cts.; total, $20,228; awarded contract. Camden Iron Works, Camden, N. J. (*a*), $25.95; (*b*) $24.95; (*c*) 2 3/8 cts; total, $22,598.50. All bids f. o. b. Newark, N. J.

SEWERAGE AND SEWAGE DISPOSAL

North Tonawanda, N. Y.—There is talk of a special election in June to vote on a $32,000 appropriation for sewers in the Ironton district.

Youngstown, O.—The State Board of Health has approved the plans for an important storm sewer.

Watsonville, Cal.—It is reported that an issue of bonds for sewers will be voted on in June.

Oshawa, Ont.—The lowest bid received May 5 for building a system is reported to be $27,000, from Ed. Hartnett of Toronto. McQuillan & Co., Toronto, bid $119,475 for both sewer and water systems. See "Water."

North Braddock, Pa.—It is reported that the contract for a $7,600 sewer has been awarded to Ott Bros.

Trenton, N. J.—Bids are said to be wanted for a sewer in Cooper St. See "Paving."

Wauwatosa, Wis.—A special sewerage committee has been appointed to investigate means for improving local sanitary conditions.

Elkhart, Ind.—It is reported that a contract for trunk sewers has been awarded to Kinney & Swinehart of Elkhart.

Olneyville, R. I.—It is reported that a storm sewer will be built.

Seattle, Wash.—It is said that plans have been prepared for sewers in a number of streets.

Chambersburg, Pa.—The question of sewers is being discussed.

Port Jervis, N. Y.—It is said that the question of building a storm sewer in East Main St. will be voted on at the coming election.

Newburgh, N. Y.—It is reported that the approximate cost of a proposed 18, 20 and 24-inch pipe sewer is $8,400. Bids for the same are wanted on or before June 6.

Evansville, Ind.—The Board of Public Improvements is said to recommend main sewers for the southern part of the city. See "Water."

Rankin, Pa.—It is reported that an issue of bonds for $35,000 for street and sewer improvements will be voted on next month.

Little Falls, N. Y.—The Common Council is said to have voted to lay a 30-inch sewer.

Indianapolis, Ind.—Bids are wanted May 15 for a sewer in South St. M. A. Downing, Chmn. Bd. Pub. Wks.

St. Paul, Minn.—All bids received May 1 for the Hamline sewer system have been rejected and new bids will be received May 15. C. H. Bronson, Clk. Bd. Pub. Wks.

Montreal, Que.—Bids are wanted May 15 for a main sewer in St. Denis ward, in St. Laurent Parish. Percival W. St. George, City Surveyor.

Centerville, Mont.—The Commissioners of Silver Bow County, Butte, are interested in the construction of a sewerage system here. W. W. Pennington, Engr., Butte.

St. Paul, Minn.—Bids are wanted May 15 for sewer work in Smith and Cherokee Aves. and Jessamine St. C. H. Bronson, Clk. Bd. Pub. Wks.

Laurel, Del.—See "Water."

Jamestown, N. D.—Bids are wanted June 5 for a sewer. L. B. Niemeyer, Co. Aud.

Walla Walla, Wash.—See "Water."

Brookfield, Mo.—Hiram Phillips, 525 Lincoln Trust Bldg., St. Louis, has been appointed engineer for the proposed sewerage system; probable cost, $13,500.

Cincinnati, O.—Bids are wanted June 2 for sewers in Chase Ave. Saml. Nieman, Pres. Bd. City Affairs.

Chicago, Ill.—Bids are wanted May 17 for vitrified tile pipe sewers. L. E. McGann, Pres. Bd. Local Improvements.

Victoria, B. C.—The City Engineer is said to have reported that 3,290 ft. of sewers should be built this year at a cost of about $4,146.

Muncie, Ind.—Bids are wanted May 29 for sewer in 8th St. F. W. Clevenger, City Clk.

Wilmington, Del.—T. Chalkley Hatton, Engineer in Charge of Sewers is preparing plans for sewers in a number of streets.

Portland, Ore.—A number of residents are said to be working for an extension of the sewers.

Vancouver, B. C.—Bids will be received about June 1 for sewerage work to cost about $100,000. Thos. H. Tracy, City Engr.

Joslin, Ill.—Fred. Whiteside of Joslin is Chmn. of Com. appointed to organize a district with a view of constructing a drainage system in Hampton and Zuma Township.

Atlanta, Ga.—See "Government Work."

Cedar Rapids, Ia.—City Engineer Merridith writes that all bids on B Ave. West storm sewer have been rejected, as they were too high. New bids are wanted May 19. R. M. Buck, Chmn. Com.

Oxford, Miss.—The Aldermen on May 2 passed a resolution voting $20,000 to establish a system of sewerage in connection with the water-works.

Sheridan, Pa.—Bids are wanted May 19 for 16,792 ft. of 10 to 18-in. pipe sewers; also 8,891 cu. yds. grading. Jas. B. Smith, Boro. Engr., Pittsburg.

Oberlin, O.—Bids are wanted June 6 for furnishing 2,700 ft. of 6 and 8-in. sewer pipe. A. B. Spear, Village Clk.

Wilkesbarre, Pa.—The citizens on May 9 are stated to have voted to issue $60,000 bonds for sewers and $30,000 for streets.

Wallace, Idaho.—Bids are wanted May 22 for $18,000 sewerage bonds. J. C. McDisarmid, City Clk.

Butte, Mont.—City Engineer Bickenbach recommends that the sanitary sewer outlet be extended and that a storm sewer be built.

Birmingham, Ala.—A correspondent writes that bids are wanted May 17 for sewer work; estimated cost, $2,500.

Hillsboro, N. D.—Bids are wanted June 5 for a sewer in Caledonia Ave. J. R. Carley, City Aud.

Carnegie, Pa.—Bids are wanted May 16 for 9,000 ft. of 10 to 24-in. tile sewers, manholes, etc. T. J. Kearns, Chmn. St. Com.

Wahpeton, N. D.—Bids are wanted May 26 for 958 lin. ft. egg-shaped Buck, 776 lin. ft. circular Buck and 12,728 lin. ft. of 12 to 24-in. pipe sewers. E. A. Aspinwall, City Aud.

Woonsocket, R. I.—The contract for Sec. 4 of the trunk sewer is said to have been let to Bell & Co. of Roxbury, Mass., for $12,805. The other bids received were as follows: Baker & Judson, Gloversville, N. Y., $13,770; Geo. M. Bacon, Boston, $15,747.60 J. H. Leavitt, Boston, $16,740; Lyons & Doran, Providence, $17,908.50; Cumberland Construction Co., Valley Falls, $18,935.60; Frederick Shaw, Providence, $19,770; Frank L. Allen, Worcester, $25,580; John Bristow, Narragansett Pier, $27,595.90.

Cohoes, N. Y.—Press reports state that the contract for section 3 of the new sewer system has been awarded to E. H. Post of Wilkesbarre, Pa., at $46,363.15. The other bids were as follows: F. S. Ablett, $52,624.41; R. H. Strong, Albany, $67,261.75; A. M. Banker, Gloversville, $48,381.47; Harrington & Beach, Troy, $53,341.79; Thomas H. Karr, Troy, $76,410.26; Cohoes Construction Co., $54,962.83; J. H. Neary, Cohoes, $54,596.48; P. H. Harrison & Son, New York, $52,334.20; Baker & Judson, Gloversville, $60,717.81; Chas. T. Hookaway, Syracuse, $53,687.25.

Bridgeport, Conn.—The following bids are said to have been received for sewers: *a*, sewer in Stratford Ave.; *b*, sewer in Olive St., and *c*, sewer in Norman St.: Thos. F. Maher, New Haven, *a*, $3,977.20; *b*, $5,413; *c*, $7,154.90. Pierce Mfg. Co., Bridgeport, *a*, $4,204.95; *b*, $4,772.70; *c*, $6,402.50. B. D. Pierce, Jr., Co., Bridgeport, *a*, $4,345; *b*, $4,806.60; *c*, $6,241.50. John Doolittle & Co., New Haven, *a*, $4,408.50; *b*, $5,373; *c*, $7,667.50. Charles T. Hookway, Syracuse, N. Y., *a*, $4,414.75; *b*, $5,320.50; *c*, $7,074.50. Geo. B. Stucker, Harrisburg, *a*, $4,608.90; *b*, $5,846.10; *c*, $8,141. P. H. Harrison & Sons, New York, *a*, $4,922.50; *b*, $4,577; *c*, $6,072.50. Jas. J. Newman, Providence, *a*, $4,997.25; *b*, $6,550; *c*, $10,459. Frank Pidgeon, New York, *a*, $6,590.50; *b*, $7,500.30; *c*, $10,580. Thos. E. Collins, Bridgeport, *a*, $5,362.85; *c*, $8,889.

South Nyack, N. Y.—The State Board of Health has approved the sewer plans for the village.

Buffalo, N. Y.—Bids are wanted May 25 for 10 to 18-in. tile sewers. R. G. Parsons, Secy. Bd. Pub. Wks.

Honolulu, H. I.—Contracts for materials for the Honolulu sewerage system, Rudolph Hering Consulting Engr., have been placed as follows: Outfall pipe and dirt pails, Risdon Iron Works, San Francisco, Cal.; sluice gates, Adams & Co., York, England; valves, Ludlow Valve Co., Troy, N. Y.; Portland cement, W. K. Grace & Co., San Francisco; sewer pipe, Gladding, McBean & Co., San Francisco; manhole covers, Sessions Foundry Co., Bristol, Conn.

Bids for constructing the sewers will be received until June 1, and plans and specifications may be seen at the Hawaiian Consulate, 206 Sansome St., San Francisco.

BRIDGES.

Humboldt, Ia.—Bids are wanted June 6 for a steel bridge. Harwood Sharp, Co. Aud.

Brookings, S. D.—Bids are wanted June 1 for 2 steel or combination bridges. L. H. Storgaard, Co. Aud.

Starkey, N. Y.—Local press reports state that the Northern Central Ry. contemplates erecting an iron bridge this summer at Rock Stream. Estimated cost $45,000.

Buffalo, N.Y.—The Board of Aldermen adopted a report in favor of awarding the contract for constructing the Elk St.-Abbott road viaduct to W. F. Boysen for $114,779.90.

Belding, Mich.—F. P. Smith, City Clk., writes that the city will build a one span iron bridge this summer 100 ft. long. Contract will soon be let.

Denison, Tex.—It is stated that the City Secretary has been instructed to advertise for bids for repairing the viaduct; estimated to cost $5,467.

Redcliffe, Colo.—Governor Thomas has signed a bill for a bridge over Grand River, to cost $5,000.

Cincinnati, O.—The County Commissioners are stated to have condemned the Baltimore & Ohio Southwestern bridge on Montgomery pike at Norwood and instructed the County Engineer to prepare plans and specifications for a new bridge to cost $31,000.

New London, Conn.—It is stated that the Central Vermont R. R. Co. is soon to build a drawbridge at Hallam St. to replace present structure. E. C. Smith, Pres., St. Albans, Vt.

Cumberland, Md.—Bids are wanted June 6 for 10 steel bridges. D. P. Le Fevre, Co. Engr.

St. Paul, Minn.—The Park Board will construct a bridge over the tracks at Interlachen, with necessary approaches, to cost $5,000.

Newport, Ind.—Local press reports state that a steel bridge to cost about $35,000 is to be built across the Wabash River.

Baltimore, Md.—Bridge Superintendent Mays recommends the building of a new bridge over Long Green run, near Hartley's Mill.

Rice, Minn.—Press reports state that the construction of a bridge across the Mississippi River, to cost $7,000, is under consideration.

Doylestown, Pa.—The Pittsburg Bridge Co., Pittsburg, is stated to have secured the contract for repairing and building the Hulmerville bridge, for $16,890.

St. Johnsbury, Vt.—The Board of Railroad Commissioners is considering the matter of constructing a viaduct from Railroad St. to Portland St. An adjourned hearing is set for July 6.

Cohoes, N. Y.—Local press reports state that the City Council passed a resolution authorizing the City Clerk to request all bridge companies to submit plans, specifications and estimates for a steel buckle plate bridge to be constructed across the Mohawk River at Ontario St.

Newport, Ky.—The County Board has instructed County Surveyor Ball to prepare estimates for 6 iron bridges.

Castlerock, Colo.—The Governor has signed a bill for a bridge over Blue River, to cost $5,000.

New London, Conn.—The construction of an iron bridge to replace the wooden one across the cove in front of Riverside Park is said to be under consideration.

North Milwaukee, Wis.—The citizens are stated to have voted to issue $6,000 bonds for a bridge across the creek at 32d St.

Seymour, Ill.—Bids are wanted May 16 by the Town Clerk for a bridge.

Eau Claire, Wis.—Bids received April 1 by the City Council for the erection of the stone abutment for the Barstow St. bridge have been rejected. City Engineer Wolf has prepared new plans. The work will cost about $4,000.

Sault Ste. Marie, Mich.—The proposition to issue $75,000 bridge bonds is stated to have been carried.

Marietta, O.—Arrangements have been made with the Canton Bridge Co., Canton, to draw plans and specifications for the Putnam St. bridge.

Ft. Worth, Tex.—Bids will be received about July 1 for a viaduct on Jennings Ave., in which the city, the Texas & Pacific Ry., and the Ft. Worth St. Ry. Co. is interested. John B. Howley, City Engr.

Walla Walla, Wash.—It is stated that bids are wanted May 20 for a steel girder bridge over Mill Creek at 4th St. R. P. Reynolds, City Clk.

Pittsburg, Pa.—Bids are wanted May 17 for the superstructure and masonry of 13 steel plate girder highway bridges and 4 stone arch bridges. W. E. Thompson, Co. Compt.

Syracuse, N. Y.—Press reports state that bids will soon be asked for 2 steel girder bridges over Onondaga Creek, one at Rich and one at West Fayette St.

Plymouth, Ind.—Bids are wanted June 8 for constructing a bridge and repairing stone abutments of a bridge over Pine Creek, Polk township. Fredk. Seider, Chmn. Co. Commrs.

Hot Springs, Ark.—It is stated that bids are wanted June 1 for a steel highway bridge at Garner's Ferry. S. P. Van Patten, Chmn. Co. Bridge Com., 316 Prospect Ave.

St. Paul, Minn.—The following bids for the substructure of the Raymond Ave. bridge were opened May 2 by City Clk. M. Jensen: Chas. Stone, St. Paul, $9,961; Butler-Ryan Co., St. Paul, $9,205. Bids for the superstructure were opened at the same time; the total tenders and price per pound for steel were as follows:

	Total.	Steel. cents.
C. L. Strobel, Chicago	$41,510	3.7
Toledo Bridge Co	41,278	3.62
Pittsburg Bridge Co	43,720	3.85
Chicago Bridge Co	49,984	4.35
Gillette-Herzog Co	42,388	3.78
Wrought Iron Bridge Co	44,523	3.95
Wisconsin Bridge Co	38,970	3.41
King Bridge Co	45,556	4.5
Milwaukee Bridge Co	39,731	3.45

Chicago, Ill.—The following bids were opened April 26 by the Sanitary District Trustees for the substructure and superstructure of the Taylor St. railway bridge: Pennsylvania Steel Co., $297,385; King Bridge Co., $335,412; C. L. Strobel, $335,533; Toledo Bridge Co., $337,677; Chicago Bridge & Iron Co., $345,363; J. G. Wagner Co., $385,825; Massillon Bridge Co., $388,642. The itemized bid of the Pennsylvania Steel Co., which is reported to have reecived the contract, was as follows: 12,000 cu. yds. excavation at 50 cts.; 225,000 ft. B. M. sheet piling and bracing at $34 per M ft.; 5,040 ft. B. M. timber in foundation and pier protections at $44; 44,840 lin. ft. piles at 18 cts.; 44,840 lin. ft. pile driving at 33 cts.; 3,450 cu. yds. natural cement concrete at $3.85; 3,650 cu. yds. Portland cement concrete at $5.75; 940 cu. yds. stone masonry at $13; air pipe, laid, $1,000; superstructure complete, $214,500; extra medium or soft steel, 4¾ cts. per lb.; extra iron castings, 4¼ cts. per lb.; extra steel for superstructure, 8½ cts. per lb.; extra steel castings for machinery, 10½ cts. per lb.; extra phosphor-bronze, 30 cts. per lb.; extra counterweight block castings, 2 cts. per lb.

The following bids were opened at the same time for the substructure and superstructure of a highway bridge at the same street. Chicago Bridge & Iron Co., $71,040; King Bridge Co., $77,132; Toledo Bridge Co., $77,569; Massillon Bridge Co., $79,831; C. L. Strobel, $81,216; Pennsylvania Steel Co., $82,507; J. G. Wagner Co., $99,503. The itemized bid of the Chicago Bridge & Iron Co., which is reported to have received the contract, is as follows: 1,500 cu. yds. excavation at 55 cts.; 50,000 ft. B. M. sheet piling at $40 per M; 6,500 ft. B. M. timber in foundation at $50 per M; 10,840 lin. ft. piles, delivered, at 20 cts.; 6,760 lin. ft. pile driving in foundation at 33 cts.; 4,080 lin. ft. pile driving in protection at 30 cts.; natural cement concrete at $4.40 per cu. yd.; 905 cu. yds. Portland cement concrete at $6.60; 136 cu. yds. stone masonry at $15.40; superstructure complete, $52,000; extra medium or soft steel 6 cts. per lb.; extra iron castings, 10 cts. per lb.; extra steel in track plates, 10 cts. per lb.; extra steel castings at 10 cts. per lb.; extra phosphor-bronze at 50 cts. per lb.; extra counterweight block castings at 2 cts. per lb.; removal of present abutments, $2,200.

Tiffin, O.—It is stated that bids are wanted May 20 by the County Auditor for rebuilding a bridge in London township.

Algona, Ia.—Bids are wanted May 22 for bridges in Lincoln township. W. Warburton, Clk.

Boston, Mass.—The following bids were opened May 10 by City Eng. William Jackson for bridges on the extension of Summer St., over A and C Sts.: New Jersey Steel & Iron Co., Trenton, N. J., A, $12,486; C, $10,346. Canton Bridge Co., Canton, O., A, $12,140; C, $11,688. Groton Bridge & Mfg. Co., Groton, N. Y., A, $12,365; C, $10,230. King Bridge Co., Cleveland, O., A, $13,450; C, $11,200. Youngstown Bridge Co., Youngstown, O., A, $12,200; C, $10,120. Mace Moulton, Springfield, Mass., A, $12,810; C, $10,426; R. F. Hawkins Iron Works, Springfield, Mass., A, $14,440; C, $13,200. Toledo Bridge Co., Ohio, A, $12,230; C, $10,158. Boston Steel & Iron Co., Boston, Mass., A, $12,700; C, $10,200. New England Structural Co., Boston, Mass., (awarded contract), A, $11,894; C, $9,906; H. W. Hayes Co., Boston, Mass., A, $12,821; C, $11,976. F. R. Long & Co., New York, A, $12,836; C, $11,990. New Columbus Bridge Co., Columbus, Ohio, A, $14,000; C, $12,805.

PAVING AND ROADMAKING.

Winona, Minn.—Press reports state that several streets have been ordered paved with vitrified brick.

Harrisville, R. I.—Among the appropriations recently reported were: $7,500 for macadamizing and $3,500 to purchase a steam roller.

Petersburg, Va.—The Street Committee is said to have recommended the Porter vitrified brick for paving. Contracts were awarded to John Jacoby, at $2.22 per sq. yd. for vitrified brick, and to Chas. Gasser for $2.33 per sq. yd. for granite.

Rensselaer, Ind.—It is stated that several streets are to be improved with crushed stone. Schuyler C. Irwin, City Clk.

Brockton, Mass.—A loan of $50,000 has been authorized for repairs to the highways.

New Rochelle, N. Y.—An issue of $150,000 street improvement bonds and of $18,000 bonds for altering and improving the city hall and prisons has been authorized.

Buffalo, N. Y.—The Aldermanic Com. on Streets have reported in favor of the recommendation of the Bd. of Pub. Wks., to resurface 18 asphalt streets.

Rochester, N. Y.—The contract for a new macadam pavement has been let to H. N. Cowles for $34,652.40.

Greeneville, Pa.—A contract has been awarded O. N. Gardner, Jamestown, N. Y., at 31 cts. per ft. for curb, 16½ cts. per cub. yd. for excavating and $1.01 per sq. yd. for paving with Brady Run brick.

Pittsburg, Pa.—Local press reports state that it has been decided to repave two streets.

St. Paul, Minn.—Orders are reported adopted for paving four streets with brick.

Punxsutawney, Pa.—A bond issue of $9,000 has been authorized to complete paving Mahoning St.

Salt Lake City, Utah.—A project is under way to pave Brigham St. with asphalt. The distance is approximately one mile, and the estimated cost, $160,000.

Hartford, Conn.—The Legislature has authorized the issue of $200,000 additional paving bonds.

Rochester, N. Y.—The Executive Board has awarded the contract for paving Thrush St. with asphalt to Whitmore, Rauber & Vicinus, 279 S. St. Paul St., for $20,516.50.

Bath, Me.—Among the appropriations made by the city the following are reported: $15,000 for highways, $6,000 for new streets.

Owensboro, Ky.—It is stated that the paving committee will recommend that Main St. be paved with brick.

Louisville, Ky.—Press reports state that bids for paving Greenwood Ave. with brick have been rejected.

Athens, Ga.—The $100,000 bond issue for street improvements is reported sold. It is said that fully half of the money will be used this year.

Norwood, O.—Bids are wanted May 19 for $86,362.70 bonds, part to be used for the improvement of Montgomery Pike. W. E. Wichgar, Clk.

Castle Rock, Colo.—Governor Thomas has signed several bills for making appropriations for wagon roads: Wagon Wheel Gap to Creede, \$12,000; Montrose to Naturita, \$7,000; Trinidad to Stonewall, \$5,000; in San Miguel Co., \$8,000; Bear Creek, \$8,000; Empire to Berthoud Pass, \$6,000.

Rankin, Pa.—See "Sewerage and Sewage Disposal."

Cleveland, O.—The Board of Control has approved several ordinances for brick paving.

Geneva, N. Y.—Several paving ordinances are under consideration, asphalt, macadam and Medina block.

Binghamton, N. Y.—The Street Commission has acepted the proposition of the Warren-Scharf Asphalt Paving Paving Co., 81 Fulton St., New York City, to pave Chenango St., at \$1.25 per sq. yd., with a 5-year guarantee.

Dover, N. H.—According to press reports W. C. Ogden, City Engr., has submitted plans and specifications for a new road.

Niagara Falls, N. Y.—The Council is reported in favor of a \$12,000 pavement on Second St.

Leavenworth, Kan.—The City Council has authorized the paving of several streets with vitrified brick.

Jersey City, N. J.—The Erie R. R. Co. has, it is said, agreed to take up three tracks crossing Grove St., at grade, and will place them on a bridge. The street will also be depressed and the company will pave it with block pavement and concrete foundation.

Chicago, Ill.—Bids are wanted May 17 for improving Diversey Boulevard. Paul Redieske, Pres. Commrs. Lincoln Park.

Portsmouth, O.—Bids are wanted June 6 for the improvement of Gallia St. Ed. K. Walsh, City Clk.

Muncie, Ind.—Bids are wanted June 5 for the improvement of Howard St. F. W. Clevenger, City Clk.

Shelby, O.—Bids are wanted June 2 for about 38,000 sq. yds. brick or asphalt paving, and on June 5 for \$70,000 bonds, as advertised in "The Engineering Record."

Binghamton, N. Y.—Bids are wanted May 23 for vitrified brick or asphalt paving on 5 streets. S. D. Kane, City Clk.

Risingsun, Ind.—It is stated that bids are wanted May 22 for macadamizing about 16 miles of road in Cass and Randolph townships. Robt. C. Nelson, Co. Aud.

Stamford, Conn.—Bids are wanted May 15 for 3,657 sq. yds. asphalt block paving on Main St. Paul Nash, City Engr.

Charleston, W. Va.—The Council has passed ordinances for paving several streets.

Kansas City, Kan.—The Council has voted to pave several streets.

Newport, R. I.—The Council has authorized the paving of a number of streets with macadam.

St. Paul, Minn.—The Park Board is said to have made an appropriation for macadamizing and road making in the parks.

Boston, Mass.—Jones & Meehan, 1 Beacon St., have been awarded contracts aggregating \$18,808.

Birmingham, Ala.—A correspondent writes that bids are wanted May 17 for grading, macadamizing and curbing; estimated cost, \$16,000.

Scottdale, Pa.—The citizens are stated to have voted to issue \$35,000 bonds for paving and erecting a public hall.

Guelph, Ont.—The Council wants bids for a steam road roller.

Wilkesbarre, Pa.—See "Sewerage and Sewage Disposal."

Williamsport, Pa.—Press reports state that the Highway Committee has been authorized to pave W. Fourth St. with brick or asphalt.

Jersey City, N. J.—Bids are wanted May 16 for 2,186 sq. yds. asphalt and 1,800 sq. yds. macadam paving on Carleton and Cator Aves. Geo. T. Bouton, Clk. Bd. St. & Water Commrs.

Camden, N. J.—Bids are wanted May 17 for a stone road. Harry F. Wolfe, Dir. Bd. Freeholders.

Omaha, Neb.—The following are reported as being the lowest bidders for paving in various districts. Asphalt per sq. yd: Hugh Murphy, \$1.57, \$1.87, \$1.89 (tied with Grant Paving Co.), relaying, \$1.77; Grant Paving Co., \$1.72, \$1.49, \$1.47. Brick: Iowa Brick Co., \$1.57, \$1.56.

Buffalo, N. Y.—Bids are wanted May 25 for repaving 2 streets. R. G. Parsons, Secy. Bd. Pub. Wks.

Hackensack, N. J.—The following bids were opened May 4 for building 10,437 ft. of 16-ft. macadam roads and 134,431 ft. of 12-ft. roads, all 4 ins. thick, in Franklin Township: George A. Rogers, Plattsburgh, N. Y., \$63,510; Silk City Construction Co., Paterson, N. J., \$55,694; Dewitt C. Bouker, 136 First Pl., Brooklyn, N. Y., \$54,652.

New Orleans, La.—The following bids for asphalt paving were opened April 24, according to press reports: (*a*) Alix St., (*b*) Seguin St., (*c*) Verret St., (*d*) Elmira St. Louisiana Improvement Co., *a*, \$2.29; *b*, \$2.29; *c*, \$2.29; *d*, \$2.29. Barber Asphalt Co., 11 B'way, N. Y. City, *a*, \$2.31; *b*, \$2.31; *c*, \$2.29; *d*, \$2.31. Southwestern Alcatraz Co., *a*, \$2.31; *b*, \$2.29; *c*, \$2.31; *d*, \$2.29. Ayers Paving Co., *a*, \$2.30; *b*, \$2.30; *c*, \$2.30; *d*, \$2.30.

Jamestown, N. Y.—The following bids for about 5,800 sq. yds. of brick paving, 2,920 lin. ft. of curbing and 200 ft. of curved curbing, were received by A. A. Amidon, Chmn. Bd. of Pub. Wks., May 6: *John Mahoney, Jamestown, N. Y., \$9,314.60; Gust. Burloud, Jamestown, N. Y., \$10,377.70; Jamestown Construction Co., \$9,537.50.

*Contract awarded.

Trenton, N. J.—The following bids are reported as received May 2 for paving South Broad St. First is given the bid per sq. yd., for a guaranty of 5 years; second, the same, for 10 years; third, the bid per ft. for setting new curb; and fourth, for resetting old curb. Robt. A. Montgomery, Trinidad Lake asphalt, \$1.67, \$1.82, 32 cts. and 4 cts.; Richardson & Ross, asphalt, \$1.19, \$1.49, 42 cts., 6 cts.; Wm. F. McGovern, sheet asphalt, \$1.80, \$1.98, 40 cts., 4 cts.; The Barber Asphalt Paving Co., 11 B'way, N. Y. City, Trinidad, \$1.72, \$1.97, 32 cts., 4 cts.; Henry R. Fell, rock asphalt, \$2.00, \$2.05, 10 cts., 5 cts.

Fort Wayne, Ind.—Bids for asphalt paving were opened May 4 and according to reports the Barber Asphalt Paving Co., 11 B'way, N. Y. City, bid \$2.23 per sq. yd.: Vulcanite Paving Co., Philadelphia, Pa., \$2.29; Alcatraz Paving Co., San Francisco, Cal., \$2.33. The bids per sq. yd. for brick pavement are stated as follows: Jos. W. Derheimer, Metropolitan, \$1.67; Athens, \$1.66; Nelsonville, \$1.67; Trimble, \$1.47. Moellering Bros., Metropolitan and other brick, \$1.45. S. B. Fleming, Metropolitan, \$1.61; Athens, \$1.62; Nelsonville, \$1.63; Lake Erie Asphalt block, \$3.95.

Ithaca, N. Y.—The following bids for about 25,000 sq. yds. of brick and stone paving and furnishing about 10,000 ft. of Medina curb were opened May 2 by the Paving Commission. The city furnishes the brick. In the table A is the price of excavation per cu. yd., B the price of pavement per sq. yd., C the price of curb per lin. ft.:

	Stone Pav. A cts.	Stone Pav. B	Stone Pav. C cts.	Brick Pav. A cents.	Brick Pav. B cents.	Brick Pav. C cents.
Sullivan & Graham, Columbus, O.	25	\$1.60	45	24	60	40
Castello & Neagle, Elmira, N.Y.	30	1.64	49	25	62	45
Bartow & Coryell, Williamsport, Pa.	24	1.34	43	24	57	43
John Horan, Medina, N. Y.	40	1.70	42	....	....	....
Walter Bradley & Co., Oswego, N. Y.	45	1.65	48	27	67	45
John Dempsey, Elmira, N. Y.	48	1.64	44	24	59	43
Fred P. Spaulding, Bethlehem, Pa.	25	1.36	45	20	45	42

The stone pavement was awarded to Bartow & Coryell and the brick pavement to F. P. Spaulding.

Houston, Tex.—According to press reports, the following bids were received for paving, first figures bid per sq. yd., 5 years' guarantee; second figures bid per sq. yd., 10 years' guarantee. Sheet asphalt: Hipp & Key, \$1.90 to \$1.95, \$2.10 to \$2.22; Alcatraz Co., San Francisco, \$2.07, \$2.37; Louisiana Improvement Co., \$2.18, \$2.43. Rock asphalt: Municipal Improvement Co., \$1.78, \$1.90. Brick pavement, 5-inch stone and concrete foundations: Hipp & Key, \$1.95 to \$2.00; Shurter & Drennan, \$1.87 to \$1.97, \$1.82 to \$1.92, \$1.72 to \$1.82; Lockhart & Clark, \$1.93. Brick, 6-inch gravel and concrete foundation: Hipp & Key, \$1.55 to \$1.60; Shurter & Drennan, \$1.67 to \$1.87, \$1.62 to \$1.82, \$1.52 to \$1.72. Brick, 5-inch rock and concrete foundation: Shurter & Drennan, \$1.82 to \$1.97. Brick, 6-inch gravel foundation: Shurter & Drennan, \$1.52 to \$1.67. Brick, intermediate course hard burned brick on 6-inch sand: Shurter & Drennan, \$1.62 to \$1.77. Telford macadam: Hipp & Key, \$1.20; Shurter & Drennan, \$1.37. Gravel: Hipp & Key, 80 cts.; Shurter & Drennan, 75 cts.; Lockhart & Clark, 90 cts. Concrete, per cu. yd.: Hipp & Key, \$6; Alcatraz Co., \$7; Shurter & Drennan, \$8; Louisiana Imp. Co., \$6.50 and \$6.25; Municipal Imp. Co., \$6.85.

Detroit, Mich.—Bids were opened May 1 by the Bd. of Pub. Wks. for cedar block pavements on concrete foundation. The following contracts are reported awarded: John A. Mercier, \$1.222 per sq. yd., with Medina curb, total, \$21,456.05; and \$1.27 per sq. yd., with Berea curb, \$6,615.86; Geo. Currie, \$1.46 per sq. yd., Berea curb, \$6,867.47.

POWER PLANTS GAS AND ELECTRICITY.

Statesboro, Ga.—It is stated that J. G. Mitchell proposes to construct an electric light plant.

Marion, Ind.—The Council has granted franchise to Benj. F. Burk of the Marion Window Glass Works and Wm. H. Anderson, retired capitalist, to build and operate an electric lighting plant in this city.

Summerville, S. C.—See "Electric Railways."

Jonesboro, Tenn.—The House has passed a bill authorizing the issue of bonds for an electric light plant.

Sparta, Tenn.—There is talk of forming a company to construct an electric light plant.

Cincinnati, O.—The County Commissioners are said to be considering the matter of constructing an electric light plant for the court house and jail.

Norwood, Minn.—Citizens are said to be considering the matter of constructing an electric light plant.

Charlotte, N. Y.—P. M. Schwartz, Village Clk., writes that the proposition to bond the village for \$6,000 for installation of an incandescent electric lighting plant was carried at an election May 2. Bonds to be sold May 17.

Syracuse, N. Y.—Bids are wanted May 16 for electric light fixtures in Washington Irving school. P. D. Cooney, Clk, Bd. Educ.

Williamsburg, Ia.—T. T. Osborn, Recorder, writes that A. W. Dawson & Co. of Mason City, Ia., have received the contract for a 2,000 70 c. p. gasoline gas plant with 11 blocks of street mains, at a cost of \$4,280. About 2 miles of additional mains will be put in during the summer, but the contract for same has not yet been let.

Lyons, N. Y.—The Council on May 5 granted a franchise for an electric light plant to Jacob Straus of Lyons and associates. A franchise was also granted to Jas. D. Bashford for lighting, and an electric railway system from Lyons to Sodus Point.

East Grand Forks, Minn.—See "Water."

Denver, Colo.—Mayor Johnson has recommended that a municipal electric light plant be established.

Belgrade, Minn.—See "Water."

Schoolcraft, Mich.—Henry I. Allen, Chmn. Light Com., writes that the Council has decided to grant an electric light franchise and will receive bids from responsible parties.

Mechanicsville, Ia.—Bids are wanted June 1 for lighting the streets with 25-50 c. p. incandescent electric lights. L. L. Kennedy, Mayor.

Harrisburg, Pa.—Chas. A. Miller, City Clk., writes that the Harrisburg Electric Co., 147 N. 4th St., has received the contract for lighting the city for five years at \$82 per light per yr., 2,000 c. p., 45 volts, 10 amperes, to burn every night and all night.

Newbern, N. C.—See "Water."

Shepherdstown, W. Va.—John A. Livers, Mgr. Light & Power Co., of Harper's Ferry, W. Va., has received a franchise for an elctric light plant here, to cost \$10,000.

Joplin, Mo.—The Electric Light Committee will shortly receive bids for an electric light plant. E. C. Squire, City Clk.

Danville, Ill.—It is stated that bids are wanted May 26 for a 50-year gas franchise. Address Jno. L. Fate, 203 Chamber of Com. Bldg., Chicago.

Hastings, Neb.—John M. Ragan is about to petition the Council for a franchise for an electric light, power and heating plant here to cost about \$70,000. D. E. Thompson of Lincoln is also said to be interested.

Barrie, Ont.—It is stated that bids are wanted May 17 for one 125-H.-P. steam engine, 2 independent condensers, 125 and 200-H.-P.; 2 approved steam boilers, 125 H.-P. each; one duplex steam feed pump, for above boilers, piping, etc., for the electric light plant. E. Donnell, Town Clk.

Petrolia, Ont.—It is stated that bids are wanted June 15 by the Town Clerk for lighting the town with 1,600 c. p. arc lights for a period of 5 years.

Waterville, N. Y.—The citizens on May 6 voted to light the streets by electricity.

New York, N. Y.—Bids are wanted May 22 for lighting the streets in the Boroughs of Manhattan, Bronx, Brooklyn, Queens and Richmond for one year. Henry S. Kearny, Commr. Pub. Bldgs., Lighting & Supplies.

Peoria, Ill.—The Peoria Lighting & Power Co. has been incorporated; capital, $50,000. Incorporators: Lewis W. May, Godfrey M. Luthy and Fred Luthy.

Portland, Me.—The Council has granted permission to the Portland Electric Light Co. to construct an electric light system in the city.

Highland, Ill.—It is stated that the contract with the Electric Co. will expire in a few months. The Mayor recommends the building of a municipal plant. John Leu, Mayor.

Sanford, N. C.—See "Water."

Newport News, Va.—Bids are wanted May 26 for street lighting. J. A. Massie, City Clk.

Trenton, N. J.—The Kern Incandescent Gas Light Co. has been incorporated with a capital of $12,000,000 to do a general gas lighting business. Incorporators: Ernest F. Ayran, 100 B'way, and Chas. W. Dayton, 13 Morris Park, West, New York City, and J. P. Murray, of Jersey City.

Wonewoc, Wis.—See "Water."

Doylestown, O.—The citizens are stated to have decided to issue $10,000 bonds for an electric light plant and to offer inducements for the construction of a street railway.

Paris, Ill.—The Gas Light & Coke Co. has received a franchise to lay pipes for furnishing hot water.

Bridgeport, Pa.—An election will soon be held to vote on issuing $10,000 bonds for an electric light plant.

Easton, Pa.—The Easton Consolidated Electric Co. is stated to have decided to install an improved three-phase machine in its light and power plant on East Ferry St.

ELECTRIC RAILWAYS.

Salt Lake City, Utah.—The Salt Lake City R. R. Co. has petitioned the Council for permission to construct additional car lines, to be operated by electric or compressed air power.

Indianapolis, Ind.—The Commissioners of Marion County are stated to have granted a franchise to the Union Traction Co.

Lyons, N. Y.—See "Power Plants, Gas and Electricity."

Hinckley, Ill.—The Geneva Lake, Sycamore & Southern Ry. Co. has received a franchise.

Hagerstown, Md.—Douglas Bros. are stated to have applied for a franchise to enter the city. The road is to be 20 miles long and to start from Myersville, Md.

Kenosha, Wis.—It is stated that the Milwaukee Electric Light & Power Co. will extend the electric railway from this city to Waukegan, Ill.

Summerville, S. C.—At a meeting of Council May 3 two petitions were presented. One from P. H. Gadsden of Charleston for electric light & railway franchise; the other from Julian Fishburne of Summerville for a railway franchise.

Chippewa Falls, Wis.—Arthur P. Appleyard of the Chippewa Valley Electric Co. is said to be interested in the construction of an electric line to Bloomer, to connect with the present system.

Terre Haute, Ind.—The County Commissioners have granted W. S. Stone and C. E. Webster of Boston a franchise through Vigo County to the Clay County line.

Ravenna, O.—The Cleveland & Warren St. Ry. Co. is stated to have received a franchise through Portage County.

Hamburg, N. Y.—The Hamburg Ry. Co. has filed with the County Clerk a notice of its intention to extend the road to West Seneca.

Mauch Chunk, Pa.—The Carbon County Electric Ry. Co. is stated to have been granted right of way through the Bloomingdale Valley to Summit Hill, near Lansford.

Leavenworth, Kan.—The Winner Electric Line Co. of Leavenworth is about to build an electric railway between Leavenworth and Kansas City, Mo. The grading is already begun.

St. Paul, Minn.—The County Commissioners are stated to have granted Theo. Borup, Chas. W. Bunn and others of St. Paul, a franchise from the city limits to White Bear Lake.

Louisville, Ky.—Bids are wanted May 15 for the franchise of constructing, operating and maintaining an electric street railway in 18th St., a distance of 3,500 ft., for a period of 20 years. Thos. P. Craig, Secy. Bd. Pub. Wks.

Montreal, Que.—The Road Committee on May 5 decided to report to Council in favor of allowing the Montreal Belt Line Ry. Co. to enter the city and use electric power.

Laporte, Ind.—It is stated that the survey is completed for the electric railway, which the Northern Traction Co. proposes to construct between Laporte and Michigan City. W. W. Huff is said to be interested.

Martinsville, Ind.—The County Commissioners are stated to have granted a franchise to the Indianapolis & Martinsville Traction Co.

Doylestown, O.—See "Power Plants, Gas and Electricity."

Linwood, Mass.—The Linwood St. Ry. Co. is stated to have received a franchise.

Petersburg, Va.—The contract for building the new street electric railway here is stated to have been awarded to Jas. F. Bradley, of Manchester, Va.

Redlands, Cal.—The Redlands St. Ry. Co. has applied for a franchise and it is stated that bids will be received for same May 31. L. W. Clark, City Clk.

RAILROADS.

Rapid City, S. D.—A charter has been granted to the South Dakota & Eastern Ry. Co. with a capital of $6,500,000 to construct a railroad across the reservation from Pierre to Rapid City. Incorporators: John R. Brennen and Virgil T. Price of Rapid City, A. Everett of Pierre and others.

Eureka, Cal.—The Eureka & Klamath R. R. Co. has applied for a franchise to construct a railroad through the city.

Chicago, Ill.—It is reported that the Chicago, Milwaukee & St. Paul road will expend about $2,500,000 this year on new lines and improvements.

Oshkosh, Wis.—Wm. H. Fisher and Albert Schaeffer of St. Paul are said to be considering the matter of constructing a railroad from Stevens Point to this city. The Board of Trade is reported as interested.

Seymour, Ind.—The City Council is stated to have granted a right of way to the Southern Indiana Railway, owned by John R. Walsh of Chicago, to parallel the Panhandle tracks from the north corporation line to the center part of the city.

Norfolk, Va.—It is stated that the Norfolk & Western Ry. Co. will construct a road from Radford to Floyd Court House, a distance of 25 miles.

Minneapolis, Minn.—Johnson Bros. & Faught of St. Elmo, Ill., are stated to have received the contract for about 135 miles of railroad work for the Minneapolis & St. Louis road.

Des Moines, Ia.—The Duluth & New Orleans Ry. Co. has applied for a franchise to construct single or double standard gauge railway tracks on two streets.

PUBLIC BUILDINGS.

(See also Schools and Government Work.)

Covington, Ky.—Bids are wanted May 15 for a city hall. Theo. Von Hoene, City Clk.

Minneapolis, Minn.—Bids are wanted May 29 for a building for horticulture and physics, and additions to heating and lighting plant at the School of Agriculture, Anatomical and Clinical buildings for the University of Minnesota. J. S. Pillsbury, Pres. Bd. of Regents.

Cohoes, N. Y.—M. H. Hubbard of Utica is said to be preparing plans for a $30,000 edifice for the First Baptist Church.

Philadelphia, Pa.—The plans of Edgar V. Seeler, 328 Chestnut St., are stated to have been accepted for the new church and Sunday school of the First Baptist Church; probable cost, $160,000.

Jersey City, N. J.—Norcross Bros., 160 5th Ave., N. Y. City, have received the contract for the public library, at $190,191.

Lafayette, O.—Bids are wanted May 15 for a town hall. C. N. Biteman, Township Clk.

Kenosha, Wis.—The plans of D. H. Burnham, Rookery Bldg., Chicago, Ill., are stated to have been accepted for the Z. G. Simmons public library, to cost about $90,000.

Central City, Colo.—Bids are wanted May 17 for a court house. J. S. Updegraff, Co. Clk.

Cincinnati, O.—L. P. Hazen, 806 B'way, Cincinnati, is stated to have received the contract for the erection of an annex to the Longview Hospital, at $46,700.

Cayuga, Ont.—Bids are wanted May 20 for heating the Court House and gaol. R. F. Miller, Chmn. Bldg. Com.

Richmond, Ind.—Louck & Hill of Richmond are stated to have received the contract for a building for the Eastern Indiana Insane Hospital, at $24,600.

Vancouver, B. C.—Bids are wanted May 30 for a drill hall. E. F. E. Roy, Secy. Dept. Pub. Wks., Ottawa, Ont.

Jamestown, N. D.—The plans of Architect Friedlander of Fargo are stated to have been accepted for the 2 ward buildings for the North Dakota Hospital for Insane. Bids for the erection will be received about June 2. Anton Fried, Secy. Bd. Trus.

Little Rock, Ark.—Frank W. Gibb, 314 W. Markham St., is stated to have prepared plans for a $25,000 building for the Infirmary of Insane.

Birmingham, Ala.—The plans of T. U. Walter & Ullman, Chalifoux Bldg., have been accepted for the Hillman Hospital; probable cost, $30,000.

Orting, Wash.—Bids are wanted May 24 for a dormitory and amusement hall combined, at the Washington Soldiers' Home. J. R. Rogers, Chmn. State Bd. of Audit & Control.

Allegheny, Pa.—Plans are being prepared for a $23,000 addition to the Allegheny Carnegie Library.

Hamilton, O.—It is stated that bids are wanted by the County Commissioners May 30 for an elevator in the court house.

Dartford, Wis.—It is stated that bids are wanted May 31 for heating and plumbing the new court house and jail. Geo. N. Clark, Co. Treas.

Butler, Pa.—The plans of C. H. Owsley of Youngstown, O., are stated to have been accepted for the new poor farm buildings for Butler County; estimated cost, $75,000. Bids will be called for at once.

Marietta, Ga.—It is stated that bids are wanted June 22 for remodeling the present court house and for an annex to same. Golucke & Stewart, Archts., 24½ Whitehall St., Atlanta.

Centreville, Mich.—The Building Committee is considering plans for a $50,000 court house for St. Joseph County. Mr. Leinbeck, Chmn. Com.

Erie, Pa.—Bids are wanted May 26 for an engine house. Chas. A. Gaither, Secy. Bd. Fire Commrs.

New Rochelle, N. Y.—See "Paving and Roadmaking."

Springfield, Mass.—Bids are wanted May 24 for alterations to the court house. Robt. O. Morris, Clk. Co. Commrs.

Rahway, N. J.—Henry Dickson, 22 Clinton St., Newark, who prepared the modified plans for the partial completion of the Rahway Reformatory at a cost of $230,000, has been retained by Governor Voorhees as expert to complete the plans and to supervise the work. It is stated that the plans and arrangement for the work, including the award of the contracts, will not be ready before the fall.

Sitka, Alaska.—Bids are wanted May 31 for a building for the Agricultural Experiment station. C. C. Georgeson, Special Agt. in Charge of Alaska Investigation.

Scottdale, Pa.—See "Paving and Roadmaking."

Savannah, Ga.—Bids are wanted May 20 for 3 buildings. J. H. Dingle, City Surveyor.

San Antonio, Tex.—Bids are wanted June 5 for a market house and convention hall. W. W. Johnson, City Clk.

Parkersburg, W. Va.—Bids are wanted May 22 for a court house; probable cost, $100,000. B. F. Stewart, Clk. Co. Court. L. W. Thomas, Archt., Canton, O.

Danville, Ill.—Bids are wanted May 31 for erecting a building, and for a coal and ash conveyor for the National Home for Disabled Volunteer Soldiers, as advertised in "The Engineering Record."

Blackwood, N. J.—The contract for erecting an addition to Camden County Insane Asylum here has been awarded to Philip Anns Co., Bourse Bldg., Philadelphia, at $38,688. Heating to Chas. F. West of Gloucester, N. J., at $5,799.

Salisbury, N. C.—Bids are wanted May 29 for an addition to the court house. J. Frank McCubbins, Chmn. Bd. Co. Commrs.

BUSINESS BUILDINGS.

Erie, Pa.—Ex-Mayor Black is said to be interested in the erection of an office and opera house building on 6th and Market Sts., to cost about $100,000.

Ft. Worth, Tex.—Smith & Bardon of Ft. Worth are stated to have received the contract for the union depot for the Gulf, Colorado & Sante Fe Ry. Co., at $50,000.

Spokane, Wash.—It is stated that Clary & Sweeney will erect a $120,000 fire-proof business building on Riverside and Lincoln Sts.

Akron, O.—The Knights of Pythias are said to be considering plans for a temple and an opera house, to cost $40,000 each.

Boston, Mass.—Chas. Brigham, Archt., 7 Mt. Vernon St., has filed plans for a $300,000 building to be erected for Albert C. Burrage on Commonwealth Ave. and Hereford St.

The plans of Andrews, Jacques & Rantoul, 8 Beacon St., have been approved for an 11-story building adjoining the Boston Athenaeum.

Eagle Grove, Ia.—It is stated that bids are wanted May 22 for a building for the Masonic Building Association. D. C. Filkins, Pres.

Dayton, O.—S. W. Hornabrook of Wyoming, O., is stated to have received the contract for the superstructure of the depot for the Dayton Union Ry. Co., at $155,800.

Philadelphia, Pa.—Roydhouse, Arey & Co., Builders' Exchange, have received the contract to erect a plant for National Biscuit Co. at 13th St. and Glenwood Ave. Cost, $200,000. Hales & Ballenger, Archts., 1200 Chestnut St.

Same contractors will build a 2-story flange shop for the Baldwin Locomotive Works. Cost, $65,000.

Birmingham, Ala.—Collignon & Hodgson have prepared plans for a 5-story building to be erected on 20th St. and 2d Ave. for S. Rich, to cost about $40,000.

Los Angeles, Cal.—Morgan & Walls of Los Angeles are stated to have prepared plans for a brick car house, waiting room, etc., 26x100 ft., for the Los Angeles Ry. Co.

NEW YORK CITY.

Permits for the following buildings have been issued; o, signifies owner; a, architect; b, builder, and c, contractor.

120 2d St, br stores & flat, cost $27,000; o, Julius Dreyfus; a, G F Pelham.

140 Lewis St, br stores & flat, cost $20,000; o, Ely Greenblatt; a, Nathan Langer.

124 East 4th St, br stores & flat, cost $20,000; o, August Ruff; a, Kurtzer & Rohl.

West Broadway & Spring St, br stores & lofts, cost $40,000; o, Arthur A Hodges; a, Small & Schumann.

165 Eldridge St, br stores & tenem't, cost $27,000; o, Julius Dreyfus; a, Geo F Pelham.

512 to 520 7th Ave, br hotel, cost $300,000; o, Eliza White; a, Barney & Chapman.

5th Ave & 16th St, br stores & loft, cost $450,000; o, Harry Chaffee; a, R S Townsend.

152 to 156 West 36th St, br warehouse, cost $100,000; o, Park & Tilford; a, Francis H Kimball.

540-542 West 38th St, br stable, cost $20,000; o, James Kennedy; a, J L Jordan.

109th St & 2d Ave, br stores & flat, cost $42,000; o, Lamonte & B & F Carnese; a, C A Millner.

Blackwell's Island, opp 51st St, br hospital, cost $23,000; o, City New York; a, Horgan & Slattery.

99th St & 3rd Ave, 2 br stores & flats, cost $50,000 all; o, John H Dalmke; a, Rudolph Werner.

18 & 20 East 116th St, br store & tenem't, cost $26,500; o, Mary C Gallagher; a, Rudolph Moeller.

68th & 69th Sts & West End Ave, 8 br stores & flats, cost $210,000 all; o, J T & J A Farley; a, Thom & Wilson.

Finton Ave & 165th St, br stores & flats, cost $20,000; o, Walter L McLaughlin; a, Edw Wenz.

BROOKLYN, N. Y.

Manhattan Ave & Varet St, br club house, cost $25,000; o, Rubinson Bros; a, H Vollweiler.

Fulton & Jay Sts, br stores, cost $90,000; o, Jacob Rothschild; a, Harding & Gooch.

DWELLINGS.

Pittsburg, Pa.—E. M. Butz of Pittsburg, Pa., has prepared plans for a 10-story fire-proof apartment house to be erected on Hiland Ave., east end.

NEW YORK CITY.

Permits for the following buildings have been issued; o, signifies owner; a, architect; b, builder, and c, contractor.

398 Grand St, br flat, cost $20,000; o, Eliza Hawthorne; a, L F Heinecke.

100 Columbia St, br tenem't, cost $24,000; o, Bertha Wolkenberg; a, M Bernstein.

409 West 52d St, br flat, cost $20,000; o, Mrs Mary Lorentz; a, A G Rechlin.

307 & 309 West 24th St, 2 br flats, cost $40,000 all; o, J D Karst, Jr; a, Louis Korn.

106th St and Riverside Drive, 4 br dwellgs, cost $110,000 all; o, J A Farley; a, Janes & Leo.

81st St & Broadway, br flat, cost $150,000; o, The Fire Proof Apartment Co; a, Lamb & Rich; b, John Langley.

111th St & 5th Ave, 2 br flats, cost $40,000 all; o, Max Goldstein; a, Thos Graham.

111th St & 7th Ave, br flat, cost $100,000; o, Ida E Moore; a, C A Millner.

132nd St & Lenox Ave, br flat, cost $24,000; o, Etty Wolff; a, Rudolph Werner.

Hamilton Pl & 141st St, br flat, cost $75,000; o & a, Patrick H Lynch.

133rd St & Amsterdam Ave, 5 br flats, cost $100,000 all; o, Behnken Bros; a, Lawrence & Ringrose.

Cauldwell Ave & 156th St, br flat, cost $24,000; o, Arthur Gorsch; a, Franz Wolfgang.

3rd Ave & Wendover Ave, 3 br flats, cost $75,000 all; o, Katie Nierenberg; a, R Werner.

St Anns Ave & 157th St, 4 br flats, cost $107,000 all; o, Isidore Cohen; a, R Werner.

3rd Ave & 171st St, br flat, cost $25,000; o, David Cohen; a, R Werner.

Hewitt Pl & 156th St, br flat, cost $20,000; o, James O'Hare; a, W C Dickerson.

Sands & Bridge Sts, 2 br tenem'ts, cost $40,000 all; o, W W Davies; a, F S Lowe.

NEW INDUSTRIAL PLANTS.

C. L. Searcy, Waco, Ky., is to enlarge his brick and tile plant, and will put in a 30-H.-P. boiler and engine.

James Leffel & Co., Springfield, O., are to enlarge their foundry and will put in a three-motor electric traveling crane.

The Cataract Mfg. Co., Buffalo, N. Y., is to build a 4-story brick factory, 150x36 ft., and will want sprinkler system, elevator and machinery for working steel and iron.

I. A. Hall & Co. of Paterson, N. J., have plans prepared for a 3-story mill, 50x150 ft., and will probably want a 100-H.-P. boiler and 75-H.-P. engine.

The Castalia Portland Cement Co. of Pittsburg, Pa., will soon increase the capacity of its plant from 700 to 1,400 bbls.

Irving Bros. of Portsmouth, Va., are to erect a 3-story, 90x32-ft. spring bed and mattress factory.

The Utica Cabinet Co. of Utica, N. Y., will move its plant to Knoxville, Tenn., and will use 250 to 300 H.-P. to operate the same.

W. E. Fountain and associates of Tarboro, N. C., are to erect an 80x300-ft. hosiery yarn mill, with 300 H.-P., and want shafting, fittings, etc.

M. F. Moore has contracted with the Berlin Iron Bridge Co. for the erection of a 200x100-ft. building at Harrison, N. J., for shipbuilding.

The St. Louis Motor Carriage Co., St. Louis, Mo., is erecting a 3-story, 40x115-ft. factory.

The Wheeler & Wilson Mfg. Co., Bridgeport, Conn., are making additions to their foundry, wood-working shop and box mill.

The Burlington Malting Co. of Burlington, Wis., is erecting a factory 125x50 ft. and 85 ft. high, with a capacity of 200,000 bushels.

The International Seal & Lock Co., Hastings, Mich., will rebuild its plant, putting up a 50x100-ft. brick building with a 40-H.-P. power plant.

Clinton Burnham, Milwaukee, Wis., is erecting an 85x100-ft. foundry, and will begin casting with a 10 to 12-ton plant.

BUSINESS NOTES.

Evans, Almirall & Co., 44 Dey St., New York, have closed a contract with the Red Oak, Ia., Electric Light Co. for a central heating plant using the Evans system of exhaust hot water heating.

The Oliver Hotel, South Bend, Ind., is putting in an unusually complete electric plant and has ordered two 60 H. P. and one 100 H. P. engine from the Ball Engine Co., Erie, Pa. The latter company reports selling recently a 175 H. P. tandem compound engine to the Edward Ford Plate Glass Works, Toledo, Ohio; an engine for electric service to the American Chemical & Spirit Co., Evansville, Ind.; two engines for the same service to the West End Trust Co. Building, Philadelphia, and to have a number of orders for Russia, Japan, Mexico and Venezuela.

Westinghouse, Church, Kerr & Co. report extensive orders for the new Roney mechanical stokers, including 12 for the Pressed Steel Car Co., Pittsburg, Pa.; 116 for the Metropolitan Street Railway Co., New York; 8 for Cheney Bros., South Manchester, Conn.; 24 to the General Electric Co.; 16 to the Trenton, N. J., Iron Works, and 20 to the Nichols Chemical Co., Brooklyn, N. Y.

The Berlin Iron Bridge Co. reports a number of important contracts on hand. It is putting up a 72x170 foot machine shop for the Duncan Co. at Mechanicsville, N. Y., in which the roof trusses are arranged with trolley beams and hoists so that rolls of paper can be lifted in and out of the paper machines by power. The Providence Gas Co. has ordered the construction of a meter house, a purifier house and a gas holder building, all of them very large structures. The Hendey Machine Co., Torrington, Conn., has placed a contract with the company for the steel work of a 40x60-foot engine room, which will have the company's patent anti-condensation lining on the roof. The same company has contracts for the bridges on the line of the Shelton Street Railway, which aggregate between 800 and 900 feet length. The annual reception and oyster roast, which has become one of the prominent annual functions in Connecticut, was held at the works of the company recently; it was attended by guests from all the large cities of New England and from many of the neighboring states, and to judge from all the accounts which have been received, was an even more brilliant affair than those held in previous years.

The Chicago Pneumatic Tool Co. announces that Mr. Sydney H. Wheelhouse is now connected with the company as its southwestern agent, with salesroom and office at 409 North Fourth St., St. Louis, Mo. The surprising demand for pneumatic tools in this country is shown by the fact that on Monday this company received orders for 81 pneumatic hammers and riveters, 57 drills and 17 sundry tools, a total of 155 orders for a single day.

The Buffalo Forge Co. have recently shipped two fans for induced draft to the Compania Metalurgica Mexicana, San Luis, Potosi, Mexico. The fans are said to be the largest that have ever been built for this work, and without question the largest, if not the first, draft fans ever used in Mexico. The power plant of S. D. Warren & Co., Cumberland Mills, Me., is to be equipped with Buffalo fans of the same size. This installation includes economizers and was put in by Westinghouse, Church, Kerr & Co. Another recent order of importance for an induced draft plant is one shipped to Johannesburg, South Africa. The latter are to be driven by direct-connected, two-cylinder, double-acting and closed engines of the U. S. Navy type.

PROPOSALS OPEN.

Bids Close		See Eng. Record
	WATER-WORKS.	
May 15.	Gallatin, Tenn.	Apr. 22
May 15.	Wellsville, O.	Apr. 22
	Adv., Eng. RECORD, Apr. 29.	
May 16.	Pipe etc Montreal, Que	May 6
May 16.	Ottawa, Ont	Apr. 22
May 16.	Boilers, Chicago, Ill	Apr. 29
May 16.	Pig lead, Jersey City, N. J	May 13
May 17.	Washington, D C	Apr. 29
May 17.	Boston, Mass	Apr. 29
	Adv., Eng. RECORD, Apr 29, May 6.	
May 18.	Highlands, Ky	May 13
May 18.	Steel pipe, Chicago, Ill	May 13
May 22.	Cullman, Ala	Apr. 29
	Adv., Eng. RECORD, Apr. 29.	
May 22.	Pine Island, Minn	May 13
	Adv., Eng. RECORD, May 13	
May 24.	Gaffney City, S C	May 6
	Adv., Eng. RECORD, May 6, 13.	
May 25.	Tacoma, Wash.	May 6
May 26.	Cincinnati, O	Apr. 29
May 27.	Washington, D. C	Apr. 29
	Adv., Eng. RECORD, Apr. 29.	
May 27.	Pipe, Washington, D. C	May 6
	Adv., Eng. RECORD, May 6.	
May 29.	Allentown, Pa	May 6
	Adv., Eng. RECORD, May 6.	
May 31.	Pendleton, Ore	May 6
June 5.	Winnipeg, Man	May 6
	Adv., Eng. RECORD, May 6, 13.	
June 13.	Pipe, Cincinnati, O	May 13
	Adv., Eng. RECORD, May 13.	
June 27.	St. Louis, Mo	May 6
——	Grand Forks, N. D.	Apr. 22
——	Peekskill, N Y	Apr. 15
	Adv., Eng. RECORD, Apr. 15, 22.	
——	Napoleonville, La	Mar. 25
——	Corinth, Miss	Mar. 25
	SEWERAGE AND SEWAGE DISPOSAL.	
May 15.	St. Paul, Minn	May 13
May 15.	Montreal, Que	May 13
May 15.	Indianapolis, Ind	May 13
May 15.	Elizabeth, N. J	Apr. 29
May 15.	Lead, S. D	Apr. 29
May 15.	Supplies, Worcester, Mass	Apr. 29
May 15.	Medford, Ore	Apr. 1
May 15.	Quincy, Mass	May 6
May 15.	Warren, Pa	May 6

May 16. St. Louis, Mo....................May 6
May 16. Atlanta, Ga....................May 13
May 16. Carnegie, Pa....................May 13
May 17. Chicago, Ill....................May 13
May 17. Birmingham, Ala....................May 13
May 17. Auburn, Ind....................Apr. 22
Adv., Eng. RECORD, Apr. 22.
May 18. Norristown, Pa....................Apr. 29
May 19. Cambridge, O....................Apr. 29
Adv., Eng. RECORD, Apr. 29.
May 19. Cedar Rapids, Ia....................May 13
May 19. Sheridan, Pa....................May 13
May 20. Auburn, Ind....................Apr. 8
May 20. Norristown, Pa....................May 6
May 22. Muncie, Ind....................May 6
May 25. Tacoma, Wash....................May 6
May 25. Buffalo, N. Y....................May 13
May 26. Wahpeton, N. D....................May 13
May 29. Muncie, Ind....................May 13
June 1. Honolulu, H. I....................May 13
June 2. Cincinnati, O....................May 13
July 5. New Orleans, La....................Apr. 29
Adv., Eng. RECORD, May 6, 13.
June 5. Jamestown, N. D....................May 13
June 5. Hillsboro, N. D....................May 13
June 6. Pipe, Oberlin, O....................May 13

BRIDGES.

May 15. Wessington Springs, S. D....................Apr. 29
May 15. Honolulu, H. I....................Apr. 22
May 15. Plainfield, N. J....................Apr. 29
May 15. Petersburg, Va....................Apr. 29
Adv., Eng. RECORD, Apr. 29.
May 15. Haverhill, Mass....................Apr. 29
May 15. Road roller, Nanaimo, B. C....................Apr. 22
May 16. Buffalo, N. Y....................May 6
May 16. St. Louis, Mo....................May 6
May 16. Seymour, Ill....................May 13
May 16. Albany, N. Y....................May 6
Adv., Eng. RECORD, May 6, 13.
May 17. Norristown, Pa....................Apr. 22
May 17. Forman, N. D....................Apr. 29
May 17. Pittsburg, Pa....................May 13
May 20. Tiffin, O....................May 13
May 20. Walla Walla, Wash....................May 13
May 22. Algona, Ia....................May 13
May 22. Toronto, Ont....................Apr. 29
Adv., Eng. RECORD, Apr. 29, May 6.
May 22. Hailey, Idaho....................May 6
May 24. Aberdeen, S. D....................Apr. 29
May 27. Washington, D. C....................Apr. 29
Adv., Eng. RECORD, Apr. 29.
May 31. Chicago, Ill....................Apr. 8
Adv., Eng. RECORD, Apr. 15.
June 1. Hot Springs, Ark....................May 13
June 1. Brookings, S. D....................May 13
June 6. Humboldt, Ia....................May 13
June 6. Cumberland, Md....................May 13
June 8. Plymouth, Ind....................May 13
—— Quincy, Ill....................Feb. 25
Adv., Eng. RECORD, Feb. 25.
—— Bradford, Pa....................Apr. 15
—— Randolph, Utah....................Apr. 15

PAVING AND ROADMAKING.

May 15. Norwich, Ont....................May 6
May 15. Erie, Pa....................May 6
May 15. Albany, N. Y....................May 6
May 15. Union City, Pa....................May 6
Adv., Eng. RECORD, May 6, 13.
May 15. Stamford, Conn....................May 6
Adv., Eng. RECORD, May 6, 13.
May 16. St. Louis, Mo....................May 6
May 16. Jersey City, N. J....................May 13
May 17. Birmingham, Ala....................May 13
May 17. Chicago, Ill....................May 13
May 17. Camden, N. J....................May 13
May 19. Roselle, N. J....................May 6
May 20. San Antonio, Tex....................May 6
Adv., Eng. RECORD, May 6, 13.
May 20. Washington, D. C....................Apr. 22
(2 advts.) Adv., Eng. RECORD, Apr. 22.
May 22. Cincinnati, O....................Apr. 29
May 22. Glens Falls, N. Y....................Apr. 22
Adv., Eng. RECORD, Apr. 29 to May 13.
May 22. Randolph, Ind....................May 13
May 23. Binghamton, N. Y....................May 13
May 23. Watertown, Wis....................Apr. 29
Adv., Eng. RECORD, Apr. 29 to May 13.
May 24. Veedersburg, Ind....................May 6
May 25. Alliance, O....................May 6
May 25. Buffalo, N. Y....................May 13
May 26. Cincinnati, O....................May 6
May 29. Bowling Green, O....................May 6
June 2. Shelby, O....................May 13
Adv., Eng. RECORD, May 13.
June 5. Muncie, Ind....................May 13
June 6. Portsmouth, O....................May 13

POWER, GAS AND ELECTRICITY

May 15. Lebanon, Pa....................Apr. 22
May 15. New York, N. Y....................May 6
May 16. El. light fixtures, Syracuse, N. Y....................May 13
May 17. Boilers, etc., Barrie, Ont....................May 13
May 22. Vincennes, Ind....................Apr. 8
Adv., Eng. RECORD, Apr. 8, 22, May 6.
May 22. Cullman, Ala....................Apr. 29
Adv., Eng. RECORD, Apr. 29.
May 22. New York, N. Y....................May 13
May 26. Newport News, Va....................May 13
May 26. Gas franchise, Danville, Ill....................May 13
June 1. Prineville, Ore....................Apr. 15
June 1. Mechanicsville, Ia....................May 13
June 15. Petrolia, Ont....................May 13
—— Pleasantville, O....................Dec. 24

GOVERNMENT WORK.

May 13. Chattanooga, Tenn....................Apr. 15
Adv., Eng. RECORD, Apr. 15 to May 6.
May 15. New York City....................Apr. 15
Adv., Eng. RECORD, Apr. 15 to May 6.
May 15. Cleveland, O....................Apr. 22
Adv., Eng. RECORD, Apr. 29, May 6.
May 15. Fort Myer, Va....................May 6
May 16. Sewers, Atlanta, Ga....................May 13
May 16. Ellis Island, N. Y. Harbor....................Apr. 22
Adv., Eng. RECORD, Apr. 22, 29.
May 17. Milwaukee, Wis....................Apr. 22
Adv., Eng. RECORD, Apr. 22, May 13.
May 17. New York, N. Y....................Apr. 22
Adv., Eng. RECORD, Apr. 22, May 13.
May 17. Wreck, Boston, Mass....................Apr. 22
May 18. Baltimore, Md....................Apr. 15
Adv., Eng. RECORD, Apr. 15 to May 6.
May 18. Ellis Island, N. Y. Harbor....................Apr. 22
Adv., Eng. RECORD, Apr. 22, 29.
May 18. Dredging, etc., New London, Conn....................Apr. 22
May 18. Fort Trumbull, Conn....................Apr. 29
Adv., Eng. RECORD, Apr. 29 to May 13.
May 19. Pier, St. Joseph, Mich....................Apr. 22
May 20. Steel I beams, etc., Chicago, Ill....................May 13
May 20. Buffalo, N. Y....................Apr. 22
May 22. Ellis Island, N. Y....................Apr. 29
Adv., Eng. RECORD, Apr. 29, May 6.
May 22. Oswego, N. Y....................Apr. 29
Adv., Eng. RECORD, Apr. 29 to May 13.
May 22. Cement, Louisville, Ky....................Apr. 29
Adv., Eng. RECORD, Apr. 29 to May 13.
May 22. Bldg., Washington, D. C....................May 13
May 25. Tompkinsville, N. Y....................May 13
May 25. Storehouse, Baltimore, Md....................Apr. 29
May 25. Milwaukee, Wis....................Apr. 29
Adv., Eng. RECORD, Apr. 29 to May 13.
May 25. Mobile, Ala....................Apr. 29
Adv., Eng. RECORD, Apr. 29 to May 13.
May 25. Chicago, Ill....................Apr. 29
Adv., Eng. RECORD, Apr. 29 to May 13.
May 25. Hospital, Chicago, Ill....................May 6
Adv., Eng. RECORD, May 6, 13.
May 25. Tacoma, Wash....................May 6
May 27. San Francisco, Cal....................Apr. 29
Adv., Eng. RECORD, Apr. 29, May 6.
May 29. Dredging, San Francisco, Cal....................May 6
May 29. Louisville, Ky....................May 6
May 31. Armor plate, Washington, D. C....................Apr. 8
May 31. St. Louis, Mo....................Apr. 22
Adv., Eng. RECORD, Apr. 22, 29, May 13.
May 31. Rock Island, Ill....................Apr. 29
Adv., Eng. RECORD, Apr. 29 to May 13.
May 31. St. Augustine, Fla....................May 6
Adv., Eng. RECORD, May 6, May 13.
May 31. Bldgs., Atlanta, Ga....................May 13
May 31. Bldg., etc., Spokane, Wash....................May 13
June 3. Excavating, etc., New York City....................May 6
Adv., Eng. RECORD, May 6, 13.
June 3. Dredging, New York City....................May 6
Adv., Eng. RECORD, May 6, 13.
June 5. Hospital, etc., Madison Barracks, N. Y....................May 13
June 7. Repairing Custom House, Detroit, Mich....................May 13
Adv., Eng. RECORD, May 13.
June 8. Dredging, New London, Conn....................May 6
June 8. New Orleans, La....................May 6
June 8. Dredging, Newport, R. I....................May 13
Adv., Eng. RECORD, May 13.
June 8. Levee work, New Orleans, La....................May 13
Adv., Eng. RECORD, May 13.
June 8. Wreck and dredging, Philadelphia, Pa....................May 13
June 9. Piers, Holland, Mich....................May 13
June 9. Dredging, Cleveland, O....................May 13
June 9. Dredging, Mobile, Ala....................May 13
Adv., Eng. RECORD, May 13.
June 9. Dredging, New London, Conn....................May 6
June 10 Bremerton, Wash....................May 6
June 10. Dry dock, San Francisco, Cal....................Apr. 15
June 12. Breakwater, New York, N. Y....................May 13
Adv., Eng. RECORD, May 13.
June 12. Dredging, Portland, Me....................May 13
Adv., Eng. RECORD, May 13.
June 12. Excavation, Portland, Me....................May 13
Adv., Eng. RECORD, May 13.
June 15. Dredging, Portland, Me....................May 13
Adv., Eng. RECORD, May 13.
June 15. Htg., etc., Washington, D. C....................May 13

BUILDINGS.

May 15. School, Jamestown, N. Y....................May 13
May 15. City hall, Covington, Ky....................May 13
May 15. Town hall, Lafayette, O....................May 13
May 15. School, Geneva, O....................Apr. 29
May 15. School, Colfax, N. D....................Apr. 29
May 15. School, Watkins, Minn....................Apr. 29
May 15. Schools, New York, N. Y....................May 6
May 15. School, Franklin, Minn....................May 6
May 15. School, Wakefield, Neb....................May 6
May 15. Court house, Piggott, Ark....................May 6
May 15. City hall, Elwood, Ind....................May 6
May 15. School, Stevens Point, Wis....................May 6
May 15. Home, Vineland, N. J....................May 6
May 15. Lake Park, Minn....................May 6
May 16. Jail, Stillwater, Minn....................May 6
May 17. Plans, school, Trenton, N. J....................May 6
May 17. Court house, Central City, Colo....................May 13
May 17. Jail, Kingston, N. Y....................May 6
May 17. Infirmary, Norristown, Pa....................Apr. 22
May 17. Htg. Plant, Columbus, O....................Apr. 22
May 17. Vent. and htg. school, West Burlington, Ia....................Apr. 29
May 18. School, Des Moines, Ia....................Apr. 29
May 18. School, Syracuse, Utah....................May 6
May 18. Boilers, Athens, O....................May 6
May 19. School, Springfield, Mass....................May 13
May 20. School, Newton, Ia....................May 6
May 20. School, Dazey, N. D....................May 6
May 20. School, Martins Ferry, O....................May 6
May 20. School, Cleveland, O....................May 6
May 20. School, Wyocena, Wis....................May 6
May 20. Schools, Montgomery, Ala....................May 6
May 20. School, Huntington, W. Va....................Apr. 29
May 20. School, Centerville, Ia....................Apr. 29
May 20. Savannah, Ga....................May 13
May 20. School, Paulding, O....................May 13
May 20. Htg. court house and gaol, Cayuga, Ont....................May 13
May 20. Plumbing school, Washington, D.C....................May 13
May 22. School, Canton, O....................May 13
May 22. Temple, Eagle Grove, Ia....................May 13
May 22. Court house, Parkersburg, W. Va....................May 13
May 22. Schools, Bottineau, N. D....................May 6
May 22. School, Oskaloosa, Ia....................May 6
May 22. Schools, New York, N. Y....................May 13
May 22. School, Paulding, O....................May 13
May 22. School, Glenwood, Minn....................May 13
May 23. Schools, Detroit, Mich....................May 13
May 23. Dormitory, Washington, D. C....................Apr. 29
May 23. School, Arkansas City, Kan....................May 6
May 24. Hospital, Ft. Steilacoom, Wash....................May 6
May 24. Dormitory, Grand Forks, N. D....................May 6
May 24. School, Des Moines, Ia....................Apr. 29
May 24. School, Auburn, O....................May 13
May 24. Dormitory, Orting, Wash....................May 13
May 24. Court house, Springfield, Mass....................May 13
May 24. School, Mapleton, Utah....................May 13
May 26. Engine house, Erie, Pa....................May 13
May 27. School, Hinton, Ia....................Apr. 29
May 27. School, Pleasant City, O....................May 6
May 27. School, Landis, O....................May 13
May 29. School, Toledo, O....................May 13
May 29. Minneapolis, Minn....................May 13
May 29. School, Keswick, Ia....................May 13
May 29. Court house, Salisbury, N. C....................May 13
May 30. School, Tehamah, Neb....................May 13
May 30. Drill hall, Vancouver, B. C....................May 13
May 30. Elevator, Hamilton, O....................May 13
May 31. School, Pleasantville, Ia....................May 13
May 31. Home, Danville, Ill....................May 13
Adv., Eng. RECORD, May 13.
May 31. Sitka, Alaska....................May 13
May 31. Heating, etc., court house, Dartford, Wis....................May 13
June 1. Htg. school, Ellendale, N. D....................May 6
June 1. School, Beattyville, Ky....................Apr. 22
June 1. Town hall, Utica, Ia....................Apr. 29
June 1. Htg. school, Ludden, N. D....................May 13
June 3. School, Mayfield, O....................May 13
June 5. Market house, San Antonio, Tex....................May 13
June 6. Hospital, Auburn, Cal....................Apr. 29
June 12. Htg. asylum, New Albany, Ind....................Apr. 29
June 15. Plans, school, Madison, Wis....................Apr. 29
June 22. Remodeling court house, Marietta, Ga....................May 13

MISCELLANEOUS

May 15. El. Ry. franchise, Louisville, Ky....................May 13
May 15. Railroads, Santiago, Chile....................Apr. 15
May 15. Engineers' supplies, New York, N.Y....................May 6
May 15. Grading, etc., Parral, Mexico....................May 6
May 16. R. R. work, Richmond, Va....................Apr. 29
Adv., Eng. RECORD, Apr. 29.
May 16. Cement, etc., Jersey City, N. J....................May 13
May 17. Cement, Pittsburg, Pa....................May 13
May 18. Chicago, Ill....................May 13
May 18. Subway, Morristown, N. J....................May 6
Adv., Eng. RECORD, May 6.
May 23. El. Ry. franchise, Riverside, Cal....................May 6
May 24. Dredging, Brooklyn, N. Y....................May 13
May 24. Rails, Santiago, Chile....................Apr. 22
May 26. Garbage disposal, Binghamton, N.Y....................May 6
May 29. Fire Alarm, New Orleans....................May 6
Adv. Eng. RECORD, May 6.
June 30. El. Ry., Shanghai, China....................Mar. 4
May 31. Coal and ash conveyor, Danville, Ill....................May 13
Adv., Eng. RECORD, May 13.
May 31. El. Ry. franchise, Redlands, Cal....................May 13
June 1. Street cleaning, Utica, N. Y....................May 13
Oct. 1. Railroad, Moscow, Russia....................Feb. 25
—— Garbage plant, Savannah, Ga....................Apr. 29
Adv., Eng. RECORD, Apr. 29, May 6.

SCHOOLS.

Ludden, N. D.—Bids are wanted June 1 for furnishing a boiler and installing a steam heating plant in North Dakota Industrial and Manual Training School. T. H. Fans, Secy. Bd. Trus.

Worcester, Mass.—J. Wm. Patson of Worcester has prepared plans for a $30,000 school to be erected on Grafton St.

Keswick, Ia.—Bids are wanted May 29 for a school. J. F. Cameron.

Lowell, Mass.—A $30,000 school will be erected on Paige and John Sts.

Minneapolis, Minn.—The Board of Education on May 1 adopted the report of the committee on buildings, which recommended the erection of new schools and additions, to cost $187,700.

Milwaukee, Wis.—The Lutheran Synod is stated to have appropriated $35,000 to build an additional building at Concordia College.

Pleasantville, Ia.—Bids are wanted May 31 for a school. W. R. Parsons & Son Co., Archts., Des Moines.

Washington, D. C.—Bids are wanted May 20 for repairs to and changes in plumbing in Brightwood school. John B. Wight, Commr. D. C.

Hartford, Conn.—Geo. H. Gilbert, 67 Willard St., has prepared plans for a $20,000 school for the North East district.

Westfield, Mass.—An appropriation of $30,000 is stated to have been made to build a normal school.

Searcy, Ark.—W. R. Stewart & Bro. of Newport are stated to have received the contract for a building for the Galloway Methodist Female College, at $26,840. Chas. L. Thompson, Archt., Little Rock.

Springfield, Mass.—Bids are wanted May 19 for a training school at the Westfield State Normal School. Joel D. Miller, Chmn. Bd. Visitors.

Tekamah, Neb.—Bids are wanted May 30 for a school; also ventilating and heating same. G. W. Green, Secy. Bd. Educ.

Glenwood, Minn.—Bids are wanted May 22 for a school. C. L. Peterson, Secy. Bd. Educ.

Mapleton, Utah.—Bids are wanted May 24 for a school. J. H. Lee, Chmn.

Taunton, Mass.—Plans are under consideration for a $40,000 addition to the high school.

Parkersburg, W. Va.—The plans of W. H. Patton of Parkersburg, have been accepted for the $25,000 school.

Canton, O.—Bids are wanted May 22 for a school in Washington township. G. E. Loger, Clk.

Stewartville, Minn.—The citizens have voted to erect a $15,000 school.

Landis, O.—Bids are wanted May 27 for a school. Chas. Hansbarger, Clk.

Mayfield, O.—Bids are wanted June 3 for a school in Mayfield Township. G. J. Straight, Clk. Bd. Educ.

Auburn, O.—Bids are wanted May 24 for a school. G. B. Ridge, Clk. Bd. Educ.

Detroit, Mich.—Bids are wanted May 23 for 2 schools, also for ventilating and heating apparatus in same. Bids are also wanted for 10 steam boilers and automatic stokers for 10 boilers. L. H. Chamberlin, Secy. Bd. Educ.

Jamestown, N. Y.—Bids are wanted May 15 for additions to 3 schools. Fredk. A. Fuller, Jr., Pres. Bd. Educ.

Toledo, O.—It is stated that bids are wanted May 29 for a school. Franklin Hubbard, Clk. Bd. Educ.

New York City.—The Board of Estimate on May 3 authorized a bond issue of $1,441 for heating Grammar School No. 93, in the Borough of Bronx; $21,000 for heating Grammar School No. 173, in same borough; $88,000 for additions to Grammar School No. 84, in the Borough of Richmond, and $307,827 for 8 school sites.

Bids are wanted May 22 for alterations, repairs, etc., to several schools, Borough of Manhattan; also for additions and repairs to heating apparatus in schools No. 87 & 96, Borough of Manhattan, and for a ventilating and heating apparatus for schools No. 5 and 70, Borough of Brooklyn. Richard H. Adams, Chmn. Com. on Bldgs.

A permit has been issued for two 3-story brick schools to be erected on Whipple St. and Throop Ave., Boro. of Brooklyn, for All Saints R. C. Church, to cost $46,000. F. J. Berbenbach, Archt., 260 Graham Ave.

A permit was also issued for a 3-story brick extension to the Berkeley Institute, 183 Lincoln Pl., to cost $25,900. Walker & Morris, Archts., 44 Pine St., N. Y. L. W. Seaman, Jr. & Son, Builders, 133 Grand Ave.

STREET CLEANING AND GARBAGE DISPOSAL.

Montclair, N. J.—The contract for collecting and disposing of garbage for the coming year has been awarded to J. J. Alworth for $3,700.

Colorado Springs, Colo.—The City Clk. has been instructed to secure bids for disposing of the city's garbage.

Utica, N. Y.—It is stated that bids are wanted June 1 by the Clerk of the City Council for street cleaning.

GOVERNMENT WORK.

Madison Barracks, N. Y.—Bids are wanted June 5 for a Post Hospital; also for heating, plumbing, etc., in same. Lt. T. A. Pearce, 7th Inf., Q. M.

Atlanta, Ga.—Bids are wanted May 16 for a sewer system at Tybee Island. John Simpson, Dept. Q. M. Gen., U. S. A., Ch. Q. M.

Newport, R. I.—Bids are wanted June 8 for dredging in New Bedford Harbor, Mass., as advertised in "The Engineering Record."

Atlanta, Ga.—Bids are wanted May 31 for 1 set non-com. officers' quarters at Fort Pulaski. John Simpson, Dept. Q. M. Gen., U. S. A., Ch. Q. M.

Detroit, Mich.—Bids are wanted June 7 for changes, alterations and repairs to the U. S. Custom House, as advertised in "The Engineering Record."

New York, N. Y.—Press reports state that the contract with Andrew Onderdonk for deepening the east channel has been approved by Secretary of War Alger.

New Orleans, La.—Bids are wanted June 8 for improving Bayou Plaquemine, La., as advertised in "The Engineering Record."

Holland, Mich.—Bids are wanted June 9 for repairing government piers. Capt. Chester Harding, Corps Engrs., U. S. A., Grand Rapids, Mich.

Spokane, Wash.—Bids are wanted May 31 for a building, plumbing, steam-heating and gas piping at the new military post. Capt. R. B. Turner, 6th Inft., Constructing Q. M.

Chicago, Ill.—Bids are wanted May 20 for furnishing at Chicago, St. Louis or San Francisco, steel I beams, Larimer columns, plate girders and roof trusses. Col. J. G. C. Lee, Ch. Q. M.

Tompkinsville, N. Y.—Bids are wanted May 25 for the erection of West Bank light station and for furnishing metal work for same. Bids are also wanted May 27 for furnishing metal work for the East Face wharf, Light-House Dept. Lieut. Col. D. P. Heap, Corps Engrs., U. S. A.

Cleveland, O.—Bids are wanted June 9 (readvertisement) for dredging in Cleveland harbor. Col. Jared A. Smith, Corps Engrs., U. S. A.

Portland, Me.—Bids are wanted June 12 for dredging at Lubec Channel, Me., and for ledge excavation at Mooseabec Bar and Sullivan Falls, Me., and on June 15 for dredging Georges River, Me., as advertised in "The Engineering Record."

Brockton, Mass.—The following bids were opened May 8 at the office of the Supervising Archt., U. S. Treasury Dept., for ventilating and heating apparatus in the Brockton Post Office: Edward B. Bates, Albany, N. Y., $3,751; Lynch & Woodward, Boston, Mass., $3,669; A. B. Franklin, Boston, Mass., $3,734; Frank Dobson, New York, $4,000; E. Rutzler, New York, $3,457; Pittsburg Heating & Supply Co., Pittsburg, Pa., $2,779; Edward Joy, Syracuse, N. Y., $4,309.

Washington, D. C.—Bids are wanted June 15 for repairs to the heating and power plants in the U. S. Treasury, Winder and U. S. Marine Hospital service buildings. Jas. Knox Taylor, Supervising Archt.

Chicago, Ill.—The following proposals were opened May 9 by Major W. L. Marshall for constructing 13 miles of feeder of the Illinois & Mississippi Canal. Sections 17 and 18 contain 245,712 cu. yds. earthwork excavation; Sections 19 and 20, 241,823 cu. yds.; Sections 21 and 22, 288,502 cu. yds.; Sections 23 and 24, 372,263 cu. yds.; Sections 25 and 26, 393,189 cu. yds.; Section 27, 102,592 cu. yds.; Section 28, 127,604 cu. yds.; Section 29, 167,621 cu. yds.

Corbett & Currie, Chicago, Ill., Sec. 27, $10,741.

Callahan Construction Co., Omaha, Neb., Secs. 17 and 18, $30,714; Secs. 19 and 20, $29,623; Secs. 21 and 22, $44,718; Secs. 23 and 24, $64,215; Secs. 25 and 26, $62,910; Sec. 27, $10,003; Sec. 28, $15,951; Sec. 29, $23,048; total bid, $281,182.

John J. McCaughey, Summit, Ill., Secs. 17 and 18, $44,228; Secs. 19 and 20, $33,662; Secs. 21 and 22, $70,683; Secs. 23 and 24, $83,759; Secs. 25 and 26, $75,414; Sec. 27, $13,655; Sec. 28, $19,013; Sec. 29, $39,391; total bid, $379,805.

George W. Jackson Construction Co., Chicago, Ill., Secs. 17 and 18, $23,957.

Christie, Lowe & Heyworth, Chicago, Ill., Secs. 17 and 18, $38,036; Secs. 19 and 20, $37,434; Secs. 21 and 22, $44,660; Secs. 23 and 24, $57,626; Secs. 25 and 26, $60,866; Sec. 27, $15,881; Sec. 28, $19,753; Sec. 29, $25,948; total bid, $300,205. This proposal being based on award of entire work only and not being lowest for the whole work, was not considered in arriving at lowest bid for each mile or section.

T. W. Kinser & Sons, Terre Haute, Ind., Secs. 17 and 18, $29,117; Secs. 19 and 20, $28,656; Secs. 21 and 22, $77,896; Secs. 23 and 24, $122,847; Secs. 25 and 26, $106,161; Sec. 27, $19,492; Sec. 28, $24,245; Sec. 29, $28,496; total bid, $436,909.

Mobile, Ala.—Bids are wanted June 9 for dredging channel, Gulfport to Ship Island, Miss., as advertised in "The Engineering Record."

New York, N. Y.—Bids are wanted June 12 for building riprap breakwater at Larchmont Harbor, Long Island Sound, as advertised in "The Engineering Record."

Philadelphia, Pa.—Bids are wanted June 8 for dredging in Alloway Creek and Rancocas River, N. J.; also for the removal of the wrecked sloop "John W. Elliott," lying in Delaware River, opposite mouth of Alloway Creek. Lieut. Col. C. W. Raymond, Corps Engrs., U. S. A.

Washington, D. C.—Bids are wanted May 22 for additions to the annex buildings of the Weather Bureau. Jas. Wilson, Secy. U. S. Dept. of Agriculture.

PROPOSALS.

Proposals for Installing a Complete System of Water-Works for the Village of Pine Island, Minn.

Sealed proposals will be received at the office of the undersigned, until 12 o'clock, noon, the 22d day of May, 1899, for furnishing, trenching and laying in the said Village of Pine Island, Minn., about (120) one hundred and twenty tons of cast iron pipe, (8-6-4 in.) eight, six and four inches diameter respectively; (2½) two and one-half tons of specials; (12) twelve double nozzle hydrants; (6) six gate valves; one 15 H.P. gasoline engine; one single acting deep well triplex pump of (15,000) fifteen thousand gallons capacity per hour; construction of a storage reservoir of (60,000) sixty thousand gallons capacity, and one suction well.

Each bid must be accompanied by satisfactory bond covering the entire amount of each respective part of the work bid upon, signed by two sureties; or each bid must be accompanied by a certified check, for 10% of the total amount of each respective bid, such checks and bonds to be returned to unsuccessful bidders.

Specifications may be seen at the office of the undersigned or at the office of the Consulting Engineer, Mr. A. M. Patitz, 1101 Pabst Building, Milwaukee, Wis., and at Room 1636, Monadnock Building, Chicago, Ill., where contractors may view them and obtain such additional information as is required.

The Village Board reserves the right to reject any or all bids.

JOHN E. CLARK, Village Recorder.
Pine Island, Goodhue County, Minn.

Proposals for Coal and Ash Conveyor for Danville Branch, N. H. D. V. S.

National Home for D. V. Soldiers,
HARTFORD, CT., May 10th, 1899.

Sealed proposals will be received at the office of the National Home for Disabled Volunteer Soldiers, near Danville, Illinois, until three o'clock P. M., Wednesday, the 31st day of May, 1899, for furnishing materials, labor, etc., and putting in place complete coal and ash conveyor, hoppers, engine, etc., for the boiler house at the Danville Branch of the National Home for D. V. Soldiers. For all necessary information apply to Wm. C. Gunnell, Civil Engineer, at the National Soldiers' Home, Danville, Illinois, where drawings, specifications, etc., can be seen and blanks for proposals obtained. Each bid must be accompanied b~ a certified check for five per centum of the amount of the proposal. The Home reserves the right to reject any or all bids and to waive defects.

J. M. BERMINGHAM,
General Treasurer, N. H. D. V. S.
Approved:
W. B. FRANKLIN,
President Board of Managers, N. H. D. V. S.

Proposals for Headquarters Building at Danville Branch, N. H. D. V. S.

National Home for D. V. Soldiers,
HARTFORD, CT., May 10th, 1899.

Sealed proposals will be received at the office of the National Home for Disabled Volunteer Soldiers, near Danville, Illinois, until three o'clock P. M., Wednesday, the 31st day of May, 1899, for furnishing materials, labor, etc., and erecting a Building for Headquarters at the Danville Branch of the National Home for D. V. Soldiers. For all necessary information apply to Wm. C. Gunnell, Civil Engineer, at the National Soldiers' Home, Danville, Illinois, where drawings, specifications, etc., can be seen and blanks for proposals obtained. Each bid must be accompanied by a certified check for five per centum of the amount of the proposal. The Home reserves the right to reject any or all bids and to waive defects.

J. M. BERMINGHAM,
General Treasurer, N. H. D. V. S.
Approved:
W. B. FRANKLIN,
President Board of Managers, N. H. D. V. S.

MISCELLANEOUS.

Buffalo, N. Y.—Mayor Diehl has a[pp]roved bills allowing the city to fill [in] and sell the Hamburg canal and iss[ue] $550,000 bonds for the same.

Chicago, Ill.—Bids are wanted May [] for pumping out clay hole betwe[en] Southport and Perry Aves. L. E. M[c]Gann, Commr. Pub. Wks.

Little Rock, Ark.—Bids are wante[d] June 5 for $100,000 Plum Bayou leve[e] bonds. S. Geisreiter, Chmn. Inspect[or] of Plum Bayou Levee Dist.

Brooklyn, N. Y.—Bids are wanted Ma[y] 24 for dredging Gowanus Canal. Ja[s.] Kane, Commr. of Sewers.

Pittsburg, Pa.—Bids are wanted Ma[y] 17 for 3,300 bbls. of cement. W. [] Thompson, Co. Compt.

Danville, Ill.—See "Public Buildings[."]

West Memphis, Ark.—A contract f[or] about 1,248,000 cu. yds. of levee wor[k] has been awarded to Robert Johnso[n,] Memphis, Tenn., at 14.7 cts. by the S[t.] Francis Levee Board, John B. Drive[r,] Prest.

Jersey City, N. J.—See "Paving a[nd] Roadmaking."

Jersey City, N. J.—Bids are want[ed] May 16 for furnishing 3,000 fire bric[k,] 10,000 North River hard burned bric[k,] 85 bbls. cement, etc. Geo. T. Bouto[n,] Clk. Bd. St. & Water Commrs.

PROPOSALS.

PROPOSALS FOR FURNISHING A[ND] DELIVERING

CAST IRON PIPE AND SPECIAL CAS[T]INGS FOR THE SETTLING RESERVOIRS AND FOR THE PUMP MAINS FROM THE EASTERN PUMPING STATION

ON THE WATER-WORKS GROUND[S] NEAR CALIFORNIA, OHIO

Sealed proposals will be received at th[e] office of the Board of Trustees, "Commi[s]sioners of Waterworks," of the City [of] Cincinnati, Ohio, until twelve o'clock noo[n] of Tuesday, June 13th, 1899, for the manu[]facture, furnishing and delivery of ca[st] iron pipe and special castings for the se[t]tling reservoirs and for the pump mai[ns] from the Eastern pumping station, on th[e] Waterworks grounds, near the Village [of] California, in Hamilton County, Ohio, [in] accordance with plans, specifications an[d] detail drawings on file in the office of th[e] Chief Engineer of the Board of Trustee[s] "Commissioners of Waterworks."

The same to be paid for as stipulated [in] the form of contract for the performan[ce] of the above work, and which form [of] contract is on file in the office of the Boa[rd] of Trustees, "Commissioners of Wate[r]works."

Plans and detailed drawings of the ca[st] iron pipes and special castings, and copi[es] of the specifications, estimated quantiti[es] of the pipes and special castings to be fu[r]nished, form of proposal, forms of bon[d] and form of contract can be secured [at] the office of the Chief Engineer of th[e] Board of Trustees, "Commissioners [of] Waterworks."

Bidders must enclose their bids in seal[ed] envelopes, and deposit the same with th[e] Clerk of the Board of Trustees, "Commi[s]sioners of Waterworks," before Tuesda[y] the 13th day of June, 1899, at twelve o'clo[ck] M., and such sealed envelopes must ha[ve] endorsed thereon the nature of the bid an[d] the name and address of the bidder.

Bids will be opened on Tuesday, the 13[th] day of June, 1899, at 12 o'clock M., at th[e] office of the Board of Trustees, "Commi[s]sioners of Waterworks."

Each bid shall be accompanied with [a] bond in the sum of $15,000, proper[ly] stamped and signed by two sureties, f[or] the acceptance of the contract, if award[ed] by the Board of Trustees, "Commissione[rs] of Waterworks"; or the bidder may d[e]posit with the Board of Trustees, "Co[m]missioners of Waterworks," in lieu [of] such bond, a certified check or bank ce[r]tificate of deposit, payable to the ord[er] of the Board of Trustees, "Commissione[rs] of Waterworks," or cash equal in amou[nt] to the bond as above required.

Bidders must furnish satisfactory e[vi]dence of their ability to do the class [of] work required.

Bidders must use the printed forms, [as] none other will be received.

The Board of Trustees, "Commission[ers] of Waterworks," reserve the right to [re]ject any and all bids.

By direction of the Board of Truste[es] "Commissioners of Waterworks."

AUG. HERRMANN, Presiden[t.]
CHARLES G. ROTH, Clerk.

Proposa's continued on pages xi and xi[]

THE ENGINEERING RECORD.
Volume XXXIX. Number 25

TABLE OF LEADING ARTICLES.

The Engineering Record, conducted by Henry C. Meyer, is published every Saturday at 100 William Street, New York. Its opinions on technical subjects are either prepared or revised by specialists.
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WIRELESS TELEGRAPHY.

When a physicist has carried on a line of investigation to such a state that a single successful experiment causes a serious flurry on the London Stock Exchange, the nerve center of the financial world, it is certainly time to consider his work attentively. Investigation will prove that the people who disposed of their cable stocks at panic prices because Mr. Marconi transmitted messages by wireless telegraphy across the English Channel, were actuated by needless apprehension. If they had consulted an engineer they would have learned that messages were being sent daily across bodies of water without the intervention of metallic conductors for a period of several years before the brilliant experiments of the gentleman named. There is nothing new about wireless telegraphy. It simply utilizes a wave motion of the ether not so very unlike that of the light, which was employed by Agamemnon in prehistoric times, according to a classic, to transmit the news of the fall of Troy to Clytemnestra. The heliograph simply does for light waves what the new system of telegraphy does for what are known as Hertzian waves. The fact that the fundamental idea is so old does not, however, detract in the least from the value of the work of Messrs. Preece, Marconi and others working with waves which are far more useful for purposes of communication because they are not affected by clouds, rainstorms and other conditions which render the heliograph useless.

The experiments of Mr. Preece conducted several years ago were just as noteworthy in their way as those of Mr. Marconi. Mr. Preece had behind him a government bureau, which was not so much interested in obtaining publicity for the unpatented inventions of this distinguished electrician as the Wireless Telegraph Company which is exploiting Mr. Marconi's devices with such notable results. Not only was the Post Office of Great Britain acquainted with etheric telegraphy several years ago, but the British Admiralty has had in its possession for several years confidential reports showing that Captain Jackson sent Morse signals through space before that officer knew anything of Marconi or his system.

More than five years ago Mr. Preece demonstrated before the Society of Arts the possibility of the transmission of messages without wires by the use of electro-magnetic waves of low frequency, some 400 per second. One year later a cable forming the telegraphic connection between the Island of Mull and the mainland was broken, and public and press messages were regularly transmitted by wireless telegraphy across the intervening channel under Mr. Preece's direction. He stretched a covered copper wire along the coast of Argyllshire, and utilized an iron wire which was already in place between the two points on the island. For more than a year the soldiers of the British War Department have been communicating across the Bristol Channel from Lavernock, near Cardiff, to the Island of Flatholm in precisely the same manner. Various improvements have been made from time to time in this system of communication, but owing to the fact that its basic principles were unpatented by Mr. Preece and no company had an incentive to take them up, they have received but little publicity and the system is to-day still comparatively undeveloped.

In the Marconi system of etheric telegraphy the waves have a very high frequency, many million per second in all probability. They are produced by an induction coil, the same apparatus used to illuminate vacuum tubes and to excite Roentgen rays. The apparatus has been developed with marked ability, but its details need not be referred to in this place, as the results only are under discussion. Instead of using horizontal wires on each side of a waterway, Mr. Marconi employs vertical wires. The height of these wires increases as the distance the message is to be transmitted. The experimentally determined relation between these factors is that the distance increases as the product of two vertical conductors of different heights. If the two vertical wires are of equal lengths then the distance a message may be sent by this system varies as the square of the length of one wire.

The apparatus at the station from which the messages are sent is called a radiator, because every time the key which controls the apparatus is depressed electric waves are radiated from the vertical wire in every direction as long as the key is held down. Experiments have been made with reflectors which will gather up these rays and send them toward any desired point in the same manner that light rays are treated by the familiar parabolic reflectors in use for many purposes. These experiments do not seem to be particularly successful, however, and another method of securing the transmission of messages with secrecy is believed to offer greater advantages. At the receiving station the rays are detected by a little apparatus called a coherer connected with the vertical wire at this place It received this name because a mixture of nickel and silver filings which it contains is made to cohere under the influence of an electric field. The most promising method of controlling messages so that those sent for one station cannot be read at another depends on a principle familiar to all who have noticed certain effects of sound waves. Probably most people have noticed at one time or another that in some rooms tones of a certain pitch will cause a reverberation which is not noticed with other notes. A piano wire tightly stretched over a sounding board can be made to give forth a note sounded by some other instrument or by the voice, if the two bear certain relations. This principle of syntony is used by Mr. Marconi. The receiving instruments at the various stations are adjusted for certain rates of vibration and respond to them only, and if a message is to be sent to one of these stations, it must be transmitted under the conditions which will make the apparatus at that station respond.

At the present time the field of the new system of communication seems restricted to such purposes as the transmission of messages between lighthouses, light ships, vessels generally and the shore; it is conceivable that under certain conditions it might be useful for military purposes. Its commercial field has yet to be demonstrated. A single cable between Great Britain and France can, according to Mr. Preece, transmit 125 times as many words per unit of time as the Marconi system in its present state. It does not seem, therefore, that there is any ground for apprehension that existing systems of communication will be in any way affected by these comparatively new scientific marvels. The panic with which the introduction of electric lighting in Paris was signalized on the London Stock Exchange is a case in point. Timid investors then failed to appreciate the fact that every important invention yet made has not displaced existing institutions to any degree, but has developed a new field for itself. In Great Britain to-day the mere operating expenses of the gas works are greater than the total capital invested in electric lighting undertakings. The new system of lighting simply made a new place for itself, and the old system has kept on developing in a notable manner. The telephone has had no influence on the telegraph, and the fact that a man in New York can talk to Chicago does not seem to have interfered with passenger traffic on the railways. Hence the fact that Mr. Preece, Captain Jackson, Mr. Marconi and others have transmitted messages by etheric waves is no indication whatever that existing methods of communication have a dangerous rival, for all precedent teaches that if the new systems have merit they will be allies and not foes of the old.

NEW JUDICIAL LIGHT ON HYDRANT RENTALS.

The Supreme Court of Michigan has just decided that in the absence of any other method of compensation, a fair charge for fire protection is 8 per cent. of the cost of the plant necessary to furnish it. On account of the importance of this decision it may be well to examine it more in detail. According to the full report in 78 N. W. Rep., 890, where the case is indexed as City of Grand Haven vs. Grand Haven Water-Works, the new decision is supplementary to one rendered six years ago in which the relations between the two parties were determined. It was then decided that the water-works company had failed to comply with the terms of its contract and the city had exercised its right to annul the agreement. The case was then sent back to the court below for an accounting for the use of hydrants, as it was equitable that payment should be made for whatever use the plant had been for fire protection. The allowance made to the company in the lower court was $1,500, from which the company appealed as inadequate.

The Supreme Court had much difficulty in fixing a basis for an estimate of the value of the service rendered the city by the company. The circuit judge had the same trouble and could find no other basis than the estimation of the actual number of gallons furnished at fires, and the appraisal of the value of this water at 50 cents per thousand gallons. The Supreme Court found some apparent injustice in this basis of computation, for the reason that the cost of maintaining pressure for fire purposes is greater than the cost of maintaining domestic pressure, and for the further reason that the computation leaves out of account the occasions when, on notice of fires, extra pressure is provided at the expense of the company, although no water at all is used. "If this apparent injustice can be avoided in any way by the use of any data appearing in the record we feel that it should be done. If, however, as contended by the complainant, no such data appear, we are powerless to relieve the defendant."

From October 24, 1884, when the first fire occurred, down to the fall of 1887, when the city began the extension of its own water-works, the community was inadequately protected from fire by the city plant, which was worth, according to the testimony of witnesses, about $6,000. The deficiency of the municipal plant in this respect was substantially made up by the company's works. The cost of a plant which would furnish adequate fire protection was estimated at $20,000 by one of the expert witnesses for the city. The court therefore decided that the city was saved the interest and depreciation on $14,000, which, at the rate of 8 per cent., would amount to $1,120. This condition continued for three years, when the city

spent an additional $10,000. The same basis for calculation during 1877-88 would give a saving to the city by the company's plant of the sum of $320. In the fall of 1888 the city spent $6,000 more, and from that time on another basis of estimation of the value of the company's works had to be adopted. The Supreme Court believes that the method of the lower court should be employed, viz., to base the allowance on the amount of water actually furnished. The court recognized that this might not give an adequate compensation, but it had no better data upon which to base a decree. The cost of the service to the company was not taken as the criterion for the reason that the company "cannot profit by its own default or subject the city to any expense by reason of its failure to live up to its contract." On this basis the number of gallons used after the date mentioned was substantially 608,000, which, at a rate of 50 cents per thousand gallons, amounted to $304, so that the total amount due to the company from the city, on the Supreme Court's method of computation, is $3,984.

A GREAT UNDERGROUND RAILWAY UNDERTAKING.

The City of New York is to have an underground railway very soon, not, it is true, in the location about which so much discussion has been held in the past, but in the Borough of Brooklyn. For many years that borough, until recently an independent municipality, has been intersected by a double-track surface railway which has practically severed it in a manner working much injury to the community. The late Austin Corbin believed that a tunnel would be the proper solution of the difficulty under which both the Long Island Railroad Company, operating the road, and the city labored. Unfortunately a very large part of the business men and influential residents of Brooklyn spend their working hours in the present Borough of Manhattan and failed to recognize as they should the importance of Mr. Corbin's project. After his death the directors of the railway company have been furthering the plan to the best of their ability, and, with the assistance of some of the leading men of the borough, have at last succeeded in obtaining full consent for an improvement which must be classed among the great municipal undertakings of the present time.

The tunnel, which will run from Maiden Lane in New York under the East River into the heart of the business district of Brooklyn, will, it is true, not be the first under the East River, for there is already a small tunnel for distributing gas under that waterway. The railway tunnel, however, will be of far greater proportions, and its construction will involve engineering problems of much greater difficulty, as the work must be conducted under important streets lined with large buildings, as well as across the East River. It will be noticed in the account of the history of the project which follows that a part of the expense is to be borne by the city, and it is well worth noticing also that the commission which has brought its arduous labors to a successful close was a city commission, and numbered among its members one of the leading engineers of the Borough of Brooklyn, and two members from the railway company. In this way the commission had represented among its members all the interests which the proposed improvement involved; it was able to go about its work in a direct manner and arrive at a definite conclusion expeditiously, and, it is believed, advantageously to the interests of the community and the corporation most directly interested in the undertaking. The success of the commission's labors is an indication of the value of such an organization over one which represents no particular interests, other than possibly a board of trade or something of that sort, which experience has shown may labor for some years and bring forth nothing but reports.

The project consists of two parts. The first is a tunnel from a point near the junction of Church and Cortlandt Streets, in the Borough of Manhattan, under the East River to Brooklyn, and thence to the present Flatbush Avenue Depot of the Long Island Railroad Company. The second consists of the removal of the present railroad tracks from the surface of Atlantic Avenue from the junction of Flatbush and Atlantic Avenues to the old city line.

The section under the East River is to consist of twin tunnels, each carrying a single track, while the portions adjoining the river section on each side are to consist of a single tunnel containing a double track. There are to be two intermediate stations on this portion of the project; one near Maiden Lane and Pearl Street in Manhattan, and the other near the Borough Hall in Brooklyn. The station at Cortlandt Street is to be about 70 feet below the street level, connecting with the street and elevated roads by means of elevators. The station at Pearl Street and Maiden Lane is to be about the same depth below the surface, and will connect with the elevated roads at that point by means of elevators. The tunnel will be carried under the Brooklyn streets within the curb lines. At the Borough Hall station the depth below the surface will be about 115 feet, and from that point the tunnel will rise by an easy grade to the present station at Flatbush and Atlantic Avenues, which is to be about 18 feet below grade.

The railroad tracks on Atlantic Avenue have long been a source of annoyance and trouble, and their history is somewhat interesting. The first railroad authorized to be constructed and operated in Brooklyn was the Brooklyn and Jamaica Railroad Company, which was incorporated in 1832; two years later the Long Island Railroad Company was incorporated and leased the Brooklyn and Jamaica road in 1836. Along the line of the railroad a street was laid out from the East River for about two miles, which was later extended to and beyond the city line. In 1855, by an agreement between the railroad company and the City of Brooklyn, the tracks of the former were removed from a strip of land at the side to the center of the street. In 1844 the railroad company received authority from the Brooklyn Common Council to construct a tunnel under a portion of Atlantic Avenue below Flatbush Avenue, which was constructed and operated until 1861, when it was closed. At this time the steam railroad tracks were removed from the avenue on the payment to the railroad company of $125,000, the terminus of the railroad on the river front being transferred to Long Island City. Horse cars were then run on Atlantic Avenue for a number of years. In 1872 the Atlantic Avenue Railroad Company was incorporated, and two years later secured the rights of existing railroad companies in Atlantic Avenue, which, in turn, were leased in 1877 to the Long Island Railroad Company. In 1876 the use of steam power on Atlantic Avenue east of Flatbush Avenue was again authorized, and its use has been continued since that time.

The running of frequent trains at high rates of speed through the middle of the street has resulted in many demands for the removal of the tracks from the avenue, and in 1896 a commission was appointed by the mayor of Brooklyn to investigate the problem and report as to what could be done to improve the condition of the avenue. This commission consisted of the following gentlemen: Mr. Eugene G. Blackford, president; Mr. Edward F. Linton, secretary, and Messrs. Edward H. Hobbs, William E. Phillips and Walter M. Meserole. Mr. Phillips was succeeded in 1898 by Mr. J. A. K. Steele. The commission held a number of meetings and hearings, and filed a report in 1897 recommending removing the tracks to a tunnel at some places and to an elevated structure at others, and the change to electricity as a motive power. They also took into consideration the project of a tunnel under the East River. In May, 1897, a bill providing for this removal passed the Legislature, and was approved by the mayor of Brooklyn and signed by the Governor. It created the Board of Atlantic Avenue Improvement, consisting of seven members, whose duty it should be to carry into effect the provisions of the law. This board consisted of the same gentlemen as constituted the former commission, with the addition of Mr. William H. Baldwin, Jr., president of the Long Island Railroad Company, and Mr. Charles M. Pratt, also representing the railroad interests. While the act of 1897 provided ways and means for making the desired changes on the avenue, it also contained a provision that work should not be commenced until the necessary rights, franchises, consents and funds were procured to build a tunnel from the old railway station in Brooklyn to the Borough of Manhattan, the idea being that the city should not spend the money required for the improvement of the avenue, and the objecting property owners should not be burdened with the elevated structures planned for parts of the work without the compensating advantages which would accrue from direct connection with the business center of Greater New York. No work of construction has been done as further legislation was desired. This has just been secured by the passage by the Legislature and by the approval of Mayor Van Wyck and Governor Roosevelt of two bills. One of these permits the construction of the tunnel under the East River with a franchise for fifty years, and the right of extending it for an additional twenty-five years. The other confirms to the railroad company its old right to construct and operate a street railway on the surface of Atlantic Avenue after the removal therefrom of the present steam railway tracks.

The second bill was of importance to the whole scheme because the plans contemplate using a surface trolley line operating under ordinary street railway conditions to gather and distribute traffic along the line between the two stations at which the fast trains on the new tracks will stop.

From the Flatbush Avenue station the tracks are to be depressed a distance of about 6,700 feet, the depression being covered by means of girders and masonry arches, restoring the street for public use throughout its whole width. Then the tracks will rise in an open cut between two successive intersecting streets and pass to an elevated structure which affords sufficient headroom for all street traffic. The posts of the elevated structure are to be 22 feet 3 inches apart, which will leave ample room for all surface traffic, as the avenue has a total width of 120 feet. The extreme width of the top of the elevated structure will be 32 feet, and, being of moderate height, it will not obstruct the light and air of the adjacent property owners, as it might in a narrower street. The elevated section is about 8,000 feet long, and is succeeded by another tunnel about 2,900 feet in length, which is followed by 6,070 feet more of elevated structure, before the tracks are allowed to remain on the surface.

There are to be two stations between Flatbush Avenue and the city line. The motive power is to be electricity, and it is expected that the running time from Cortlandt Street to Jamaica, a distance of about twelve miles, will be about twenty four minutes. At Jamaica connection is made with the Long Island Railroad to all points on Long Island. The expense of removing the tracks from the surface of the avenue is to be borne equally by the city and the railroad corporation, provided, however, that the cost to the city shall not exceed $1,250,000. This does not include the cost of stations, sidings, nor of expenditures due to change of motive power, etc., which are to be borne by the

railroad alone. The tunnel from the junction of Atlantic and Flatbush Avenues under the East River is to be built by a separate corporation, organized in the interest of the Long Island Railroad Company.

After the removal of the tracks from the surface of the avenue, it is proposed to improve it by paving two roadways each 30 feet wide, with an unpaved strip between, on which a trolley road will be operated. The sidewalks on each side will have a uniform width of 18 feet. The estimated cost of this improvement is about $612,000, and allows for a vitrified brick or asphalt pavement on a concrete foundation or a granite pavement on a sand foundation. On this portion of the work there are eighteen water pipes, varying in size from 6 to 30 inches, crossing the avenue, in addition to those running along it, of which the largest is a 48-inch pipe paralleling the proposed improvement for about four miles. There are also sewers at twenty-eight street crossings, which vary in size from a 12-inch pipe to a 60-inch brick sewer. It is expected that this improvement will be completed in about two and a half years.

Fatigue Formulas in Bridge Specifications were briefly discussed in these columns on November 5, 1898, in connection with a valuable paper on the Launhardt formula presented to the American Society of Civil Engineers by Mr. Henry D. Seaman. The discussion and correspondence on the paper have recently been published by the Society, and in the author's summary the following observations are made concerning the views advanced in the editorial mentioned: "Soon after the publication of the paper a statement appeared in one of the technical journals, that since the allowable unit strains are within the elastic limit, there is no necessity of considering fatigue. Several discussions have followed the same suggestions. Such a statement violates the fundamental principle of scientific bridge construction. A well-designed bridge must be as uniformly economical as unlimited life and absolute safety will permit, and there is no more reason why the dead strain should be a ratio of the elastic strength than that the live strain should be a ratio of the alternating strength. It is not merely necessary to build a safe bridge. Such a bridge may be constructed by the selection of a uniform allowable strain based solely upon the alternating strength, but it would be a design which no engineer would endorse. It is true that bridges are not built to fall, but the proper design of bridges has the point of failure constantly in view, not merely for the purpose of avoiding it, but for the purpose of uniform economy throughout. A factor of safety is selected to cover contingencies which may exist. Where the strains are defined and the contingencies are possible defects in material and workmanship, this factor is usually three, and provides that only one-third of the full area of the member may be relied upon as perfect when compared with the results of a test specimen. While, therefore, the material may receive a nominal strain of 18,000 pounds or more per square inch, estimated on the total section, it is supposed actually to be strained close to the ultimate strength of some unseen imperfection. It is this critical section, always assumed and ever possible, to which the bridge is designed. This is economical bridge construction, and anything short of it is a crude approximation, wastefully expensive in proportion as the light of experiment and reason is hidden, and the impulse of arbitrary and unreasonable precaution or dictum is followed. If the factor of safety is assumed too large it should be reduced, but advantage should not be taken of it to confuse other irregularities which may be properly separated and defined. Furthermore, it is not merely the construction of bridges which must be considered in outlining specifications, but also their maintenance, since it is here that the closest study of existing conditions is required, and for the lack of which many efficient bridges have been consigned to the scrap heap. When the overloaded structures of impoverished roads are to be maintained to the extreme limit of absolute safety, it requires a most careful consideration of the capacities of the material. It is a very easy matter to condemn the bridge, but not so easy to maintain it to the final limit. In such cases the question of fatigue is an important one." In reading these statements by Mr. Seaman, attention should also be paid to the following portion of the editorial which appeared last November: "It is not intended to argue that allowances for impact and for live load need not be made, for it is imperative that they should. It is only an open question as to the method. So far as our present state of knowledge is concerned, it is reasonable to say that that method is best which makes due allowances justified by experience and in the simplest manner. Does the fatigue method meet those requirements, especially the last?"

Still Another Important Bridge is to be built abroad by an American firm. The Pennsylvania Steel Company is manufacturing a viaduct 2,260 feet long and 320 feet high for a Burmah railway. The towers are constructed for double track, but the superstructure is for single track only. The erection of the Hawkesbury bridge in Australia by the Union Bridge Company was the first instance of an important structure of this class being awarded to Americans in a British colony. The bridge manufactured by the Phoenix Bridge Company for the only railway in Corea was illustrated in these columns a short time ago, and the Atbara bridge which the Pencoyd Iron Works is erecting for the Egyptian War Office will long be remembered for the protests it drew from British manufacturers.

The Pneumatic Canal Lock about which so much has been said the last few years can be put to a practical test under the provision of a bill passed by the last legislature of New York and now a law, provided the parties interested in promoting it care to go to all the expense of its construction themselves. It will be recalled by those familiar with the course of recent work on the Erie Canal that these locks, designed by Mr. Chauncey Dutton, formed an important feature of the improvements designed by ex-State Engineer Adams, but were not approved by the consulting engineers who subsequently reviewed those plans for the state. The bill recently passed permits the canal board to authorize the construction of a canal with the necessary locks and appurtenances near Cohoes to connect the Erie and Champlain Canals and the Hudson River. Permission is granted to enter any land or water rights belonging to the state for this purpose, but not to take private property. It is expressly stated that the state shall not be rendered liable for the cost and construction of the canal and locks or its connection with existing canals. All work must be done under the supervision of the state engineer and in such a manner as to not interfere in any way with the operation of the existing canal system. When the work is completed, if the canal board considers it of use, permission is granted to lease it at the rate of 5 per cent. a year on the actual cost of construction, plus the sum now spent annually in maintaining and operating such portions of the state canals as the new work duplicates. If the state wants a work it is given authority to purchase it by agreement with the owners, or if that is impossible, by condemnation. If the lock is to be such a great saver of money as its promoters have held, it will be seen that the terms of the lease are by no means unfavorable for its construction by private parties, and considerable interest is taken in the course which will be pursued by the people who have been pushing this device so diligently and so long.

SEWAGE DISPOSAL AT GLASGOW.

[By James H. Fuertes, M. Am. Soc. C. E.]

The following article is a continuation of the series of papers on European sanitary engineering of which the last, on water filtration at Zurich, Switzerland, appeared in the issue of April 2. The gallons referred to in the following description of the Glasgow disposal works are the British or imperial units.

The River Clyde, on the banks of which Glasgow is situated, is considerably polluted by the large amount of shipping on it and the presence of the large city through which it flows. In order to remedy this condition, at least in part, the city built a very large plant for the purification of the sewage of a portion of the district within its limits. The effluent must be discharged into the Clyde, and it is necessary for it to be in a highly purified condition. As there was no land in the neighborhood on which the sewage could be utilized for irrigation, it was therefore decided to treat it with lime and sulphate of alumina, aerate the effluent over chutes, screen it through coke and filter it through sand. The district draining to these works contains about one-fifth of the total population of the city, and the normal daily flow, including storm water, is about 12,000,000 gallons. The works were designed by Mr. G. B. Alsing, Assoc. M. Inst. C. E., and were opened May 2, 1894. They are located at Dalmarnock.

The main sewer is 7½ feet in diameter where it reaches the works. It empties into a chamber 17x9 feet and 16 feet deep, which is covered with an iron grating. In the chamber are heavy wrought-iron screens to intercept large bodies floating in the sewer. From this chamber there are three 4-foot parallel sewers running to a machinery house. In front of the mouth of each is a rotary extractor screen, Figure 140, which removes the larger solids from the sewage. These screens are inclined at an angle of 45 degrees and make 14 revolutions per minute. The screenings fall into a trough, from which they are pushed into a square bucket in a sump at the end of the trough. This bucket is about 2½ feet square, and, when full, is hoisted to the floor above by an overhead derrick. The screens are operated by chains and sprocket wheels and are run every alternate two hours.

After screening, the sewage flows into two deposit chambers, each about 20x48 feet, and illustrated in Figures 141-143. The bottoms of these chambers consist of V-shaped troughs in which chain and cross-bar conveyors drag the deposited sludge to one end, where it is lifted by ordinary chain and bucket conveyors to the floor above and dumped into railway cars. The buckets of the main conveyors are each about 6x18 inches and 6 inches deep, very strongly made, and run on small wheels on guides to reduce friction. Drippings from the railway cars, into which the deposits are dumped, run through a drain under the floor to the pump well.

After leaving the deposit chambers the sewage flows through a 10-foot sewer to a pump well, the bottom of which is 3 feet lower than the bottoms of the deposit chambers. Over this well stand two 15-inch and two 18-inch centrifugal pumps, with compound marine engines coupled directly to the shafts. One 15-inch and one 18-inch pump are sufficient to develop the full capacity of the plant, but all the machinery is provided in duplicate. The combined power of these engines is about 350 horse-power. There is a connection on the discharge pipe of each pump, by which a part of the raw sewage may be turned back to the condensers and thence run to the pump well again. The discharge pipes from the pumps unite into a 3¾-foot main leading to a mixing pit. On each discharge pipe, above the pump, are placed a check valve and a steam jet for the purpose of priming the pumps. There are no foot-valves on the suction pipes.

The mixing pit is 10 feet square and 8 feet deep below the discharge pipes of the pumps and has a partition in the center running down to within 3½ feet of the bottom. The sewage, to which the chemicals have been added, is forced to pass under this wall to insure thorough mixing.

The composition of the sewage as it comes to the works varies greatly, and the proportions of the chemicals are adjusted to suit these changes. On the lines of the sewers are many factories, dye houses and mills, and the operatives at the works judge by the color of the sewage how to mix the chemicals. The accompanying table gives the quantity of the different chemicals to be put into the mixing tanks and vats every five minutes. The lime is slaked with 25 per cent. of its weight of sewage.

Table of Proportions of Chemicals for Sewage of Various Colors.

Color.		Grains per Gallon.	When Using 15-in. Pump. Lbs.	When Using 18-in. Pump. Lbs.
Gray	Alumina	4	17	23
	Slaked lime	3	17	23
Dark gray	Alumina	6	25¾	34¼
	Slaked lime	4½	26	34
Very dark gray	Alumina	8	34⅓	45¾
	Slaked lime	6	34	45
Light blue	Alumina	10	42¾	57
	Slaked lime	7½	43	57
Dark blue	Alumina	15	64¼	85¾
	Slaked lime	11¼	64½	86
Light brown	Alumina	20	85¾	114¼
	Slaked lime	15	86	115
Dark brown	Alumina	25	107	143
	Slaked lime	18¾	107½	144
Very dark brown	Alumina	30	128½	171⅓
	Slaked lime	22½	129	172

The 15-inch pumps throw 6,000 gallons and the 18-inch pumps 7,000 gallons per minute. The sulphate of alumina is mixed in four wooden vats, each about 3x5x10 feet. The lumps of alum are put in the water, and, to aid in dissolving them, the exhaust air from the sludge rams is discharged into it through a perforated pipe. The water for dissolving the alum for slacking the lime and for making the cream of lime is untreated sewage, thrown up into the vats by a small centrifugal pump driven by belting. The lime is ground in two large pan mills having revolving wheels.

After being treated with the chemicals the sewage passes into settling tanks. The supernatant liquid is drawn off by floating arms, aerated by flowing over a series of steps or riffles, strained through coke beds and sand filters, and finally discharged from the underdrains of the latter into an effluent channel.

The precipitation plant is very large, containing 24 tanks, each about 35 feet wide, 45 feet long and holding about 81,000 gallons. The tanks are arranged in two rows with a wide space between them, occupied by two stepped inclined planes sloping down to a central channel 17½ feet wide, which leads to the filters.

The sewage, on leaving the pumps and receiving its dose of chemicals, flows to the tanks and is delivered into the main distributing channel, Figures 144 and 145, which passes around the three sides of the tanks. Large gates across this channel at one corner permit diverting the sewage down either side of the plant. Between the tanks and the main distributing channel are inner distributing channels with inlet gates so arranged that the sewage may be passed from the main distributing channel to the settling tanks or it may be passed first into the inner distributing channels and then into the tanks. The sewage is admitted into the bottom of the tanks from the channels, through penstocks about 2½ feet square. The tops of the division walls between the adjoining tanks are placed so that each is 2 inches lower than the one next above it, to enable the tanks to be connected in series and operated continuously. Over the edge of the topmost tanks in each row are gates which may be lifted to start the operation on the continuous system.

In operating these tanks intermittently, which is the usual practice, each is filled in turn. This requires about seven minutes, and after forty-five minutes of absolute rest, the supernatant liquid is drawn down by floating arms nearly to the surface of the sludge. These arms pass through the walls of the tanks and discharge the sewage against a low wall about 2 feet high and a foot wide, which runs parallel with the face of the tanks. Except for a space of 10 feet in front of the end of each floating arm, the wall is perforated along the bottom to allow the sewage to flow in an even sheet down the riffles, the perforations assisting in the distribution of the sewage over the surface. Similar baffle walls run along the edges of the central channel and partition walls run across the riffles to separate them into divisions of convenient dimensions.

The sludge from the tanks is drawn through a valve into a sludge channel 6½ feet in

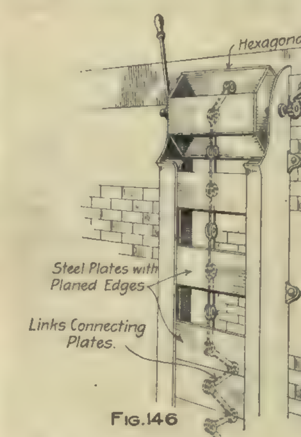


FIG. 146

Horizontal Section.
FIG. 147

THE ENGINEERING RECORD.

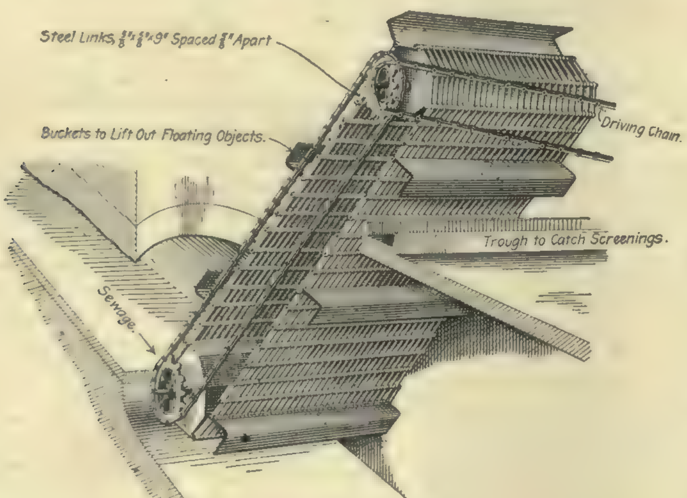


FIG. 140

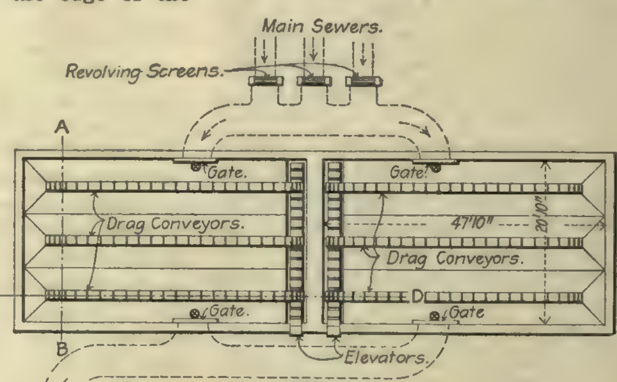


FIG. 141 Plan.

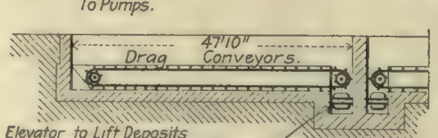


FIG. 143 Section C-D.

FIG. 142 Section A-B.

THE ENGINEERING RECORD.

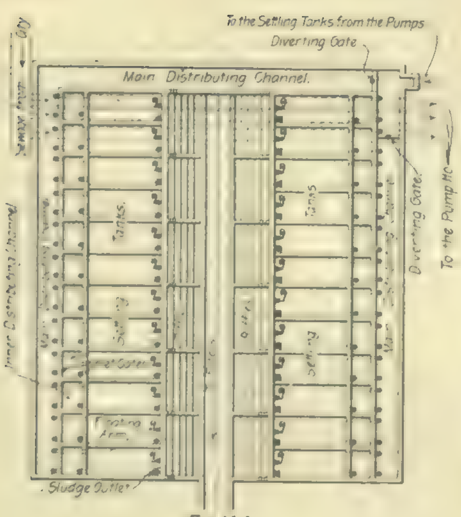


FIG. 144

FIG. 145

FIG. 149

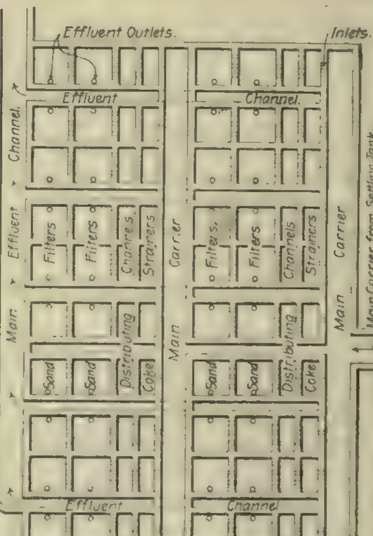


FIG. 148

THE ENGINEERING RECORD

DETAILS OF THE SEWAGE DISPOSAL WORKS, GLASGOW, SCOTLAND.

MR. G. V. ALSING, ASSOC. M. INST. C. E., DESIGNING ENGINEER.

diameter and having a slope of 3 per cent., to a sludge pit under the lime and alum mixing rooms. The pit is 46x80 feet and the bottom is 10 feet higher than the sewage pump well. This bottom slopes toward one end and the sludge flows from it by gravity into an 1,800-gallon ram operated by exhaust air from the sludge presses overhead. The sludge is forced by this ram up into two circular iron vats, each 5 feet in diameter and 4 feet deep, where lime is stirred into the sludge by revolving arms in order to facilitate the pressing process.

From these mixing vats the sludge flows by gravity into four 900-gallon compressed air rams, which raise it to the floor above the engine room and discharge it into sludge presses. There are seven of these, made by Goddard, Massey & Warner, each yielding 2,500 pounds of cake with one pressing, the final pressure being 100 pounds per square inch. The presses stand on a floor spanning a track, and have hoppers below them through which the pressed cakes can be dropped into cars and taken away.

Owing to the use of exhaust air from the presses to operate the low-pressure rams and to the convenient arrangement of the machinery, the pressing is done very economically, the cost being about 50 cents per ton at present. It is expected that this cost will be reduced to 37 cents by certain proposed changes.

There is no further charge against the plant, on account of sludge, after the latter is dropped from the presses into the cars. The City Cleansing Department hauls the cars away and spreads the cakes on the city farm, charging the Sewerage Department 16 cents a ton for the service, or mixes the sludge cakes with street sweepings and sells the mixture for a fertilizer, in which case no charge is made against the Sewerage Department for the amount sold.

There is so much water in the sludge that new sludge settling tanks have recently been built; the further settlement in these allows much of the free water to be drawn off. The tanks are low enough to permit the sludge to flow into them. The superfluous water is drawn off to the pump well, and the sludge to the old well and ram. An ingenious arrangement of iron slides, Figures 146 and 147, permits the water to be drawn off; these slides close the third side of a well which leads from the tank to the sludge effluent channel. They are made of sheet iron with planed edges and sides, and are suspended on a flexible chain, so as to hang about 6 inches apart when loose. By slacking off the chain from the top, each plate rests in succession on the one below, making a tight dam. By raising the chain by a sprocket wheel, over which the plates hang, they may be lifted one at a time and held at any stage by means of a ratchet and pawl on the shaft.

The compressed air to operate the sludge-pressing machinery is furnished by two large steam-driven air compressors, each on top of its own receiver.

The power for driving the machinery of the works comes from two compound engines of 120 horse-power each, taking steam from a battery of six 28-foot boilers 7 feet in diameter, working at 100 pounds pressure. The fuel used is coke, some of which has been previously used in the sewage strainers.

The effluent from the precipitation tank, after flowing over the riffle, runs in a wide, shallow channel to filters near the river. These are shown in detail in Figures 148 and 149. The sewage passes from the main carriers, which are 5 feet wide, to coke strainers 10 feet wide, 40 feet long and 3½ feet deep. It passes downward through the coke into distributing channels, and after passing through perforations in the brick walls, flows over the surfaces of the sand filters. The effluent is collected in underdrains which lead to outlets, and finally passes into an effluent channel 20 feet wide. There are 40 filters, each 40 feet square, containing 2 feet 9 inches of sand above the underdrain.

THAWING FROZEN WATER PIPES BY ELECTRICITY.

One of the most interesting papers presented at the meeting of the American Water-Works Association at Columbus this week was written by Mr. John B. Heim, superintendent of the water department of Madison, Wis. That city, like all others along the Great Lakes, passed through a period of unprecedented cold weather during last winter. The cold began late in November, and after that date the thermometer never registered above the freezing point for many weeks. It remained in the vicinity of zero until late in January, when, for twenty consecutive days, the reading was considerably below zero, sometimes as much as 26 to 28 degrees. This extreme prolonged cold froze the ground to depths of 6 feet in places, and as the water mains had a covering of but 5 feet in many districts much alarm was experienced, particularly over the condition of the small service pipes. The hydrants were examined, dead ends flushed and a continuous flow of water maintained at several extreme points where there were but few consumers. The result of this care and watchfulness, both day and night, was that but a single block of 4-inch main was frozen in the city. This block was 660 feet long and has a consumer about every 33 feet, but no sewer connections. The consumers draw but a few pails of water a day, and there were several unused services during the winter. The connections leading to this main froze gradually in spite of all the flushing which could be done, and the main itself was frozen for a length of about 200 feet. When it was uncovered it was found that at every tap the main was cracked both ways from the corporation cock, showing that the services were the cause of the trouble.

About 400 services in different parts of the city were frozen during this cold weather. Fortunately some of them were so situated that the parties they supplied could call upon neighbors for water, but there were many who depended entirely upon city water and found the situation one of much unpleasantness. The city refused to thaw out the services, as the work would have to be done at the expense of taxpayers and other consumers who had escaped trouble by the use of good plumbing and careful watch of their supply during the cold weather.

The plumbers used steam in clearing the pipes, requiring about a couple of days for each job. There was one service, which had a sinuous course, into which the steam tubing used in thawing the pipes could not be inserted. Mr. R. W. Wood, instructor in physics in the University of Wisconsin, resided in the vicinity of the house supplied by this service, and noticed the difficulty which was experienced in attempts to free it from ice. The idea occurred to him that the heating effects of an electric current might be utilized and he discussed the subject with Prof. D. C. Jackson of the same university. They prepared a plan of procedure and made arrangements with the local electric company to meet them at this house with the necessary apparatus. Connections were made with the frozen pipe where it entered the building and at the curb where it had been cut by the plumber to insert his steam tubing. The trial was an immediate success, and the experiment was repeated with another frozen service 150 feet long. At this place a current of 250 amperes at 50 volts was sufficient to thaw the pipes in 12 minutes. Another trial was then made by making connections at an outside faucet used for sprinkling at one house and inside another house across the street and 300 feet distant; the result was equally successful. Another trial was made by connecting one of the lead wires with a pipe inside a house supplied through a meter, and the second lead wire to a hydrant on the other side of the street. In every instance the results were satisfactory.

The electric company prepared several sets of apparatus and commenced to thaw out services all over the city, two of them being frequently thawed at the same time. Messrs. Wood and Jackson gave the results of their study, labor and experience freely. The University of Wisconsin instructed members of its senior class in electricity in the methods to be followed, and sent them to superintend such work whenever a call came from other places which were suffering from the effects of the unusual cold weather. Only the actual expenses incurred by these men were charged for their services, and through their advice and by mail at least fifty cities in Wisconsin and the neighboring states were instructed in this novel and expeditious method of work which originated at the University of Wisconsin.

Watertown, Wis., was the first city to call for aid, and Messrs. Jackson and Wood undertook this case personally, as it afforded the first opportunity to apply electricity to a frozen water main. At this place 320 feet of 6-inch main was thawed out in 2½ hours, using two 25-kilowatt transformers. The wires were connected in parallel with two hydrants a block apart and furnished a current of 100 volts. No water resistance was used, for the resistance of the main itself was sufficient to prevent overloading the transformer. A current of but 350 amperes was available, which accounts for the length of time necessary to free the main. It is interesting to notice that the preliminary computations have been shown to be correct in every instance where the current which was available corresponded with the amount used in the calculation.

The superintendent of the local electric company of Madison, Mr. L. E. Kerns, states: "We use the alternating current, 1,000 volts primary reducing through transformers to 50 volts, and at this pressure use from 200 to 325 amperes. The services which had no flaws in them or were unbroken, required an average of about 15 minutes each to thaw them out. Those that were broken or contained flaws required from 30 minutes to 3 hours. We thawed 101 services at a cost of $5.55 per service. The size of the wire that we used was No. 2 B. & S. gauge."

Superintendent W. M. Kimball of the Rockford, Ill., water-works, says: "Electrical thawing was a great success. We thawed out 126 services; the best results we obtained were when we could get from 250 to 300 amperes. In thawing out these services several blocks of frozen mains were also thawed out. The time required to thaw a service depended upon its length, the degree it was frozen, the amperage of the current, etc., and varied from 10 minutes to 2½ hours. The cost was at the rate of $4.80 per service actually thawed, including all labor, linemen, team work, etc."

Superintendent E. A. Croll of the water-works of Iron Mountain, Mich., says: "We have been very successful in thawing service pipes from ½ inch to 2 inches, and found the time varied from 6 minutes to 1 1/3 hours, according to the length. A ¾-inch iron service 240 feet long required 30 minutes, using 250 amperes at 52 volts. The lighting plant furnished us current at 1,000 volts primary, which we transformed to 52 volts. We thawed 900 feet of 2-inch wrought iron pipe in sections of 300 feet with 250 amperes at 52 volts, the last 300 feet including 160 feet of 6-inch cast-iron pipe, in 2½ hours."

The directions which Mr. Heim gives in his paper for conducting such work are as follows: "To thaw out lead or iron services up to 1½ inches diameter, you should use from 200 to 250 amperes; if you are not able to get more than 125 amperes it will take four times as long. If you use over 250 amperes you are liable to get into trouble by overheating the corporation cock, stop cock and all other brass connections. Wrought-iron pipe must be watched very closely to see that the joints do not heat. It has a lower resistance, higher conductivity, requires more current in order to become hot;

therefore you must watch the unions where the heating occurs. We have ordinarily used a transformer in the work, but in some cases have used dynamos directly. The source of current should have a pressure of not less than 50 volts. To thaw out 500 feet of 6-inch main in half an hour requires 800 amperes. If you are unable to get more than 400 amperes it will take four times as long, or two hours. Eight hundred amperes will thaw out 500 feet of 12-inch main in one hour, and a 24-inch main in two hours. The source of current for water mains should have a pressure of not less than 200 volts. In preparing to thaw out a water main make a connection with two hydrants by winding the wire around the hose nozzles. Screw the hydrant nozzle cap up to the wire so as to make a close connection. Begin at the open end of the pipe, where there is no frost, with 800 amperes or less, at 200 volts, and thaw say 50 feet at a time. Water should be kept running for at least an hour after the main has been thawed, as it will take that length of time for the water to become slightly warmer. Three-fourths of a horse-power will thaw a 6-inch main in half an hour per foot length; 0.2 horse-power will thaw a 1-inch and 0.125 horse-power will thaw a ⅝-inch service pipe in half an hour per foot length. There is no danger from electrolysis, on account of the short duration of the thawing process and the ground being frozen."

The directions for thawing service pipes up to 1½ inches in diameter, which were prepared by the University of Wisconsin, and were printed in these columns on March 11, are quoted in full by Mr. Heim, who also quotes the following estimate of the financial value of this discovery from a paper published in the fire insurance interests, of which the name is not given: "A slight estimate of the value of the invention of thawing out frozen pipes by electricity to underwriters can be formed from the fact that in 1898 insurance companies paid out nearly $300,000 in losses caused by primitive methods of thawing out pipes."

PREVENTING TASTES IN THE SYRACUSE WATER SUPPLY.

The method adopted at Syracuse, N. Y., in preventing the appearance of unpleasant tastes in the Syracuse water supply was described in a paper presented this week to the American Water-Works Association by Mr. William R. Hill, M. Am. Soc. C. E. The supply comes from Skaneateles Lake, which has an area of 12¾ square miles and collects the runoff from 60.28 miles of good country for a catchment basin. The highest number of bacteria found in the lake was 26 per cubic centimeter, and the usual number is much smaller. The chemical characteristics are shown by an analysis to be as follows: Volatile and organic solids, 4.5 parts per 100,000; mineral matter, 7 parts; total solids left at 212 degrees, 11.50; chlorine, 0.4; free ammonia, 0.00052; albumenoid ammonia, 0.0036; oxygen consumed, 0.28. Its temporary hardness is 4.89 and its permanent hardness 3.98.

The water is taken from the bottom of the lake at a depth of 40 feet and about one and a quarter miles from the shore, at which place is sunk a timber crib. The water is drawn from the crib by gravity through a steel pipe 54 inches in diameter to the wells of the gate house on the shore. At the crib the water passes through a wire screen of one inch mesh, and at the gate house through one of a quarter inch mesh. A 30-inch cast-iron conduit, which is 19¼ miles long, commences at the gate house and terminates at the distributing reservoir. Between the crest of the dam at the lake and the flow line of the reservoir there is a fall of 245 feet.

The distributing reservoir has an area of 14 acres and a capacity of 121,000,000 gallons with the water 35 feet deep. The bottom and the lower part of the sides are covered with concrete, while the upper part of the sides is paved with stone laid in cement mortar. The water enters the reservoir at the southern end, and from the northern end it is distributed by gravity throughout the city.

VIEW OF THE SYRACUSE DISTRIBUTING RESERVOIR.

On June 29, 1894, the gates in the well house at the lake were opened and the water for the first time began to flow from Skaneateles Lake to Syracuse. At first it was discharged into an old reservoir, the bottom of which was covered with clay puddle. The city was supplied from this reservoir until September 21, 1894. After that it was supplied directly from the lake until July 23, 1895, on which date the surplus water (flowing in the conduit) over what was required to supply the city was turned into the new distributing reservoir. This was filled about the middle of August, 1895, and after that the city was supplied with water from it.

About the middle of May, 1896, a complaint was received at the office of the water department that the water tasted bad. Upon examination but a very slightly unpleasant taste could be detected. After that the complaints became more frequent as the water was becoming more and more disagreeable. On May 20 it was very unpleasant to drink on account of the strong fishy taste and disagreeable odor. On this date the water in the reservoir had attained a temperature of 57 degrees Fahr. for the first time that season. The water entering the reservoir from the lake was ten degrees cooler and was perfectly free from any unpleasant taste. This water was immediately turned into the distributing system and the supply from the reservoir was shut off. The distributing system was emptied of the disagreeable water by opening the hydrants on the outskirts of the city, and in a few hours the people were supplied with a good potable water.

The reservoir was then emptied, the disagreeable odor increasing as the water was lowered. In the bottom of the reservoir, at the foot of the slope, a dark green gelatinous substance was found. When this was partly uncovered of water it broke apart and the edges curled up, disclosing that the under side was a dark maroon color. It was from an eighth to a quarter of an inch in thickness, and the stench from it was almost unbearable. The reservoir was cleaned and refilled with water on July 10, 1896, after which the city was supplied from it and no further trouble was experienced that season.

During the spring of 1897 the water in the reservoir was very carefully watched, both as to its odor and appearance. About the first of June fine black specks were noticed floating in places near the shore. Upon close examination (without the aid of a microscope), these particles were found to have the appearance of very small flies. Although at first they were very few, still they were thoroughly skimmed off. After that they were found and removed each day.

A few days after their first appearance a very fine dry yellow substance about the color and appearance of yellow corn meal was seen floating upon the surface of the water. This, like the dark particles, although developed over the entire area of the reservoir, soon floated close to the shore. The greater portion of the yellow substance formed into little balls as it was being carried to the shore. These balls could be easily skimmed off by a skimmer made of cheese cloth, but the separate particles were so fine that they would pass through the cloth, and in order to remove them it was necessary to use a tin vessel. There was no odor from them when first developed, but in less than 24 hours after they were skimmed off they would decompose and have a very strong odor similar to that of decayed fish.

During the summers of 1897 and 1898, both substances have appeared and have been removed from the surface of the water every day from about the middle of May until the first of September, the greater quantity from the first of June until the middle of July. They were found most abundant after a warm night, when about enough to fill a peck measure would be taken off. A slight breeze would carry them to the shore as they were very light and floated upon the surface of the water. They were skimmed off each day, the work ordinarily requiring the services of one man; but on a few occasions, when there was scarcely any breeze, it has required the work of six men.

The organisms are so minute that they are passed unnoticed by casual observers. They will not contaminate the water if they are removed before decomposition takes place, neither will the gelatinous substance form in the bottom of the reservoir. Not the slightest taste or odor to the water has been detected during the past two summers. Although the water in the lake reaches at times a temperature of 80 degrees Fahr., still these organisms do not develop in it. It may be that they are consumed or otherwise destroyed in the lake by other organisms which cannot exist in the reservoir because of the cement lining.

BRIDGE ERECTION AND REPAIRS.

The Highland Railway, Scotland, crosses the valley of the Findhorn River on a single-track viaduct on a curve of 40 chains radius and a grade of one in sixty. It has nine 130-foot steel truss spans 16 feet wide and supported on granite masonry piers 118 feet in maximum height. The permanent spans were erected on a traveling falsework span of which the transverse and vertical dimensions were small enough to allow it to pass telescopically inside the permanent spans between their trusses and under the floor-beams. Each falsework truss had nearly square panels, each having a pair of intersecting diagonals, a subvertical and a center horizontal longitudinal strut. Each truss member, except the bottom chord, which had an additional pair of angles with horizontal lower flanges, apparently consisted of a single flat bar with a pair of reinforcing timbers, one on each side, through bolted to it. These varied from 12x12 inches in the chords to 10x4 inches in the verticals, and were calculated to take all the compression, while the flat riveted bars were proportioned for the tension strains. Each panel had top and bottom lateral and vertical transverse bracing consisting of cross struts and adjustable diagonal rods. Pairs of wedges were set at the bottom of each vertical post to allow for tightening up and restoring the level under deflection. These trusses were 190 feet long and were assembled complete on an embankment in the bridge axis beyond one abutment, and were then pushed across to the different piers successively. Two sets of 16-inch rollers each were put under each truss and it was launched forward by tackle and windlasses until the forward end engaged the next pier, on which it was temporarily blocked up until the rear sets of rollers were brought forward and set there. Then it was pushed forward on them until the excess length of 63 feet all overhung, when it was lifted from the rollers and the rear end was used for an erecting platform for the permanent trusses. The weight of the traveling span alone was 84 tons and its rear was loaded with 40 tons of kentledge to act as a counterweight during projection. The ends of the girders were built with a camber of 6 inches to compensate for the launching deflection. In launching from pier to pier, the rear of the traveling span was carried at first on a pair of wheels attached to it and running on the inner lower chord flanges of the permanent trusses which had track plates perforated to clear the rivet heads laid on them. After the center of gravity had advanced beyond the end of the permanent span, the upward reaction at the rear of the traveling span was received on wheels fixed to the floor beams and bearing on the top chords of the traveling span on the tracks used for the erecting traveler. The maximum upward reaction was 30 tons and the traction required for launching was computed at 13 tons. After the traveling span was in position, movable horizontal cantilever platforms were attached to the lower chords on both sides and supported by adjustable diagonal suspenders from the top chords, and on them the new permanent structure was assembled. Each girder weighed about 35 tons, and the total deflection of the traveling span was about 2 inches. At each pier the traveling span was jacked transversely on greased skids to bring it to the required position for the curve of the viaduct. Care was taken to assemble both trusses to correspond, so as to have the suspended cantilever working platforms always balance each other. A description of this work, from which the foregoing has been prepared, was published in the "Proceedings" of the Institution of Civil Engineers for March, 1899.

The St. Lawrence & Adirondack Railway bridge across the Chateauguay River consists of four 150-foot through spans, which are supported on stone piers, each about 9 feet wide, 33 feet long and 17 feet in total height. The river here is 8 to 12 feet deep, with a clay bottom, having occasional deposits of gravel and boulders. For each pier 75 piles were driven through the ice and cut off at the mud line. Field stone were filled in up to the pile tops and the masonry was built in caissons with double 12x12-inch timber calked bottoms, sunk in place on the piles. The piers were riprapped to above the timber bottom to prevent scour. Immediately after the completion of the last pier a large field of strong ice, 3 feet thick, drifted against two of the piers and swung around and struck heavily on the one last completed. No damage was then noticed, but a subsequent careful examination showed that the pier had been moved an inch or two downstream and transversely at one downstream corner, and had also been swung around that point as a pivot through a horizontal arc about one foot long at the center of the pier. An 18x20-foot timber crib about 12 feet high was sunk alongside of the upstream end of the pier and bolted at the top to a row of piles driven along the outside. The eight vertical posts in the sides and corners of the crib projected a foot below the bottom and were beveled to a sharp edge on the side away from the pier so as to draw firmly into the clay bottom when the crib was loaded by stones piled on its deck above the surface of the water. Then four 50-ton hydraulic jacks, inclined upwards a little, were set between the crib and the pier, bearing against the middle of vertical side timbers, which distributed the pressure over the face of the masonry by three horizontal timbers running from end to end of the pier at the center, top and bottom. After moving 2 inches the pier grillage struck against the head of the corner pile from which it had been entirely displaced; a diver cut the pile down a quarter of an inch, after which the pier cleared it and was moved back to the original position by two 100-ton and one 50-ton jacks. No damage was observed to the masonry or pointing, and the work was executed for a total cost of about $800. The weight, in air, of the masonry was about 960,000 pounds, and that of the grillage 50,000 pounds, so that, allowing for buoyancy, the submerged weight was about 648,700 pounds, net. The net weight on one of the piers which was not moved by the pressure of the same ice was about 998,700 pounds. When the pier was replaced the water was much lower, and the net weight moved was estimated at 782,000 pounds. From these data the coefficient of friction of the pier on its piles was deduced at about 0.5, and from this value the thrust of the ice, 3 feet thick, striking the pier obliquely on a width of 5 feet, was computed at 11 tons per square foot. This work was described in a paper by Mr. R. W. Leonard, M. Can. Soc. C. E., printed in the "Proceedings" of the Canadian Society of Civil Engineers.

GOOD ROADS IN NEW YORK STATE.

The act which was passed by the New York State Legislature in 1898 for the improvement of the public highways is meeting with marked success, and petitions for thirty times as much work have been received as the State appropriation will suffice to complete. The provisions of the law were reviewed in these columns on April 2, 1898, and it is therefore unnecessary to refer to them here. Fortunately for the State, both Massachusetts and New Jersey have already been constructing highways under State supervision for a number of years, so the New York officials have had the advantage of the valuable experience gained in these neighboring commonwealths. Mr. Edward A. Bond, State Engineer and Surveyor of New York, is taking up the subject with noteworthy zeal and has recently issued a bulletin containing some interesting information on the work already accomplished.

Since the passage of the law many counties have taken advantage of the opportunity offered, but the appropriation of $50,000 made in 1898 was so small that but a few pieces of highway could be improved. These stretches of road are intended to serve as object lessons and it is confidently expected that their influence will be felt in a substantial manner during the present year. Up to March 1, 79 petitions were received for the construction of 450 miles of road, and contracts have been let for building about 15 miles at rates ranging from $3,784 to $7,295 per mile. The five contracts into which this work is divided will, with the surveys and engineering work on other roads, exhaust the appropriation. This engineering work will, however, be of value when further appropriations render it possible to begin the construction of the lines surveyed, so the money has not been wasted.

As a practical illustration of the cost to the taxpayer of a road built under the law, Mr. Bond cites a case of a 2¾-mile highway constructed in Deerfield at a total cost of $14,686. The 50 per cent. paid by the State comes out of the $50,000 raised by the law of 1898 and amounts to 1 cent on each $1,000 of assessed valuation for each taxpayer throughout the State. On the assessed valuation of the county, each taxpayer contributed 6¾ cents on each $1,000 to raise the 35 per cent. paid by the county, so that each taxpayer within its limits contributed but 7¾ cents on each $1,000 assessed valuation for this road. The remaining $2,202 will be raised by the owners of the property directly benefited by the improvement.

The law makes little provision for the proper maintenance of these State roads, as it simply specifies that after their completion they shall be kept in repair at the expense of the county. Mr. Bond believes that more stress should be laid on their proper maintenance and intelligent supervision, and he takes issue with some well-known road builders by advocating constant supervision and maintenance. He believes that the usual method in the State must be somewhat radically changed, and that the State roads should be under the charge of caretakers whose work is directed by the State Engineer. Failure on their part to conform to proper directions or the wilful doing of improper work should be punishable, in his opinion, to such an extent as to be effectually prevented. He advocates the method of conducting highway work by money assessment rather than the usual day-labor plan, in which farmers are allowed to work out their road taxes. The former plan enables the highway commissioner to lay out his work intelligently, spend the money allotted to him economically and obtain full value for it. The latter plan is well known to result in the execution of work at odd times and by unskilled men, so that its results are unsatisfactory from every point of view.

The specifications for the Deerfield road already mentioned enable some idea to be formed of the nature of the work done on these State highways. Under the head of earthwork, it is provided that the roadway shall be graded to a width of 18 feet between ditches. The latter are to have a bottom width of 1 foot and to range from 9 inches to 3 feet in depth below the crown of the road. All rock, boulders or stumps must be taken out to a depth of at least 6 inches below subgrade, and the holes filled with material approved by the engineer. Where a clay bottom is encountered it must be excavated to a uniform depth of 3 inches below subgrade for the entire width between ditches, and enough loam, sand or gravel placed over it to bring the surface to the required grade. Quicksand, spongy material and vegetable matter must be removed to the depth required by the engineer and be replaced by materials satisfactory to him. Where there is sod on the original surface of the ground, it must be broken up with a plow before any embankment is formed over it. The clause concerning embankments reads as follows:

"Embankments shall be formed of clear earth or other material acceptable to the engineer and shall be free from vegetable matter or re-

fuse of any kind. All embankments shall have side slopes of 2 horizontal to 1 vertical. They shall be constructed in successive layers not exceeding 6 inches in thickness, and each layer shall be thoroughly rolled with a sectional iron roller weighing not less than 2 tons. The several sections of such roller are to be 3 inches wide on their faces and vary alternately in diameter about 3 inches. The rolling is to be kept up continuously during the making of the embankment and until the engineer directs it to be stopped. All embankments must be sprinkled as the engineer directs while the rolling thereof is being done."

In rolling the subgrade the contractor is allowed to begin with a light roller, but the final consolidation must be completed with a steam roller of at least 10 tons weight.

The broken stone is required to be hard, of compact texture, and with a uniform grain. The pieces must have a rough surface obtained by fracture on all sides, and water-worn pebbles, crushed cobble stone and disintegrated or weather-worn stones from the surface of a quarry will not be accepted. The bottom course of broken stone, 4 inches in thickness after rolling, may be formed of gneiss, granite, flint or hard limestone from 1¼ to 2½ inches in size. The 2-inch top course must be trap rock broken to ¼ to 1¼ inches in size. Screenings must be of the same class of stone as the course on which they are rolled, and free from earth, loam, vegetable matter and dust. The rolling of both the broken stone and the screenings must be done with a 10-ton or heavier steam roller, and not less than 100 passes of the roller over each square yard will be acceptable. The clause relating to the use of water reads as follows: "During the rolling of the lower course of stone only so much water shall be sprinkled thereon as is necessary to prevent wearing by attrition; but in rolling the upper course of stone and screenings water is to be applied in such quantities and in such manner as to completely and compactly fill all the interstices with screenings soaked so as to secure a set and to produce a wave before the wheel of the roller; and the screenings shall be worked in and through to further secure this result and shall be applied to such an extent as is necessary for puddling. After all the interstices of the stone are filled with screenings, 48 hours may elapse before the final puddling, if, in the opinion of the engineer, a better result will be obtained thereby, but nothing in this provision shall be construed as entitling the contractor to longer time in completing his work according to the terms of this contract."

THE AMERICAN SOCIETY OF MECHANICAL ENGINEERS CONVENTION.

The summer meeting of the American Society of Mechanical Engineers was held in Washington from May 9 to 12 inclusive, the headquarters being at the Arlington. Many of the members reached Washington on Monday night and spent Tuesday in sightseeing. In the evening of that day a reception was held at the Corcoran Gallery of Art, the visitors being received by the president of the Society, Rear-Admiral George W. Melville, and by Mrs. George Westinghouse. Col. T. A. Brigham, Corps of Engineers, U. S. A., in charge of Public Buildings and Grounds, welcomed the visitors and explained some of the interesting features in Washington, laying particular stress upon the Washington Monument. He also announced that President McKinley would be unable to receive the Society at the White House on account of his departure from Washington in search of a rest. After the president expressed a few words of welcome the magnificent collection of paintings were inspected while the Marine Band furnished music.

The first session on Wednesday morning was partly devoted to business, various committees at first reporting. That on boiler trials reported through Mr. William Kent, who submitted the final report. A number of members suggested minor changes, Prof. C. V. Kerr proposing the use of the Berthier method of determining the heat value of coals, instead of the use of the Mahler calorimeter, as recommended in the report. Colonel Meier wanted boilers tested under 0.6 inches of draft instead of one-half an inch as recommended.

The first paper was by Prof. J. B. Stanwood and it was entitled "Standards for Direct Connected Generating Sets." In the paper the author called attention to the fact that the practice of directly connecting engines and electric generators had introduced a complication and expense to the manufacture of both, on account of the lack of standard sizes, speeds and important dimensions in both engines and generators. The adaptation of the steam engine in each case has been made a special problem, frequently requiring special design and construction. The author outlined certain features for which some standard should be adopted, and to institute a movement to this end he presented a motion to the effect that the Council be instructed to communicate with the American Institute of Electrical Engineers to ascertain if that body will appoint a committee to confer with a committee appointed by the A. S. M. E., and if a favorable reply was received to appoint the committee to carry out the work. The idea of the author met with a very favorable reception and after some discussion the resolution was passed.

A paper, "Boiler and Furnace Efficiency," by R. S. Hale and W. B. Russell, was read. The authors had collected a large number of boiler tests from various sources, and upon various types of boilers, in which flue gas analyses had been made so that the efficiency of the furnace could be determined. From this data, which was contained in numerous tables, the authors drew the following conclusions:

"In designing or selecting a boiler have the furnace roomy, and, if practicable, line it with brick in order to have a very high furnace temperature.

"Pay especial attention to the furnace if poor coal is to be used. Get rid of air leaks after the gases have left the hot furnace. Proportion the boiler so that at least 15 pounds of coal per square foot of grate must be burned to develop its horse-power, and so to keep the rate of evaporation per square foot of heating surface low. This involves a moderately high ratio of heating to grate surface.

"The horizontal return tubular boilers appear, all things considered, to be the type of boiler for best economy of steam production, although the internally fired boilers are probably as good if the furnace is roomy and the firing careful. The Thorneycroft boiler, which (from a combustion point of view) is of this type, show the best result of all.

"Certain of the water-tube boilers suffer from air leakage and from short circuiting of gases if underworked. Of course the advantages of water-tube boilers often make their choice advisable, even at the possible expense of a slight loss in efficiency. The Lancashire type suffers from air leakage and the furnace is poor.

"Stokers save nothing over hand-firing, either in better combustion or less air supply. This does not necessarily apply to all stokers, and it should be remembered that, even if it should finally prove to be true that stokers are no more efficient than hand-firing, yet saving in labor and smoke may pay good returns on their cost.

"The results show that present knowledge enables the boiler efficiency to be predicted reasonably well, provided the efficiency of combustion and the air supply are accurately known, and although these quantities themselves cannot as yet be accurately predicted, yet it is shown that the temperature of the furnace is at least one factor in the question of good combustion, and that rate of burning per square foot of grate affects the air supply.

"The most pressing need, therefore, in the study of boiler efficiency is the further determination of the factors that govern the efficiency of combustion and the air supply. The latter can be studied by the means of taking gas analysis at the bridge wall for different methods or frequency of firing, thickness of fire, etc. The factors governing efficiency of combustion can only be determined by carefully conducted and complete tests with heat balance. In this connection it should be noted that one or two accurate tests in which all the quantities, such as thickness of fires, gas analysis, etc., are observed, are, for the purpose of increasing our knowldege of boiler efficiency, worth a thousand tests in which the efficiency or evaporation is measured alone."

Mr. W. R. Roney, in the discussion of the paper, said that the data was not sufficient to warrant the authors' deductions in regard to mechanical stokers, as he believed they used considerably less air than hand-fired furnaces. Col. E. D. Meier seemed to think that the number of tests of water-tube boilers given in the paper were too few to draw conclusions from, and Mr. William Kent believed that while the authors' conclusions were undoubtedly correctly drawn from the data they had collected, yet the data was of so little value that the results were of a questionable character. He did not think the air supply could be regulated with hand-firing, though it could with stokers. He believed that a source of considerable loss, generally classed in the unaccountable losses, when coals high in volatile matter and moisture were used, was due to the generation of water gas that occurred for a few moments after each firing.

The paper discussing a "Test of a Steam Separator," by F. L. Emory, was then read. The separator was of the baffle plate type that are frequently placed in steam pipes leading to engines to intercept moisture in the steam. The moisture in the steam entering the separator was measured by calorimeters and it was found that the separator removed all but about 3 per cent. of the moisture. When tested as an oil separator the device intercepted 52 per cent. of the oil that entered it. Mr. F. H. Boyer then described an oil separator that he had used for many years in a refrigerating plant, consisting of a cylindrical tank filled with coke which was burned, when it became so impregnated with oil as to be of no use as an interceptor.

In the afternoon the party met upon the steps of the State, War and Navy building, where it was photographed. The White House was then visited, after which a very enjoyable trip to Arlington, the National Cemetery for the soldier dead, was taken.

The first paper for the evening session was by F. L. Emory, and it was entitled "Relation Between Initial Tension and Power Transmitted by a Belt." Both the paper and discussion were largely mathematical in nature.

Mr. Chas. L. Newcomb's paper, "Experiments on Various types of Fire Hydrants," which was read by title at the New York meeting, was then taken up.

"Experiences with Deep-Well Pumping Rods," by G. W. Bissell, was then read. A Johnston continuous flow deep well pump, drawing water from a well 2,215 feet in depth, was installed at the Iowa State College in the fall of 1897. The pump is double acting and has a double set of rods, one inside of the other. The inside rods were 1⅛ inches in diameter in the body; the ends were upset for a 1¼-inch bolt thread and had square shoulders for wrenches. The outside rods consisted of 2-inch pipe with ends upset and connected by very heavy couplings. A few months after the pump was started the inside rods parted. Examination showed that many of the inside rods were badly worn at the joints, and that one coupling had been so far reduced as to have parted under the working strain. Some couplings on the outside rods also showed considerable wear. This fact was

taken to indicate that the drop-pipe might be crooked, due to lack of straightness in itself or in the casing of the well. Accordingly the profiles, in two planes, of the center line of the drop-pipe were determined by Prof. Marston by means of a wire cage lowered by a steel wire into the drop-pipe from a fixed point vertically over the center of the top of the drop-pipe. Deviations of the wire from the center as the wire descended gave data for plotting the profiles. At certain depths below the pump the couplings on the outside rods were worn considerably and at these points brass winged guides, loose on the outside rods, and having broad brass shoes bearing loosely upon the inside of the drop pipe were placed. Very little wear of the outside rod couplings, or of the guides themselves, has since been observed.

The first break and wear of the inside rods were repaired by putting in new couplings. At the same time new inside rods were ordered, but the old ones parted again before the new ones arrived. The second failure occurred February 26, 1898. The new rods were put in place soon after. They differed in design from the old ones in being made of extra heavy 1-inch pipe with ends welded on and provided with couplings smaller than the body of the rods. On May 10, 1898, the rods were removed to free one of the pistons of a knot of rope which had lodged therein. At this time serious wear was noticed in the inside rods, and its character was such as to lead to the conclusion that the wear was due to the rods not being in line at the joints. Simple tests confirmed this conclusion and the rods were very carefully straightened before replacing in the well. No further trouble on account of the rods was experienced until about the middle of October, when removal of the rods was necessary and brought to light one case of serious wear, due to a crooked joint. The pipe forming the body of the joint was found to have been worn through. An interesting experience with the drop-pipe occurred. During the months of May, June and July the number of hours of pumping required to keep up with the demand was noticed to increase, the working hue of the water rose gradually, and the water became highly charged with air. A tank measurement of the pump displacement showed an enormous slip. A leak in the drop pipe was suspected and the rods were pulled. No defects of rods or pistons were noted. A test of the drop-pipe with its lower end plugged showed a considerable leakage. The casing was taken out, and at a depth of about 200 feet was found a hole worn by the erosion of the water between a coupling and the pipe to which it was attached. Evidently a small original defect in the thread of the pipe or coupling had been enlarged by erosion to the dimensions shown. At this point the pressure of the water was at least 150 pounds per square inch. The escape of the water into the space between the drop-pipe and the casing would account for the rise of the working level and the aeration of the water. No flaw of manufacture could be detected in the material of the pipe.

In the discussion Mr. Boyer and Admiral Melville strongly recommended the use of wooden pump rods.

Mr. G. C. Henning's paper, "Investigations of Boiler Explosions," was read by the author. The paper, slightly condensed, is printed upon another page.

The paper, "Pipe Flanges and Their Bolts," by A. F. Nagle, in referring to difficulty in taking care of expansive strains in steam piping, advanced the guiding principle that, whenever possible, it is better to let these expanding forces come upon torsional resistances rather than in the form of transverse stress upon the pipe. The author constructed a table, which gave the available binding power of different size bolts with various lengths of wrenches, and also what length of wrench would be required to obtain the safe limit of stress of metal in a bolt. After determining the stress that could be applied to each bolt the author calculated a new table, giving the number and size of bolts necessary in different size flanges. The author believed that a width of tongue of ½-inch in the tongue and grooved type of flange too narrow, on account of the great pressure per square inch on the gasket. It appeared to him that a more uniform pressure on the gasket was desirable, and he therefore recommended a width of 1 inch for all sizes of flanges. He also described a flange connection permitting a torsional movement.

Mr. R. P. Bolton, in the discussion of the paper, did not believe in the torsional method of taking care of expansion. His remarks were followed by a very long discussion upon pipe joints. All of the joints described in the discussion have been illustrated in "The Engineering Record" from time to time. One fact brought out worthy of attention was the universal sentiment in favor of the National Tube Works Company's joint, in which the flange is welded upon the pipe. Its cost was considerably more than screwed flanges, it was pointed out, except in the larger sizes. A number of engineers expressed the belief that there were too few bolts in the larger size flanges to stand high steam pressures.

"The Manufacture of Car Wheels," by George R. Henderson, was then read. It will be carried over to the next meeting for further discussion. Shortly after this the meeting adjourned.

The first paper on Thursday morning was "The Equipment of Tall Office Buildings in New York City," by Mr. R. P. Bolton. It was printed nearly in full in "The Engineering Record" of May 13. In the discussion Mr. W. H. Bryan stated that in St. Louis it was far cheaper, in tall buildings, to generate electricity on the premises, although the electric company made very low rates for currents, 2½ cents per kilowatt hour, during the day time, when the demand on the station was light. Mr. Ashley called attention to the need of a better system of fire protection, and referred to the feebleness of the fire stream from the Taylor building in New York City that a few days since was used in the attempt to extinguish a fire in an adjoining restaurant building.

Mr. E. P. Roberts spoke of the use of gas engines for lighting office buildings in summer time, when exhaust steam was not needed for heating. He had recently designed a plant contemplating the use of a steam engine in the winter time and a gas engine in summer, both run in connection with a storage battery. It was also intended to use the gas engine in winter, if necessary.

The next paper, "Rolling Mill Flywheels," by Mr. John Fritz, led to such a very long discussion that the remaining papers were carried over until Friday. Mr. Fritz's paper is printed elsewhere in this issue.

Thursday afternoon many of the party visited the Navy Yard and inspected the gun shop, where the machine work on the guns for the navy is done; also the tank for testing models of ships. This consists of a tank several hundred feet long, traversed by a traveling crane, which tows the model through suitable devices for recording its resistance. After the visit to the Navy Yard many of the engineers, as guests of the Capitol Traction Company, visited the company's new power house in Georgetown, where they were shown about by Mr. D. S. Carll, M. Am. Soc. C. E., Chief Engineer of the company, and by Mr. W. B. Upton, the consulting mechanical engineer of the station. The station was fully described in "The Engineering Record" of December 31, 1898.

In the evening a reception was tendered the society by Mr. and Mrs. George Westinghouse at the Blaine mansion, their residence. About 1,500 guests were present, including many of the diplomatic corps, army and navy officers and the Washington social element. The affair is said to have been the most elaborate private affair ever given in Washington.

Friday morning was a disappointment as far as the discussions were concerned, as the carrying over of three papers from the Thursday to the Friday session, and the shortness of the session on Friday, made necessary by a trip to Mount Vernon, made a discussion of the papers impossible. The papers presented and their authors were:

"The Central Heating Plant of the University of Wisconsin," Prof. Storm Bull; "The Power Plant of a University," Mr. E. A. Darling; "The Plunger Elevator," Prof. G. I. Alden; "Elevators," Mr. C. R. Pratt; "The Allan Valve for Locomotives," C. H. Quereau; "New System of Valves for Steam Engines, Air Engines and Compressors," F. W. Gordon.

The paper by Prof. Bull was about the only one discussed. It is expected to print part of the discusion at a later time, as it involved the distribution of heat and light to scattered buildings from a central point. Abstracts of Prof. Bull's and Mr. Darling's papers were printed in "The Engineering Record" of May 13.

In the afternoon a trip to Mount Vernon was made. In the evening the Washington monument, which was illuminated for the occasion, was visited, Colonel T. A. Bingham receiving the visitors and describing the interesting features of the monument to them. The programme closed with a visit to the new library for Congress, which was naturally magnificent under the electric lights. Mr. Bernard R. Green, M. Am. Soc. C. E., Superintendent of the Library, showed the engineers and their friends the details of the mechanical plant of the vast building. These were described in some five articles in "The Engineering Record" about two years ago and therefore require no explanation here. After this the journey home from Washington, the scene, doubtless, of the most successful convention the society ever held, began.

SOME HISTORIC BUT SUCCESSFUL FLY-WHEELS.

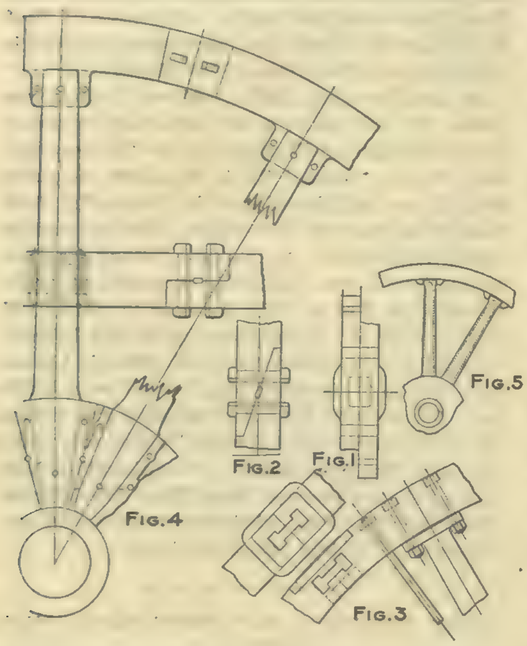
The subject of steam engine fly-wheels, as every engineer knows, is an important one. Consequently, when Mr. John Fritz presented a paper entitled "Rolling Mill Fly-Wheels" before the American Society of Mechanical Engineers in Washington last week, describing a rolling mill fly-wheel which he had successfully used for a long time, a good many engineers wanted to discuss it. There were all kinds of theories expressed by the different speakers, and many of them were contradictory. After a very long debate, one member arose and in effect suggested that he did not see the use of all their talk and theories when the author had described a type of construction for rolling mill fly-wheels which had been used for over 30 years without the occurrence of a single failure. With this common-sense suggestion in mind, "The Engineering Record" presents the interesting paper:

"In the early days of rolling mills, the machinery was of the crudest character. The men who built and looked after it were called millwrights, or forge carpenters; consequently, wood was used in its construction to as great an extent as was possible. All of the earlier fly-wheels, as you will see by the illustrations, had wooden arms, at least so far as I know, and Figure 4 shows the general way of fitting them in. They were made of hardwood, locust or white oak preferred, and about 6 to 8 inches in thickness, width as per illustration. Figures 1, 2 and 4 give the plan of securing the rims of the wheels together. The segments are in halves, and secured together with gibs and keys, same as shown in Figure 4. Having no machine tools when these wheels were built, they were put together practically as the castings came from the foundry, with the lumps and swells chipped off with a two-handed chisel and sledge, which naturally caused a weak wheel. They were made of cold blast charcoal

iron, which was greatly in their favor, and no doubt this fact prevented many accidents.

"In the course of time the millwright and carpenter were displaced by the machinist, and with the introduction of machine tools, especially the planer, the wheels were better fitted up, but not much safer, in consequence of the use of iron, made from mineral coal, in place of charcoal.

"The machinist now became the mechanical engineer, and wood not being his forte, he made the fly-wheel all of cast iron, as shown in Figure 3. The center, arms, and segments were cast separately, and had the ends of the segments been well fitted together, the wheels would have given no trouble. The slots for the tees were, unfortunately, too close to the end of the segment; the result was that they pulled the end of the cast-



ing off, and we had to chip grooves across the face of the wheel, and put heavy links around them, as shown in Figure 2, which made a good wheel out of it. This was done in 1854, and I think the wheel is yet in use, but never run at high speed.

"Not considering these wheels safe, I was in constant fear of their going to pieces, which is generally attended with the most disastrous results. I abandoned entirely the old mode of making wheels, and adopted the plan of casting the center and arms together, and the rim in one piece, with lugs on the inside of the rim, as shown in Figure 5. On the ends of the arms were pads to correspond with the lugs on rim. When the arms were put in the rim, there was a space of about one-quarter of an inch, in which oakum was driven tightly, which kept the arms in place. This made an excellent wheel, and in some cases wood was used to fill the space, in which thin steel keys were driven. There are several of these wheels that have been in use over thirty-five years, and, so far as I know, never have given any trouble. The wheels were 20 feet in diameter, with rims about 12 inches square.

"With the introduction of steel for rails and structural material, it became necessary to increase the diameter of rolls. This change necessitated heavier wheels, and larger in diameter, which made it impracticable to use solid rimmed wheels; consequently, some plan that was portable had to be adopted. After much thought the plan represented by Figure 6 was concluded the best and safest, and there are now a number of wheels of this type in use, varying in diameter from 20 to 30 feet. I do not know that any one of them ever has given a particle of trouble in any way, and there are a number of wheels, as per Figure 6, that have been in use for twenty-five years, some of which have, and are daily liable to encounter, the most severe strains that it is possible for a fly-wheel to be subjected to, and are to-day apparently as safe as the day they were started.

"It has been said that fly-wheels go to pieces in consequence of the irregular work, and engines driving dynamos for power purposes have been included in this class; but the strain on a fly-wheel driving a dynamo cannot be compared with that of a rolling mill. In the former the work occasionally varies from nil to full power, while that of an engine driving a rail mill changes from nil to practically full power while rolling a single rail twelve times, which requires about one minute. Let us for a moment think of a fly-wheel 26 feet in diameter, 16-inch rim, making from 70 to 80 revolutions per minute, rolling a steel bloom into a rail. When about one-half done, say, about 16 feet in length, instead of the piece going straight out, through the rolls on the guides, as intended, it sometimes wedges in the groove, and in less than a second of time it has completely encircled the roll, and forms what in rolling mill phrase is called a collar, and continues to wind around the roll until something must happen, either the breaking of a roll, a spindle, or coupling, or the engine must be brought to a standstill in an almost incredible short space of time. The tortion on the spindles and couplings is so great that it causes the wheel to rebound. To calculate the strain the wheel is subjected to under these conditions will require someone better posted in mathematics than I am.

"Having alluded to the fact that the introduction of steel in various forms required larger rolls, heavier wheels, and larger in diameter, which made it impracticable to use a solid rimmed wheel, led to the adoption of plan of wheel, Figure 6; the illustration makes it so plain that it wants but little explanation. The segment is cast hollow, and also the arms, which are made at the ends to compare in thickness to the segment, so as to relieve them of strains which might occur if the segments were cast solid. The holes in the segments are small at the ends, so as to make up for the metal taken out for the tees. The links, or tees, are different lengths, so that the strain on the segments will not come all at one place, and by using oil-tempered steel in the links, or double tees, the rim will be practically as strong at the joints as it is elsewhere.

"In fitting up the wheels, the center is bored out, and the ends of the hub faced off. It then is taken to the planer, and a center-guide plate for the hub is made, and bolted to the planer table. Then a boring bar is arranged to bore out the hole and face it off to a given distance from the center for the shoulder of the arm to rest on. There are small chipping pieces on both inner sides of the receptacle for the arm. They are planed off at the same setting, to the proper and uniform width, and true to the center. This finishes the center.

"Next the arm goes on the planer and is set true to the average center, and with a socket on the end of the boring bar with inside cutters the end of the arm is turned off, and the shoulder is faced off to the proper length for the arm to rest on; so at this setting the chipping piece on the upper side of arm, as it lies on the planer, corresponding with the same in the center, is planed off, and the average center of the segment is also carefully taken and correctly worked.

"After the arms are thus far finished, they are placed on the planer again, the other side up, and a socket is made to fit over the end of the arm which goes into the socket and against the shoulder. On the opposite end of the socket is a hole, bored, say 1½ inches or 2 inches in diameter. The length of arm must be, from the center of the hole to the bottom of socket which arm rests on, the same as the distance from the face upon which the arm rests to the center of the hole in shaft.

"Next secure a pin on the planer bed to correspond in size with the hole in the end of socket piece. Then put the socket on the end of the arm and on the pin; then bolt the arm down true on the side that is planed, and finish to the proper size. When this is done, find the exact length of the segment and set it in line with the center, and you have the exact angle, and when all is done correctly the wheel will fit together without a chisel or a file being used on it, and will run true, without turning, minus the irregularities in the castings.

"You will notice there are no abrupt changes in the thickness of the castings, thus avoiding as much as possible the liability of strains. The joints in the segments are generally the weak part of the wheel. In this respect a wheel made from this drawing will be stronger than the original, as the tees in the segments in the wheel now in use were made of wrought iron, and will probably not stand over 50,000 pounds tensile per square inch, while in this wheel, if I was to build another, I would use steel that would stand at least 85,000 pounds tensile. This would make the joints practically as strong as the segments.

"It will be noticed in the drawing that there

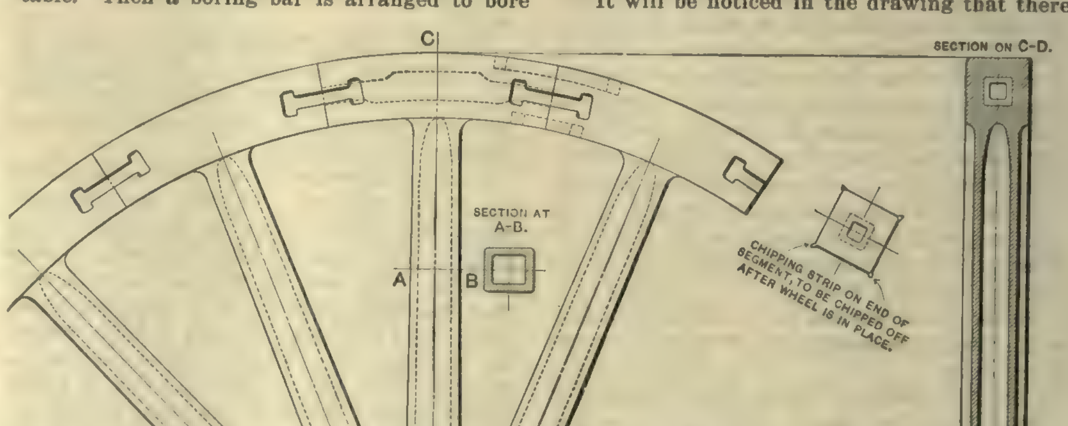


FIGURE 6.—FLYWHEEL FOR A 28-INCH RAIL MILL ENGINE.

is a space in the center, of about ¼ inch in front and rear side of each arm. This is filled with oakum and driven hard, after the wheel is finished and in place, to keep the arm from yielding in the direction of the strain, and at the same time greatly lessens the work of fitting up the wheel. The 1¾-inch round holes shown through the center and arm are reamed out, and steel pins made and turned so that they will drive in snugly.

"The bolt shown in segment in Figure 3 does not belong to this wheel, but was simply put in there to show the plan that, in many cases, was adopted to make the wheels more secure, and is used to some extent at this time."

INVESTIGATIONS OF BOILER EXPLOSIONS.

Some interesting statements in regard to the physical characteristics of plates from exploded steam boilers and methods of determining the cause of a boiler explosion from these characteristics are given in the following paper by Mr. G. C. Henning, read before the American Society of Mechanical Engineers in Washington last week:

In spite of the numerous boiler explosions constantly occurring in all kinds of service, and the numerous investigations of their causes which have been made officially and otherwise, no general method has thus far been proposed which gives any certainty of reliability of conclusions. This seems very strange, more especially when it is considered that the fundamental causes are very limited in number. They are: Excessive pressure, defective material, low water, defective workmanship and local defects.

Excessive pressure can be produced by wilfulness or by careless operation; it can be controlled by autographic recording gauges, alarm whistles, and competent management. Defective material can be readily avoided, and should never be used in any case; it is criminal to use it.

Low water may be the result not only of carelessness, but of many accidental causes, such as derangement of pumps or injectors, stoppage of pipes, gauge glasses, valves, etc., or even by suddenly augmented leakage, which cannot always be discovered promptly, or even immediately provided for after discovery.

Defective workmanship exists more or less in all boilers, except those which are built without caulked seams and rivets, and punched holes, and all parts of which are prepared and finished by machine tools and consist mainly of tubes with screwed ends. Defective workmanship develops greater or less defects during service, and necessitates constant repair and patching, and may be the cause of material weakness in course of time.

Local defects may exist in all boilers initially or develop after a while in service.

Assuming that a boiler has been properly designed there will be no excessive pressure in service except as previously stated. If all the possible safeguards have not been employed and a record of pressures has not been made, it is still possible to obtain such record for the instant of explosion, by making several tests of strips especially when cut from material of different thicknesses taken from the boiler.

It is a well-known fact that all material used in construction is subjected to stress about one-third of its yield point, but never beyond one-half of this amount. Stress sufficient to cause rupture is always about five times the working stress. If then any part of the boiler had been worn thin by corrosion such material would be overstressed and overstrained.

It is also a well-known fact that excess of stress beyond the yield point invariably raises it above its original value, and if, therefore, careful tests be made of the material, especially with an autographic recorder, the results will invariably show augmentation of yield point. Different thicknesses will show different augmentations which must always be in direct proportion to the stress applied. If calculations show that the augmentations of yield point in thick and thin material were produced by the same internal pressure, then it is proof positive that excessive pressure existed at the instant of explosion, and also its exact amount. Tests of staybolts will show the same thing. Elongation of the material is, however, reduced by excess of stress, and a second tension test of a piece of material previously ruptured will be very materially decreased. Stress beyond the yield point also changes the shape of the elastic curve in a very characteristic manner.

As it is assumed that all material used in the boiler originally was of good quality, it is only necessary to discuss the changes which might have taken place while in service. It is also assumed that all parts of the boiler are open to inspection at all times, and that, therefore, any local corrosion will be discovered at once and carefully watched during its progress. Occular inspection is always sufficient for this purpose, and such defects are always visible and easily recognizable before and after failure, and the latter can only occur under the most careless supervision. In service, material may, however, deteriorate by the action of repetitive stress, the effect of which is again clearly indicated by the result of tests, and, more particularly, by carefully drawn diagrams. The yield point will again be changed as before, and the elongation similarly. However, different parts of the boiler would show different effects according to their location, and the different action which each is subjected to would produce different results of tests. In the case of excessive stress the differences would be the same in all material in the boiler. Moreover, a careful study of the results will show other differences which are most fully described in the reference given. These changes of material are, however, produced only by such an immense number of repetitions of stress that they are rarely produced in boilers, which generally wear out and are replaced by new ones before they become distinctly developed.

Long-continued service of material in contact with fire and gases of combustion also produces very marked changes in structure and properties of the materials. The structure becomes more crystalline and brittle. It loses much of its ductility. While the yield point and tensile strength are not much changed, the former generally being lowered, the elongation is decreased materially. Bending tests on both cold and quenched material show considerable deterioration. Nicked bending tests especially produce striking differences. As different parts of the material are affected differently because of difference in temperatures of the fire, they will show different qualities in material and in proportion to these temperatures. This being the case, the cause of such deterioration can be easily traced by careful tests; it is, however, essential that complete records of tests be obtained, which is of course possible only by autographic records. It does not suffice to make the usual determinations of ordinary tests. It has never been demonstrated that boiler plate, other than that subjected to the action of fire and hot gases, has had its properties changed by long-continued service.

Low water, however caused, always produces excessive heating; and if the temperature rises sufficiently to weaken the material, failure may occur by stripping of the staybolts or rupture of the sheets by bulging between them, or otherwise. If the temperature has raised the material to a low or bright red color, this can be readily determined by superficial inspection. While the fire side will show red rust or a black color, the water or steam side will invariably show a typical steel-blue scale, which will not disappear even after years, as it is a so-called rustless coating. If this be once oiled it will always be distinguishable, even if the plates had been exposed to moisture and gases for years. The color of this scale will depend somewhat upon the temperature at which it was produced, being brightest at those points where temperature was the highest. Carefully made tests, with autographic diagrams, of such material will again demonstrate changes of properties, which are very characteristic. The yield point will be found very low, while the diagram will show a material drop of curve just after the yield point. The elongation will, however, as a rule, be materially increased, with a diminution of tenacity. Nicked and quenched bending tests will again show marked differences between strips cut from the sheet at points which in one case were overheated or were above the low-water line, and in the other were taken from a part below this line. The fracture will also be materially different. To demonstrate the temperature at which the plates happened to be at the instant of explosion, it is necessary to cut strips from points of the overheated plate below the water line. These strips polished on the edges are then held in a clear fire so that one end remains cold while the other is heated to a dull yellow or a very bright red. This temperature being reached the bars are withdrawn, and while one is rapidly plunged with one end into a pot of boiling water, the other is allowed to cool in air, but not in contact with wet material or metal or stone. When the piece which had been immersed in boiling water about one inch deep has become nearly cold, below blue heat, it is plunged into cold water.

On the polished edges of both bars will be found scale and heat colors, the temperatures producing them being well established. These bars are then carefully nicked at points opposite every change of color and then broken off at these nicks. By comparing these fractures and their scale and colors with those obtained from pieces cut from the overheated plates, the temperature at which they were at the instant of explosion can be determined with great accuracy. Having thus determined the temperature at which the sheets were during operation, it is also known whether the metal was sufficiently soft to bulge or to strip from the staybolts; examination of plates and bolts will verify the conclusion.

As defective workmanship and local defects must be of very grave importance when sufficiently serious to produce boiler explosions, and are readily noticeable to any trained eye, it is not necessary to discuss them at length; they have often been studied and described.

From the foregoing explanations, it will be seen that careful testing with proper means and apparatus, added to thorough superficial inspection, will always be sufficient to demonstrate the cause of any boiler explosion. It is the failure to apply correct knowledge in individual cases that has led to the frequent conclusion of "cause unknown" or "no reason for accident." The failure of eminent engineers to reach definite results is due entirely to inadequate investigations, which did not discover the facts available. Moreover, the tests of the material after explosion were made in such a superficial manner, and with such inadequate methods, apparatus, and care, that they were generally valueless.

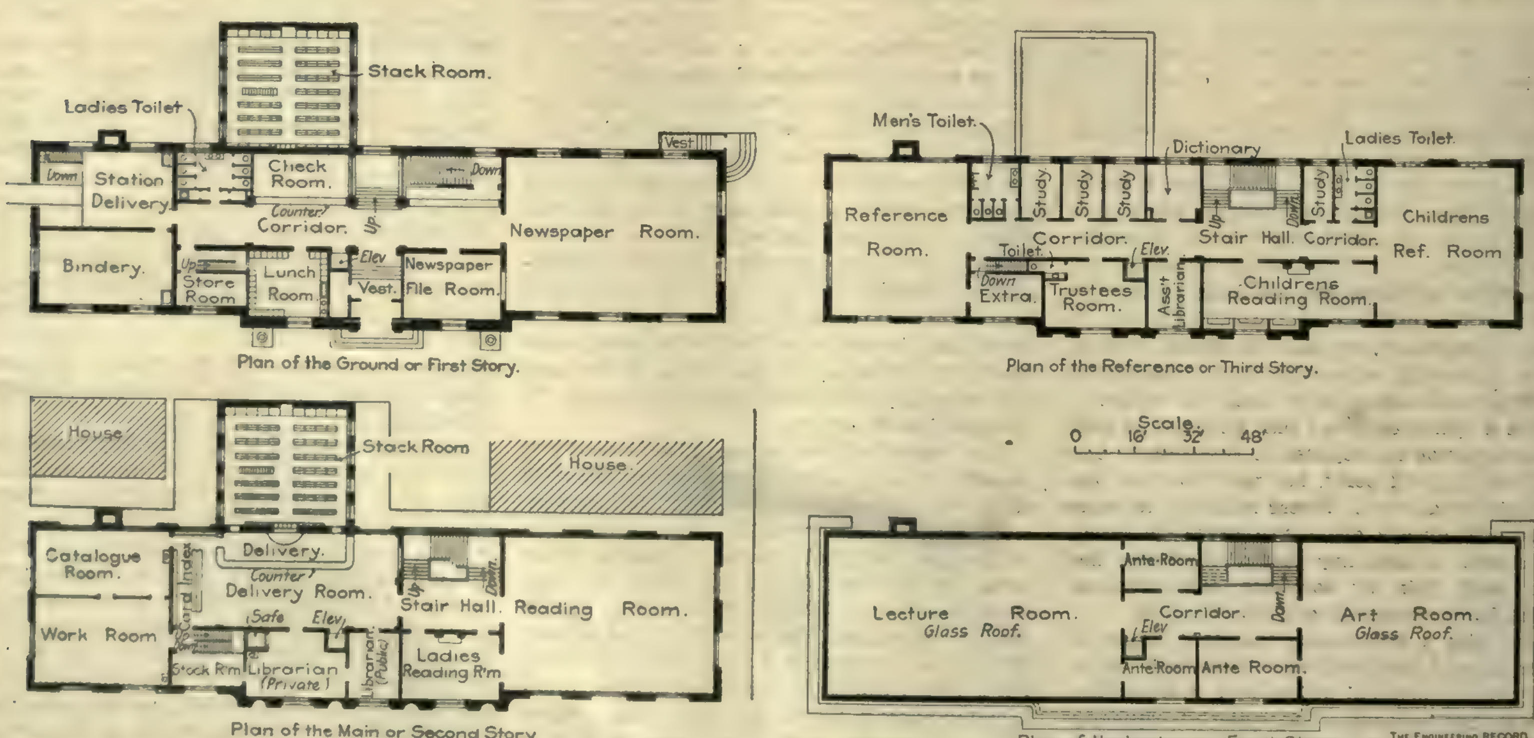
In my experience I have repeatedly found the results of tests of so striking a nature that this, taken in connection with the knowledge of original properties of the material, gave convincing proof of the causes of explosions. This is not only true of sheets, but also of flues, both of which I have had repeated occasions to study carefully, and there does not seem to exist any doubt whatever that the cause of every boiler explosion can be readily determined with simple means readily obtainable, by one who has correct and sufficient knowledge of properties of materials as affected by different conditions.

THE NEW FREE PUBLIC LIBRARY, JERSEY CITY, N. J.

The Jersey City, N. J., Free Public Library, an institution which only recently made its eighth annual report, is very soon to bring itself into greater prominence and doubtless proportionate usefulness through a new building it is about to erect on Jersey Avenue of that city. The Board of Trustees, under which it is governed, issued circulars to that end in April of last year, inviting the architectural profession to enter into a competition which it proposed to conduct. Programme, rules, and conditions were drawn up to govern the competition according to a great extent with the code devised by the American Institute of Architects. The Board of Trustees engaged Prof. A. D. F. Hamlin, of Columbia University, to act as professional adviser, and with his concurrence requested the Architectural League of New York to appoint two of its members to constitute with the adviser a committee of award, which should judge the submitted designs. Accordingly, Mr. George B. Post, then president of the American Institute of Architects, and Mr. Bruce Price, president of the Architectural League, were appointed to the committee. The competition was instituted by inviting five architects to enter designs at a compensation of $250 each. Three of them were designated by the Trustees, but the other two were chosen on the basis of a preliminary competition, restricted to architects practicing or residing in Jersey City. The general competition otherwise was made an open one, but without further provisions for the payment of participants.

The chief duty of the committee of award was to choose the seven best designs. Each competitor was required to submit three floor plans, two elevations and a longitudinal section of the proposed library. All were to be drawn to a scale of ⅛ of an inch to the foot, with solids blacked in, not merely tinted, and rendered without the use of color. Each competitor was asked in addition to prepare a typewritten memoir explanatory of the design, and to enclose a bona fide estimate from a reputable builder, based on the plans submitted. Every drawing as well as the description and blank sealed envelope containing the name of the competitor was marked with the number previously assigned to the wrapper in which they were delivered, and the identities of the seven best designs were not disclosed until the final decision had been made. The rules stipulated that the packages should be opened 48 hours after the close of the competition, that they should then be examined by the committee of award within three days for the selection of the seven best, and that within a fortnight of the opening of the drawings, the Trustees in consultation with their adviser, should make the final choice. To assist in the work the services of a building contractor were obtained to prepare, in accordance with provisions to that effect, an estimate of the cost of each of the seven designs; and the practicability of erecting any of the best designs within the cost stipulated was determined in part in this manner. There were 47 designs in all received, and the award was made to Messrs. Brite & Bacon, of New York City.

The plot of ground purchased for the library has an area of about 11,300 square feet, extending along Jersey Avenue from Montgomery Street to Mercer Street, a distance of 200 feet. The lot runs back about 50 feet on each of the two streets, and has an addition on the rear 60 feet wide, extending back 30 feet. The inside boundaries of the site are party lines, and the design had to recognize the possibility that light might be shut off at any time. The floor plans of the successful design are shown in the accompanying drawings, and the exterior of the new library may be seen in the reproduction herewith of a pen and ink perspective. The building is to be of light brick with granite trimmings, and four stories in height, measuring respectively 14, 22½, 15 and 16 feet from floor to floor. There are three entrances, one admitting a wagon, which may back up under cover, affording protection in inclement weather. The library is quite largely a circulating institution, and has many outlying branches by which books may be ordered from the central library. A wagon is therefore employed to carry the books to and from the stations.



THE NEW FREE PUBLIC LIBRARY BUILDING, JERSEY CITY, N. J.

MESSRS. BRITE & BACON, NEW YORK CITY, ARCHITECTS.

As will be seen, the main floor of the library is one flight up. A broad staircase leads to the central portion of the floor, opening at one side in a large delivery room, which is furnished with a card catalogue of 500,000 cards, and a long counter where the borrower is served by an attendant of the library. The books are stored in stacks which are built in that portion of the library erected over the rear extension of the lot, and the situation of the delivery room with its surrounding counter makes the stacks readily accessible. The stacks are to be of noncombustible material, but the actual design is as yet incomplete. They will be in five tiers, extending through the ground and main floors with shelves 8 inches deep and aisles 3 feet and 3 feet 6 inches wide. The entrance to the stack room is through doors back of the delivery desk, which is on the level with the middle of the five floors composing the stacks, each 7 feet in height. It will be noticed that light is derived by side windows, allowing the rear wall to extend to the back line of the lot. The floor area of the stack room is about 1,075 square feet, and there is room for 100,000 volumes, being therefore about 18 for every square foot of actual floor area. On the other side of the delivery room are the librarian's offices, along the front of the building, and at one end, the working department of the library. The latter is divided into two rooms by a partition, which is to be of glass in order that neither room may rob the other of any light. The whole of this half of the floor has been arranged to bring the librarian, the working rooms, and the book stacks as close together as possible. The other end of the staircase hall leads to a general reading room, and immediately in front of the visitor as he reaches the top of the stairs is a reading room set apart for women. This makes it possible to enter the ladies department without first passing through the larger room. The main reading room is lighted on three sides with high windows. Only periodicals are to be kept in the reading rooms.

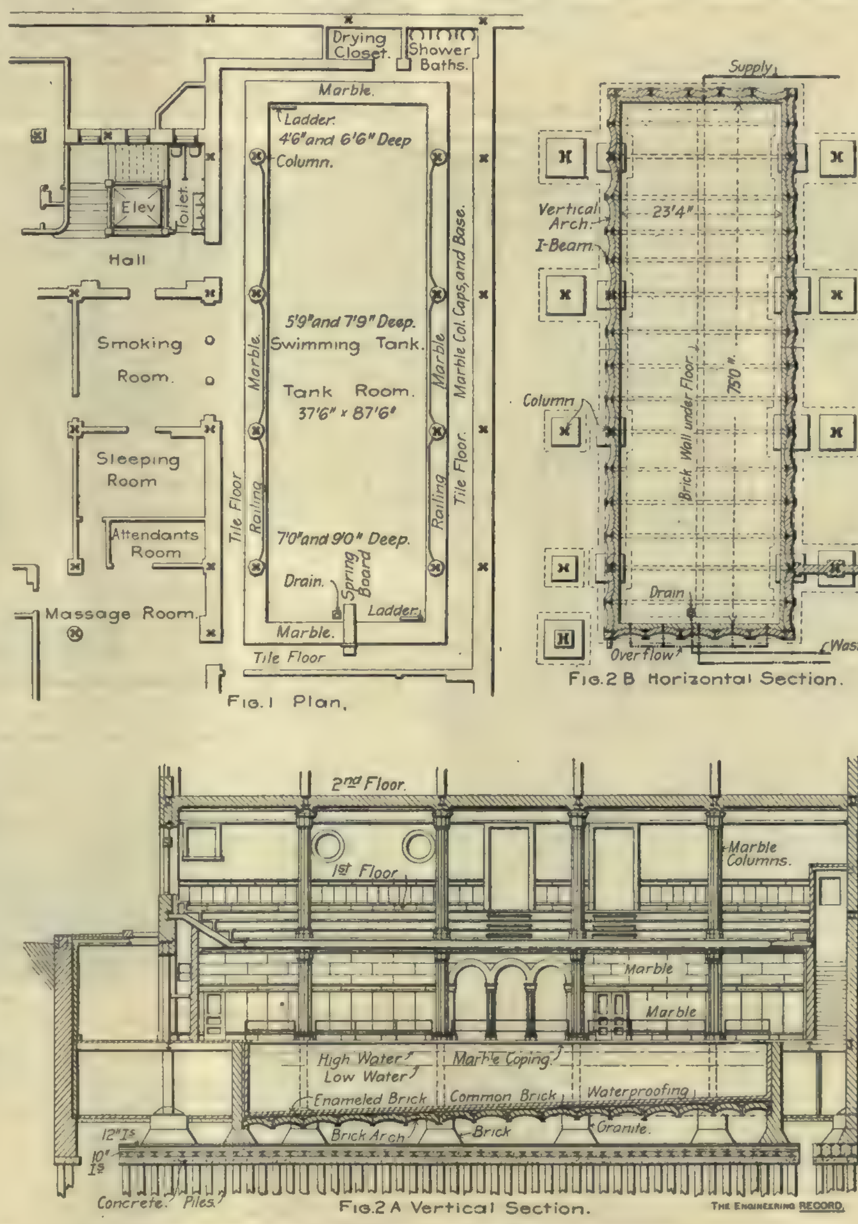
The ground or first story is taken up chiefly with the library working rooms as shown in the floor plans, and includes a private bindery; but the portion under the reading room is for use as a newspaper room. A newspaper file room has also been planned in conjunction with this with shelving for 1,500 volumes of bound newspapers. These rooms were placed on the first floor to make them directly accessible from the street for the greater convenience of the newspaper-reading public. The third story is given up to reference rooms, for children and adults, and includes a number of alcoves in which special subjects may be investigated, preferably as near as possible to the reference rooms. The main reference room is to be provided with book shelves for about 5,000 volumes, and the children's room, for 3,500 volumes. A collection of about 2,000 books is placed in each alcove pertaining to the subject for which the room is set apart. Another room is used to consult dictionaries and encyclopædias placed on its shelves. The two reference rooms are at opposite ends of the floor, according to the original instructions, and opening from the children's reference room is a children's reading room with shelves for 3,000 books. The fourth story is practically taken up with an art room and a lecture room.

The library will cost, exclusive of furniture, $200,000. The interior finish of the main reading room, delivery room and staircase is to be given special attention. The staircase is directly in front of the entrance, and will have marble steps and wainscot, and an ornamental iron railing. The reading and delivery room will have high oak wainscots, and the ceiling of the latter room is to be ornamented with stucco. The ladies' reading room, which adjoins the main reading room, will be finished in mahogany. The floors of the halls and corridors will be of terrazzo. The contract for the building has been let to Messrs. Norcross Brothers, of New York City.

An Expert Opinion on Plumbing which was rendered in 1868 by the late Moses Lane, deserves mention at this time as showing indirectly the great strides which have taken place since then in the sanitation of buildings. Mr. Francis Collingwood, M. Am. Soc. C. E., who was retained to report on the plumbing fixtures of a jail at Elmira, N. Y., wrote to Mr. Lane for information concerning the system in the county jail at Brooklyn, of which city he was then chief engineer. His reply was as follows: "There is a 6-inch iron pipe running along the rear wall of each tier of cells, having a fall of about 6 inches in 60 feet, and a valve at the lower end fitting air-tight into the pipe connecting with the sewer in the street. This valve is faced with leather, and has a handle attached to it so that it can be lifted and kept so, when the water is turned on for the purpose of flushing the pipe. It is made heavy, so as to form a tight fit by its own weight. The pipe is flushed every morning by means of a water pipe connected with the soil pipe at its higher end. This water pipe is connected with a tank placed on the roof of the building, and filled from the city distribution pipes. In each cell there is a pan for the use of the occupants which is fitted with a sheet-iron hinged lid. This apparatus is said to work very well, except that at the time of flushing, when the stench valve is raised, the foul gases from the sewer rise in the pipes and make it unpleasant for a short time. This could be obviated by putting a common syphon trap on the sewer connection beyond the valve. But a small amount of water is required to keep the pipe clean, and it would seem that if your buildings cover any extended surface that the rain water, if collected, would be sufficient. It might be collected in an underground system and thence pumped into the tank on the roof by the prisoners, and thus furnish them with work. The jail authorities think that it would be an improvement to make the soil pipe larger, say 8 inches instead of 6 as at present."

THE NEW YORK ATHLETIC CLUB'S SWIMMING BATH.

In the new house of the New York Athletic Club, at Sixth Avenue and Fifty-eighth Street, most of the basement is occupied by a Turkish bath installation and a large swimming bath. The swimming bath room is about 36x86 feet, affording a margin from 5½ to 8½ feet wide around the bath, above which there are two galleries around all sides of the room. The ceiling is about 35 feet high, and is at the level of that in the first main story. At the bath level a large smoking room is reached through a wide entrance at one side of the bath, and at one end there are shower baths in alcoves. The bath room is finished entirely in white. The steel columns supporting the gallery are encased in marble. The room is lighted by electricity and windows in one end and one side. A bronze lion's head is set over the bath at the first gallery at one end, and has a cold water supply by which an inch stream can be thrown from its mouth to the surface of the bath.



THE GENERAL FEATURES OF THE SWIMMING BATH.

This swimming bath is 75 feet long in the clear and 23 1/3 feet wide. Its bottom slopes uniformly from end to end, so as to afford a varying depth of water of from 7 to 9 feet. Unlike some swimming tanks, which have been made solidly embedded in pits or have consisted of a steel pan lined, this is wholly a masonry structure set several feet above the cellar

floor and entirely exposed on all sides so as to be always readily accessible for cleaning or repairs. The bath is located between two rows of four steel columns each, which are 26 feet apart transversely and 19 feet 7 inches longitudinally. These columns belong to the steel cage skeleton of the building and are built into the side walls of the bath. The walls are supported on vertical brick walls 24 inches thick which are carried down beyond the bottom of the bath to the cellar floor and rest there on pile foundations with wide concrete footings. These walls enclose the space under the bath and prevent access to the under side of it. There is a middle longitudinal dwarf wall parallel to the side walls, and on it and them rest transverse 12-inch steel I beams 3 feet apart. Between these I beams are sprung three-ring brick arches, which are leveled up with concrete filling over the haunches. The extremities of these beams support vertical 12-inch I beams about 10 feet long, which are firmly riveted to them and to outside horizontal bearing beams at the top. Flat arches of common red brick with vertical axes are sprung between these beams and form the main part of the walls of the tank. The inside faces of these walls are filled out to the vertical planes with concrete, and on its surface and that of the bottom is laid a waterproofing coat made of eight lapped thicknesses of tar paper swabbed with hot tar. Against this are set common red brick edgeways, and on them, in a 1-inch bed of one to one Portland cement mortar, are laid the white glazed brick which form the finished interior surfaces of the bath. There are brass movable stairs and a white marble coping around the top of the bath, which is protected by an iron hand rail, and has at one end a spring board for diving. A general plan of the main floor of the swimming bath room is given in Figure 1, which shows the position of the shower baths, an adjacent steam coil room for drying bathers' clothes while they are in the swimming tank, and of the lounging parlor. The steel columns on each side of the bath support the first and second balconies, whose outer edges extend as far as the sides of the bath. A horizontal section through the bath is shown in Figure 2, and corresponding vertical transverse and longitudinal ones, in Figure 3, which gives the arrangement of inlet and outlet connections.

The bath has a maximum depth of water of 9 feet and holds about 100,000 gallons when filled to this level. It was designed to have a uniform supply of about 10,000 gallons a day when in service, which would completely renew the contents of the tank every ten days and keep it satisfactorily clean. It was at first intended to supply the bath with hot water taken from the condensation tank of the heating tank and with water which had been used in the condenser of the refrigerating plant, thus making a second use of the water, which is purchased by meter, and so effecting a double economy. After the construction of the building the flow of ground water encountered above the cellar floor increased so greatly that the two 12-inch pipes provided to carry it off were considered insufficient and were supplemented by one of 20 inches, so there was an abundance of cold water going to waste. This was not good enough to be filtered, but was used to cool the coils of the refrigerating plant and then discharged to the sewer. The water which is now used in the swimming bath and for all other purposes throughout the building is received through two independent metered street supplies, and passes through a battery of the Continental pressure filters, comprising five 8-foot steel cylinders arranged to operate as one preliminary sand filter and two double bone-charcoal filters. These filters deliver under street pressure to the suction tank and to the 6-inch pipe supplying the bath. A branch from the filter main supplies cold water to the Gegenstrom heater, delivering the normal hot-water supply to the bath through a 2-inch pipe which is connected to the tank pressure house boiler so as to utilize that supply in case of emergency.

In order to prevent injury to the tarred wa-

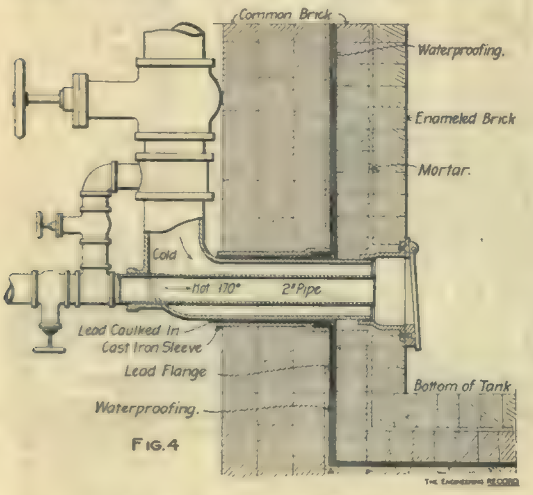


FIG. 4

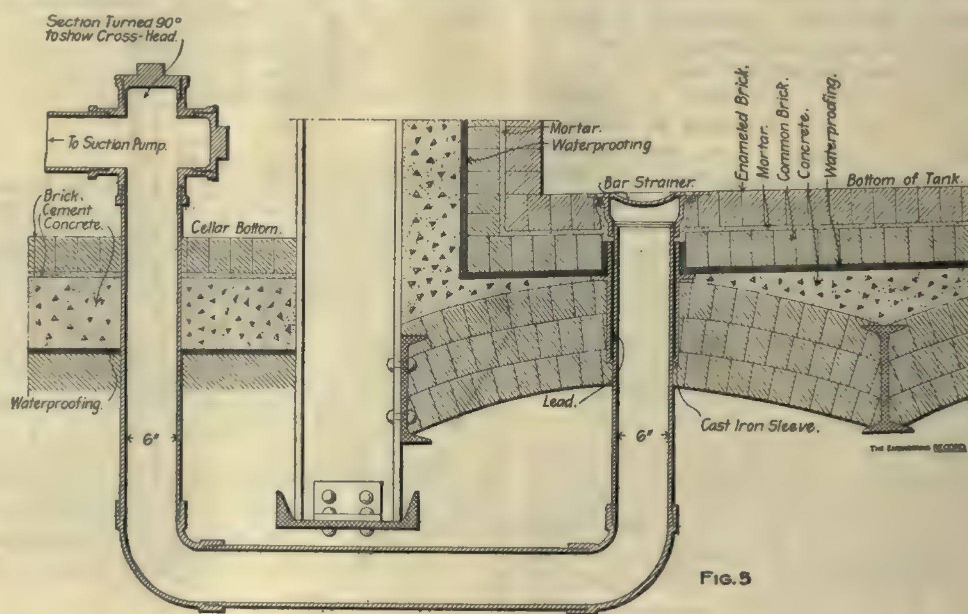


FIG. 5

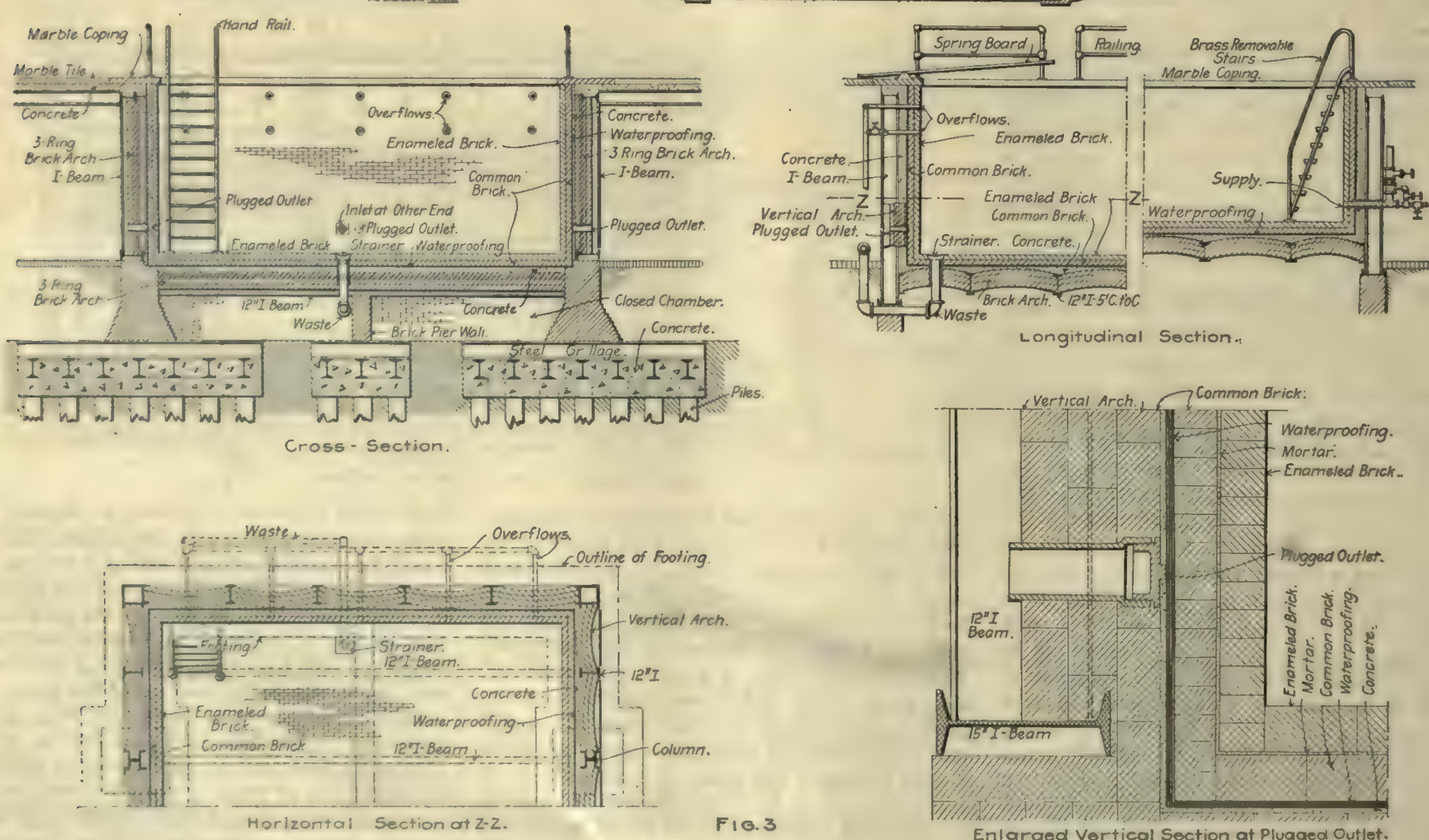


FIG. 3

DETAILS OF SWIMMING BATH, NEW YORK ATHLETIC CLUB HOUSE.
MR. W. A. CABLE, ARCHITECT; MR. A. L. WEBSTER, ENGINEER.

ter-proofing of the tank from the heat of the hot-water inlet pipe, it is jacketed as shown in Figure 4. The hot water is delivered to the bath by a 2-inch pipe which discharges through the center of the 6-inch cold water supply. The 6-inch cast-iron inlet is made with a special elbow, one end of which passes through the wall of the tank and terminates behind a brass strainer plate not shown here. A special hub is cast on the angle of this pipe and is threaded to receive the 2-inch hot-water pipe. The cold pipe is provided with a regulating valve by which the flow is adjusted to produce the temperature desired, usually about 100 degrees in cool weather. An 8-inch cast-iron sleeve is set with Portland cement in the brick wall and the 6-inch cold-water pipe is firmly calked in it and around a sheet lead flange which projected from the inside of the wall and was flashed down on the water-proofing there and then covered with the cement mortar in which the glazed brick lining was set. Both pipes terminate at the inner face of the tank and the hot and cold water is not mixed until it is discharged into the tank. The tank can be filled only through this inlet, and as it is important to fill it for renewed use as rapidly as possible after cleaning, there is a valved by-pass between the hot and cold pipes so that the latter can be made to discharge its full volume regardless of temperature. Each of the two domestic boilers has a capacity of 300 gallons, and it is estimated that its contents can be raised in 15 minutes from a temperature of 40 to 170 degrees by the 50-foot coil of 1.5-inch brass steam pipe which it contains. These boilers are fitted with automatic thermostatic attachments which control the admission of steam so as to maintain a constant temperature of between 115 and 125 degrees in the discharge.

There are ten 2-inch overflow pipes at the deep end of the tank, which are arranged in two horizontal rows of five each, one 7 and the other 9 feet above the bottom of the tank. All the upper outlets are connected to an unvalved waste pipe, but for the convenience of operation, all but one of them have been closed by fixed cover plates. All the lower outlets are connected to a valved horizontal 6-inch overflow pipe which discharges into the same trapped waste that receives the flow from the upper outlets, and was originally arranged to deliver it into the 600-gallon steel sump set below the cellar floor. Originally it was automatically emptied by a pair of Shone ejectors which discharge to the street sewer. The sump can also be emptied, if necessary, by a 10x7x10-inch Worthington pump which is installed to empty the tank directly and is also provided with a 6-inch suction to the sump. This pump has a 6-inch suction and a 5-inch discharge emptying over a large iron funnel with 8-inch trap connected into the main house drain.

The emptying pipe is carried through the bottom of the tank by a flanged cast-iron sleeve which is cemented into the brickwork and around which the water-proofing is flashed, as shown in Figure 5. A removable concave bar strainer is set flush with the bottom of the tank and fits with a ground joint over the top of the outlet pipe. The overflows are set in the same way, except they are horizontal, and their inlets are protected by brass strainers hinged on top. In the middle of each of the long sides and of the lower end of the tank is set an extra pipe sleeve closed by a screw plug and having its inner end covered by the glazed lining of the tank. These connections were provided at the outset as a precautionary measure, so as to allow for possible future inlets or outlets by merely removing a single brick without disturbing the water-proof lining or threatening its integrity.

Since the construction of the bath a new street sewer at a lower level has been built and most of the contents of the pool can be drawn off by gravity, thus saving time and pumping, and making it unnecessary to use the ejectors to discharge the overflow. In order to pass obstructions in the floor, the emptying pipe forms a deep trap and rises a little above the bottom of the bath before joining the house sewer, and this construction makes it necessary to pump out the last few inches of water from the bath. The capacity of the emptying pumps, filter plant, heater and inlet service was designed on the basis of emptying the tank in five hours, cleaning it in two hours and refilling it in five hours, so that it need not be out of service more than twelve hours at once. This is practically attained, although the filling is not as rapid as intended, but the bath is serviceable for some time after the emptying is commenced and before the filling is completed.

As the inlet and overflow are at opposite ends of the bath, and the former is set near the bottom, any discharge must cause a circulation and the floating scum is daily removed by hot water spray which is carefully played over the surface, commencing at the inlet end and gradually working down to the other end, where the single remaining overflow has previously been temporarily closed. Everything floating on the top of the water is thus collected at the overflow, which is suddenly opened after the water has risen an inch above its bottom and the upper layer of the water is drawn rapidly off, carrying along the floating impurities with a minimum amount of flush. The water is clear and transparent as delivered by the filters to the tank, but the constant deposition of atmospheric dust on the more than 1,700 square feet of its surface, and accumulation of other material, soon forms a sediment over the bottom of the tank. This is swept daily into a heap by a long-handled broom slowly and gently operated, and is sucked up through the bell-shaped nozzle of a flexible pump pipe. The bath is emptied and thoroughly washed every ten or twelve days. The bath is provided with two brass stairs set in frames of heavy polished brass pipe with hand rails, continued in a reverse curve at the upper end, where they form vertical legs about 3 feet high which are slipped over dowels set in the floor. The stairs can be raised easily so as to disengage the dowels.

FIGURE 6.—VIEW OF THE SWIMMING TANK, LOOKING SOUTH.

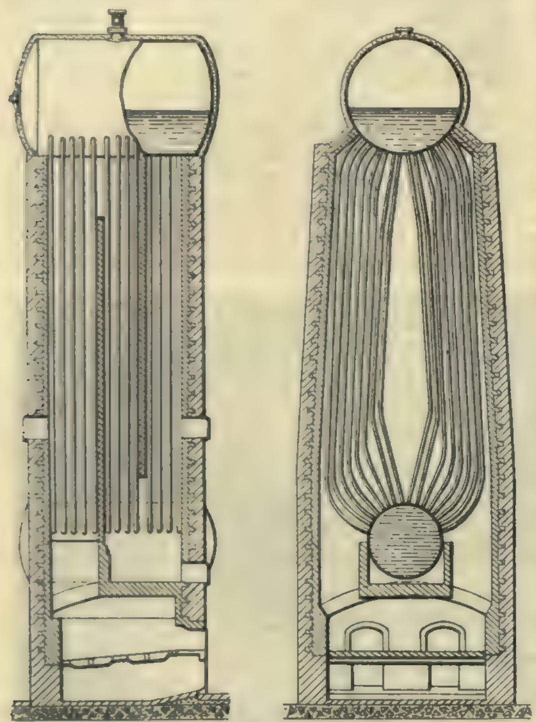
The swimming bath was designed and constructed under the supervision of Mr. A. L. Webster, M. Am. Soc. C. E., in accordance with the plans and specifications of the architect, Mr. W. A. Cable. Mr. D. K. Tangan was the superintending architect and the water-proofing work was executed by the T. New Roofing & Manufacturing Company. Mr. Leonard Hosford was the contractor for the plumbing.

A Piece of Quick Work was recently executed on the Pennsylvania Railroad. On the morning of April 29 a train derailment wrecked one of the road's standard overhead signal bridges, which consisted of riveted lattice trusses supported on steel trestle bents 101 feet between centers. Chief Engineer William H. Brown ordered a new bridge on the same day from Mr. Stacy B. Opdyke, Jr., of Philadelphia, from the plans of Mr. William A. Pratt, engineer of bridges. The delivery of the last shipment of material was made May 6, and the bridge had been erected by May 7, under the direction of Mr. Joseph T. Richards, engineer of maintenance of way. By the following morning the signals were all connected and in service.

An Engine-Room Record Book devised by Mr. Dow R. Gwinn, superintendent of the water-works at Quincy, Ill., has 365 pages, each measuring 17 x 11 inches. A page is given up to the record of each day, and is divided into two portions, 4 inches running across the full width of the page at the bottom for remarks concerning accidents, breaks, leaks, special work, boiler cleaning and materials received, and the remainder for the regular station records. There are vertical columns in which to record the half-hourly readings of the steam pressure, vacuum, temperature of the feed water, revolutions per minute of the four engines, and the clear-well pressure. Special spaces are provided for noting the time of starting and stopping of each engine and the hours it ran during the entire day, as well as for the counter readings. Room is also furnished and appropriately lettered for recording the number of boilers in use, the number of times the tubes are blown and the various valves opened, the times the fires are cleaned, the number of filters washed, the draft pressure, the oiling, the pounds of coal consumed for various purposes, the evaporation per pound of coal, the condition of the river water and its stage, barometer and thermometer readings, the rainfall, time records of employees, and other minor but important data for a correct understanding of what takes place in the power station of a water-works.

THE MAXIM BOILER.

The accompanying cut shows two vertical cross-sections of the Maxim water-tube boiler, which is being introduced by The Maxim Company of Starrucca, Pa. The boiler consists of two horizontal drums connected by tubes in the manner shown. From the figure on the left it will be seen that fire-brick partitions divide the tube-space into three passages, through which the gases circulate in succession. Access is had to the upper drum, which is 6 feet in diameter, through manholes, which enables the tubes to be inspected and cleaned. The water surface in the upper drum is unusually large, and this feature, combined with the considerable distance from the water level to the steam nozzle, greatly diminishes the liability of water



THE MAXIM BOILER.

being carried over with the steam. The outsides of both drums are accessible at all points for cleaning and inspection. The tubes have a double bend to permit expansion and contraction. The downward circulation of water is through the tubes exposed to the third, and consequently coolest, pass of the gases. The furnace is lined with fire-brick, and a similarly lined combustion chamber is provided to insure a complete combustion of the gases, which travel 50 feet in contact with the tubes. The boiler is supported by four iron brackets, two riveted to each drum, and these brackets rest on a steel framework entirely independent of the brick setting, thus relieving the tubes from strain.

TRADE PUBLICATIONS.

The Ayers Asphalt Paving Co., Zanesville, Ohio, has prepared a pamphlet describing asphalt pavements, both generally and in detail so far as the work done by the company is concerned. It uses "Standard" California asphalt, and the pamphlet illustrates some of the streets which it has paved, gives a full list of the work it has completed, amounting to over 186,000 square yards, and presents a series of specifications calculated to produce the best results with this particular brand of asphalt.

Julian Scholl & Company, 126 Liberty St., New York, have prepared a pamphlet describing contractors' machinery and supplies which will prove useful to all who have to construct municipal works of any sort. The catalogue describes and prices steam and horse rollers, stone-crushing machinery, drills, boilers, engines, road machinery, scrapers, contractors' wagons of various sorts, street sprinklers and sweepers, ploughs, wheelbarrows, concrete mixers, asphalt paving apparatus and smaller supplies.

The Chicago Pneumatic Tool Company, Chicago, Ill., has prepared a special edition, numbered 6, of its catalogue of pneumatic tools. It is illustrated with many excellent views of work executed by means of the various tools, the construction of which is explained in the pamphlet, and there are also fac-simile reproductions of testimonials received from many firms. The illustrations by themselves will prove of value to engineers on account of the hints they afford of methods of conducting work expeditiously, while the descriptive text contains data useful for practice.

Electrically driven machines and factories is a subject of interest to all mechanical and mill engineers, who will find much of value on the topic in "Bulletin No. 8," just issued by the Crocker-Wheeler Company, 39 Cortlandt St., New York City. It illustrates many types of mill, elevator, brake, car and shop motors, and the accompanying text contains some very useful information concerning the advantages of enclosed and open motors and the efficiency of the various types. The heating of an intermittantly used enclosed motor is shown by a chart. A special motor for giving two speeds by means of two sets of changeable gears and some special forms of brakes are other features of interest.

The heating apparatus manufactured by the Gurney Heater Manufacturing Co., 74 Franklin St., Boston, Mass., is described in a handsome publication of some 75 pages just issued. The new Gurney "400 Series" hot-water heaters, the "Doric" hot-water heaters which are made in various sizes with capacities of 250 to 1,600 square feet of radiation, the "Doric" steam boilers, which also run into large sizes, the Gurney "Bright Idea" safety water-tube heaters for steam or water, the "Gurney" steam heater and the "Defiance" steam boiler are illustrated in such a way as to show their details of construction and the assembled parts. The various types of radiators, including the "Yale" and "Harvard," expansion tanks, valves, gauges, etc., made by the company are also described and illustrated.

The Goodwin Car Company, 96 Fifth Ave., New York, has prepared an elaborate book showing various types of the Goodwin patent steel gravity dumping cart, which has already been described in these pages. The book shows in a graphic manner the advantages this car possesses in saving time and expense where materials must be unloaded rapidly. The Goodwin system allows the contents of a car, whether the material is large or small in size, to be dumped on either or both sides or in the center without careening the car. One man can discharge an entire train load of material while the cars are moving. The car is especially adapted to the coal and ore train, but its advantages will appeal strongly to contractors and others who have to handle large quantities of earth or rock.

For many years the series of pamphlets issued from time to time by Mr. George H. Daniels, general passenger agent of the New York Central & Hudson River Railroad, have been widely known for the valuable information they contain in addition to the well-phrased encomiums of that company's passenger service, for which this gentleman has become famous. He has recently done a real favor to people interested in railway transportation by publishing an illustrated catalogue of the "Four Track Series" of pamphlets describing various features of a modern railroad and some of the famous localities reached by the New York Central system. This series contains a number of books and folders which merit preservation in any library, and eight etchings of scenery which may be admired from the car windows of the Central's trains, the Washington Bridge, the noted Empire State Express, and the two famous locomotives known as the DeWitt Clinton and No. 999 respectively. A copy of this pamphlet will be sent on receipt of a one-cent stamp by Mr. Daniels, whose address is Grand Central Station, New York.

The Great Northwest, the land which many statisticians have predicted would become the most important agricultural region of the world, is described in a book of about 100 pages, written by Mr. O. V. Wheeler and published by Mr. Charles F. Fee, general passenger agent of the Northern Pacific Railway, St. Paul. It is printed and illustrated in the sumptuous manner characteristic of the recent publications of this company, and describes the Minnesota lakes, Yellowstone Park, the famous Gallatin Valley in Montana, where barley is raised for export to Europe, the Bitterroot Valley in Montana, which was the home of the Flathead Indians and is now remarkable for its agricultural products, the Lewiston region along the boundary line between Idaho and Washington, where vineyards and fig groves flourish, although the country is as far north as Duluth, the Buffalo Hump Mining region south of Spokane, the Walla Walla Valley in Washington, Mount Shasta and other localities. The amount of information in the book, authority for which is given in all cases of statistics or expert opinion, makes it a valuable reference book even for those who cannot at present visit the attractive scenes depicted.

The History of a Peculiar Well was detailed in an interesting manner in a recent lecture before the students of the University of Wisconsin by Mr. Onward Bates. The well was sunk in Dubuque to obtain a supply for the ordinary uses and fire protection of large railway shops in that city. "The information obtainable from the logs of other wells in that neighborhood," said Mr. Bates, "enabled the superintendent to determine about how deep he would find water, and the head from the supply of the different strata. From this investigation the well was bored to a depth of 1,263 feet, and encountered two supplies of water approximately 800 and 1,200 feet from the surface. Sufficient water could be obtained from the 800-foot level, but it would require to be pumped. The water from the 1,200-foot level would give a head sufficient to supply the ordinary purposes of the shops without pumping, but it was deemed insufficient for fire protection. He could not get the supply from the 800-foot and 1,200-foot levels jointly without losing the pressure from the lower level, because it would naturally equalize itself with that of the 800-foot level. Therefore the superintendent solved the problem by putting down first an 8-inch pipe to the rock, which was about 150 feet from the surface. This pipe was merely a casing for the protection of the inner or well pipes, enabling them to be put in or taken out at pleasure, and also keeping out the surface water. Inside of this 8-inch casing was sunk a 6-inch pipe, which was packed in the top of the rock. Then a 4-inch pipe was placed inside of a 6-inch pipe, the bottom of which rested on a shoulder left in the hole and was packed against that shoulder at a depth of 1,100 feet from the surface. At the top of the well the 6-inch and the 4-inch pipes were arranged so that they could be used jointly or separately. For ordinary purposes the water brought through the 4-inch pipe from the lower level is delivered into a tank at a height sufficient to give the proper head for distribution throughout the shop. For fire purposes there is a large pump in the engine room of the shop, connected with both the 6-inch and 4-inch pipes. When this pump is in use, it draws water from the 1,200-foot level through the 4-inch pipe, and from the 800-foot level through the annular space outside of the 4-inch and inside the 6-inch pipe, giving an abundant supply. This water supply plant was put in and set to work without any hitch and with results which were entirely as expected."

The Annual Convention of the American Society of Civil Engineers will be held at the Stockton Hotel, Cape May, N. J., June 27 to 30 inclusive. The programme presented is very attractive and includes a discussion of eight papers presented during the last six months and six subjects for informal consideration by the members. Of these latter, two relate to the discontinuance of wheel concentrations in determining bridge stresses and the status of fatigue formulas in bridge design. Among the municipal and hydraulic engineers, features of sewage disposal are to be discussed and the proper coefficient of friction in the design of riveted steel pipe. Members interested in transportation are invited to discuss the advisability of substituting electricity for steam on branch roads and the present status of the telferage system. Both the Pennsylvania Railroad and the Philadelphia & Reading Railway Companies have contributed to make the convention a success by placing special trains at the disposal of the members free of all charge. The Stockton Hotel, which accommodates about 750 people, has been secured for the exclusive use of the Society and its guests during the convention, but for the first time for many years members will be required to arrange their own hotel accommodations in advance. This is an innovation in the practice of recent conventions, but it is a highly commendable one, for heretofore the Secretary has been criticised severely for accommodations provided for some of the members attending these meetings, who, on account of their own negligence or other reason, have failed to receive what they believed was their due. By making each man responsible for his own comfort the committee of arrangements has very wisely shifted the cause of needless worry from the shoulders of the Secretary to those of the people where it belongs.

PERSONAL AND OBITUARY NOTES.

Mr. L. W. Roys has been elected city clerk of Tacoma, Wash.

Mr. L. J. Hjorth has been elected city surveyor of Neenah, Wis.

Mr. Frank Good has been appointed city clerk of Parkersburg, W. Va.

Mr. W. H. Whittlesey has been appointed superintendent of water-works, Bushnell, Ill.

Mr. W. H. Moore has been elected city clerk and Mr. J. J. Gorman water superintendent of Durango, Colo.

Mr. F. M. Turner has been appointed civil engineer of Dayton, Ohio, and Mr. E. C. Baird assistant civil engineer.

Mr. C. H. Blackall has removed his architectural office from the Music Hall Building to No. 1 Somerset Street, Room 17, Boston.

Mr. Frank Maendler has been re-elected superintendent of the Ashland, Pa., water-works, a position he has held for several years.

Mr. E. Sherman Gould, M. Am. Soc. C. E., who has been in Havana for a number of months past, is expected to return to Yonkers, N. Y., shortly.

Passed Assistant Engineer E. S. Kellogg has been detached as inspector of engineering material at Harrisburg and ordered to the Navy Yard, New York.

Gov. Tanner of Illinois has appointed Col. John Lambert, of Joliet, Albert Schoch, of Ottawa and Isaac Taylor of Peoria, as a State Commission to inspect the Chicago drainage canal before water can be turned in.

The following gentlemen were elected officers of the American Water-Works Association on Wednesday of this week: President, R. M. Clayton, Atlanta, Ga.; Vice-Presidents, William R. Hill, Syracuse, N. Y.; John B. Heim, Madison, Wis.; E. Mather, Harrisburg, Pa.; C. H. Campbell, Charlotte, N. C.; W. M. Molis, Muscatine, Ia.; Secretary and Treasurer, Peter Milne, New York; Finance Committee, Dow R. Gwinn, Quincy, Ill.; W. H. Laing, Racine, Wis.; A. A. Tucker, Memphis, Tenn.

Mr. John W. Ambrose, president of the South Brooklyn Railroad & Terminal Co., died May 15, at his home in New York, aged 61 years. He was born in Newcastle, Ireland, and came to this country at the age of fourteen, receiving his education at the New York University and Princeton College. At one time he was street cleaning contractor and is said to have laid the first pneumatic tubes used in the country. He built a portion of the Second Avenue elevated railroad in New York and in 1882 became interested in the development of Brooklyn waterfront properties. His efforts were largely instrumental in bringing about the recent large appropriations for improvements in New York harbor.

Mr. David L. Bartlett, senior member of the well-known firm of Bartlett, Hayward & Company, Baltimore, died May 11 from a complication of diseases resulting from advanced age. He was born in Hadley, Mass., December 6, 1816, and received an education in the common schools and academies of New England. At an early age he became interested in iron manufacture at Hartford, but removed in 1844 to Baltimore. Six years later he became associated with Mr. J. H. Hayward, and the firm then founded has continued with slight changes to the present time. He was also president of the Ryan & McDonald Manufacturing Company, and an officer in many financial and social organizations, both city and national.

CONTRACTING NEWS

OF SPECIAL INTEREST TO

CONTRACTORS, BUILDERS, ENGINEERS, AND MANUFACTURERS

OF ENGINEERING AND BUILDING SUPPLIES.

For Proposals see pages xi, xii and 584.

WATER.

Evanston, Ill.—Sam'l G. Artingstall, Engr., Rialto Bldg., Chicago, writes that plans and specifications are complete for the proposed water tunnel, to cost about $150,000.

Tyler, Minn.—It is stated that W. J. Huddleston, Village Recorder, will receive bids June 6 for water-works from plans of C. F. Loweth of St. Paul.

Peru, Ind.—Bids have been asked for drilling 5 wells. J. D. Oates, Chmn. Water-Works.

Elkton, Md.—The question of constructing water-works and an electric light plant is said to be under consideration.

Michigan City, Ind.—It is stated that bids are wanted in June for pumping engine, 35,000 ft. intake pipe and 16 in. water main. M. T. Krueger, Secy. and Gen. Mgr. Water Co.

Whitehall, Lehigh Co., Pa.—Press reports state the incorporation of the Clear Springs Water Co., capital $200,000, by W. W. Watson and E. S. Jones of Scranton, A. G. Leisenring of Upper Lehigh, J. W. Fuller, Jr., of Catasaqua, and others, to furnish water in Lehigh and Northampton counties.

St. Louis, Mo.—It is stated that the Board of Public Improvements will receive bids May 26 for extensive supplies for the Water Department.

Whitesboro, N. Y.—The Whitestown Water-Works Co. is reported incorporated with capital of $50,000. Directors: Henry W. Millar and Wm. E. Lewis of Utica, Wm. G. Stone of Whitesboro and others.

Elmira, N. Y.—J. B. Cahoon, Gen. Mgr. Elmira Water-Works Co., writes: "We propose putting in a 10,000,000-gal. pump, and I have submitted estimates in two ways. 1st.—Compound condensing steam. 2nd.—Electrically driven to operate in connection with our electric light plant and power house." Probable cost, $50,000.

Monroe, N. C.—The plans and specifications for electric light and water-works, it is stated, are completed. Water will be forced from three artesian wells, already sunk, by pump.

Lacrosse, Wis.—See "Sewers."

Davenport, Wash.—It is stated that an election will be held July 1 to issue $14,700 bonds for water-works.

Des Moines, Ia.—Press reports now state that the contemplated extension of the Water-Works Co. is to amount to $60,000 to $75,000.

Jackson, Mich.—See "Sewers."

Orange, N. J.—The Mayor has recommended building a reservoir and placing a pump in pumping station.

Three Oaks, Mich.—The Senate has passed a bill permitting the extension of water-works.

Duquesne, Pa.—It is stated that the Borough Council is to construct 4 wells.

Cincinnati, O.—A. J. Henkel, Cincinnati, has been awarded the contract for the settling reservoirs, pump mains, California, O., at a figure stated as $1,171,743.50.

Brownsville, Tenn.—It has been voted to issue $27,500 water-works bonds.

Flushing, (L. I.) N. Y.—The Board of Aldermen has authorized the Department of Water Supply to begin the extension of Flushing water system to Douglaston and Little Neck, at a cost of $26,000. The work, it is said, will be commenced as soon as contracts can be let.

Lanesboro, Pa.—It is reported that several springs have been purchased and that a reservoir will be built for the water supply of this place and eventually of Susquehanna, Pa.

Rat Portage, Ont.—The Council is said to have voted to issue $75,000 bonds for water-works.

Boone, Ia.—Press reports state that the city will vote May 27 on a $12,000 bond issue for water-works.

Mayville, N. D.—The contract for the water-works and electric light plant has been let to W. I. Gray & Co., Minneapolis, Minn., at $21,400. The Twin City Iron Wks., Minneapolis, will, according to report, furnish the steam plant.

Sisterville, W. Va.—The Commissioner of water-works has been authorized to order some water pipe.

Paonia, Colo.—Press reports state the incorporation of the Paonia Water & Light Co., to establish and operate a water and lighting plant. Incorporators: W. A. Clark, Milton Spencer, J. F. Wannemaker, and others.

Dickson, Tenn.—The issuance of bonds for the erection of water-works and an electric light plant is being considered.

Yates Center, Kan.—Press reports state the formation of the Yates Center Gas & Water Co., to prospect for gas and establish a water-works.

Vineland, N. J.—The citizens will probably be asked to vote in June on the question of constructing water-works, a sewerage system and an electric light plant. W. Mac George, Village Clk.

Winchester, Ind.—J. P. Miller & Co., of Chicago, are stated to have secured the contract for the water-works, and C. L. Olds Construction Co. of Ft. Wayne the contract for the electric light plant; estimated cost of both, $47,383.

Oleon, N. Y.—The Snow Steam Pumps Works of Buffalo has received the contract for a 3,000,000-gal. vertical cross compound pumping engine, at $14,170. John Z. Le Fevre, Supt.

New York, N. Y.—The Board of Aldermen have appropriated $17,000 for laying additional water mains from Manhattan Island to Blackwell's Island.

Indianola, Miss.—It is stated that bids are wanted June 5 by the Clerk of the Board of Supervisors for sinking an artesian well.

College Hill, O.—It is stated that water bonds in amount $40,000 have been sold.

Nyack, N. Y.—Louis L. Tribus of New York City is the consulting engineer for the completion of a sand filtration plant and other improvements to the water-works. G. N. Houston, Resident Engr. & Supt.

Meadville, Pa.—The water and Light Commission has submitted a report to Council recommending the purchase of a 5,000,000-gal. steam pump.

San Jose, Cal.—The incorporation of the West Coast Water Co., capital $1,000,000, is reported. It is stated that the company proposes to deal with real estate and water rights, to supply water for domestic and mechanical use and for irrigation. Directors: E. W. Clayton, W. S. Clayton, W. L. Pieper and others.

Schenectady, N. Y.—It is stated that bids are wanted May 22 for 500 tons of cast-iron pipe and 10 tons of special castings. John McDermott, Chmn. Water Commrs.

Lake Placid, N. Y.—The Lake Placid Water Co., North Elba, Essex Co., has been incorporated, with capital of $20,000, to supply Lake Placid and Newman. The directors are said to be Byron R. Brewster, Sarah E. Allen, Myron T. Brewster and others of North Elba.

Tupper Lake, N. Y.—Bids are wanted by the President of the Tupper Lake Water Co., June 1, for 2 to 5 miles of piping for a water-works system.

Media, Pa.—Bids are wanted June 1 by the American Pipe Mfg. Co., Philadelphia, for a reservoir near Media, as advertised in "The Engineering Record."

Aberdeen, Miss.—The question of water-works and sewerage system is being considered.

Newark, N. Y.—The incorporation of the City Water Co. is reported, with Chas. F. Street, Herbert J. Bickford, Wm. B. Hord and others, directors.

Gibbon, Mich.—The Council, according to reports, wants estimates for a water system.

Lake Preston, S. D.—Bonds for $5,000, it is said, will be issued for water-works.

Fulton, N.Y.—W. R. Hillick, City Clk., writes: "The proposition to purchase the water plant was defeated May 16 and this leaves us with the appropriated sum of $115,000 (voted last year) to build new plant."

Albany, N. Y.—Bids are wanted June 6 for 380 gross tons cast-iron coated water pipes, and 18,000 lbs. special castings. Geo. I. Bailey, Supt. Water Wks.

Murphysboro, Ill.—Bids are wanted June 9 for a steel water tower, as advertised in "The Engineering Record."

Port Jervis, N. Y.—P. E. Farnum, Pres. Port Jervis Water Co., writes that it is proposed to construct a 500-million gal. reservoir this summer.

Doylestown, Pa.—Bids for sinking two or more 8-in. artesian wells were opened May 11, and are reported as follows: Wm. B. Sutton, Doylestown, $1.40 per ft. for 100 ft., $1.65 per ft. for next 50 ft., $1.90 per ft. for next 50; Thos. B. Harper, Jenkintown, $2.25 per ft. 500-ft. limit; D. W. Twining, Philadelphia, $2.50 per ft. for 100 ft., and 50 cts. additional for every additional 100 ft.; Geo. J. Kennedy, Philadelphia, $1.75 per ft. for 100 ft. and 25 cts. additional for every additional 100 ft.

Wellsville, O.—The following bids for furnishing and laying about 205 tons of 12-in. and 6 tons of 8-in. pipe and specials were opened May 15 by City Clk. D. A. Davidson: P. Morley & J. W. Gipner, East Liverpool, O., $9,340; H. D. Shannon & Co., Orrville, O., received contract, $8,112; W. M. Chisholm, Pittsburg, Pa., $8,370; Eagle Hardware Co., East Liverpool, $8,336. Bids for furnishing the pipe only were received from the American Pipe & Foundry Co., Chattanooga, and the U. S. Cast Iron Pipe & Foundry Co., Chicago, which tendered at the rate of $25.90 and $25.75 respectively.

New York, N. Y.—Bids are wanted June 6 for overflow and blow off sewers, water pipes and appurtenances at the Jerome Park reservoir, Borough of Bronx. John J. Ryan, Pres. Aqueduct Commrs.

SEWERAGE AND SEWAGE DISPOSAL

Pittsfield, Mass.—Sewer bonds to the amount of $25,000 are stated to have been sold.

Stockbridge, Mass.—According to press reports the following bids for sewers were received: D. H. Parsons, *Westfield, Mass., $12,707.55; Celestine De Marco, New York City, $13,142.61; Ley & Co., Springfield, Mass., $16,162.60. *Contract awarded.

Schenectady, N. Y.—The Common Council has authorized the construction of several sewers.

Franklin, Mass.—The plans for sewers in the business section are completed and, it is said, contract will soon be let.

Chicago, Ill.—The Finance Committee has recommended that the South Side intercepting sewer be enlarged and extended. Estimated cost, $500,000 to $750,000.

Trenton, N. J.—Bids are wanted June 6 for a sewer in Cooper St. C. Edw. Murray, City Clk.

Montgomery, Ala.—An ordinance has been passed authorizing a $20,000 bond issue to construct sewers.

Elkhart, Ind.—Bids are wanted June 7 for sewers in 2 streets. D. F. Cordrey, City Engr.

Kansas City, Mo.—The following bids are reported for Vine St. sewer: S. F. Schroeder, $18,752.75; R. J. Boyd, American Bank Bldg., $19,547.27; Matt Kinlin, $20,096.86.

Port Chester, N. Y.—The desirability of a sewerage system is being considered.

Waterbury, Conn.—The Board of Public Works has recommended the construction of sewers. There is said to be $12,000 left of the sewer appropriation for this work.

Lowell, Mass.—See "Paving and Road Making."

Jackson, Mich.—Mayor Loenneeker in his message to the Common Council said that the city would expend $18,000 for sewers, $17,000 for paving and macadamizing, and $14,000 for water mains and meters.

Watertown, N. Y.—An election will be held May 29 to vote on issuing $51,514 bonds for a trunk sewer.

Monticello, Minn.—See "Power Plants, Gas and Electricity."

Northampton, Mass.—A loan of $4,000 for sewer construction has been authorized.

Aberdeen, Miss.—See "Water."

Rochester, N. Y.—The Board of Aldermen has voted for a number of sewers.

Tampa, Fla.—See "Paving and Road Making."

St. Paul, Minn.—Patrick Doherty of St. Paul has received the contract for the Hamline sewer system at $42,973; also for the sewers in Cherokee and Smith Aves., at $13,652. C. H. Bronson, Clk. Bd. Pub. Wks.

Nevada City, Cal.—The citizens have voted to issue $28,000 bonds for a sewerage system and bids for the bonds will be received June 15. T. H. Carr Clk. Bd. City Trus.

Muncie, Ind.—Bids are wanted June 12 for sewers in Willard and Jefferson Sts. F. W. Clenenger, City Clk.

Glenville, O.—Bids are wanted June 15 for a sewer in Burton Ave. Ira C. Farley, Village Clk.

Brussels, Ont.—It is stated that bids are wanted June 1 for a brick sewer. F. S. Scott, Clk.

Des Moines, Ia.—Bids are wanted May 30 for 2,000 ft. pipe sewers. G. A. Eberhart, Pres. Bd. Pub. Wks.

Quincy, Mass.—The following bids for Section 9 of the sewerage system were opened May 15. The bidders were: A, William Cashman, Quincy; B, Long & Little, South Braintree; C, C. E. Trumbull & Co., Boston; D, M. Russo & Co., Boston; E, H. A. Hanscom & Co., Boston; F, M. J. O'Hearn, Brookline; G, Frank L. Allen, Worcester.

	A	B	C	D	E	F	G
*Earth excavation.							
9,340 yds., 0-8 ft.	$0.68	$0.57	$0.65	$0.60	$0.50	$0.48	$0.45
2,570 yds., 8-14 ft.	1.00	.85	1.20	.90	1.20	.90	.85
1,230 yds., 14-20 ft.	2.00	1.80	1.25	1.50	2.00	1.30	1.50
30 yds., below 20 ft.	2.00	4.00	2.00	1.90	2.00	1.80	3.00
Masonry.							
120 yds. brick	4.50	5.50	5.00	5.00	4.50	6.90	5 00
300 yds. concrete	4 00	4.50	4 00	5.00	4.50	4.00	4.50
Laying pipe							
7,890 ft., 8 and 10 in.	.10	.16	.10	.10	.10	.15	.10
1,050 ft. 15-in.	.10	.30	.20	.10	.15	.15	.15
1,060 ft. 20-in.	.20	.30	.25	.12	.20	.20	.20
7,500 ft. Drains.	.20	.25	.20	.20	.15	.20	.25
400 ft. Chimneys	.10	.10	.10	.10	.10	.10	.05
Paving, 50 sq. yds.	.50	2.00	1.00	3.00	1.00	.70	2.50
Total	$15,852	$15,763	$15,407	$14,630	$14,538	$13,605	$13,451

Pueblo, Colo.—The City Council is said to have been petitioned to construct a system of storm sewerage as a precedent of street paving.

Chicago, Ill.—It is reported that a 5-foot sewer from Berwyn to the drainage canal is being considered, to cost from $80,000 to $110,000.

Vineland, N. J.—See "Water."

Grosse Point, Mich.—The village, it is stated, will commence a sewer system at once.

Ann Arbor, Mich.—City Engr. Geo. F. Key reports the award of a $17,593 storm sewer contract to Hutzel & Co., Ann Arbor. Three other bids were received, the highest being $22,625.

Albany, N. Y.—Bids are wanted June 5 for sewers in Morris and Morton Sts. Thos. J. Lanahan, Clk. Bd. Contract & Apportionment.

Frankfort, Ind.—Bids are wanted May 31 for sewers. Otto Wolf, City Clk.

Marlborough, Mass.—The following bids were opened by the Metropolitan Water Board, Boston, May 11 for the construction of filter beds:

Items and Quantities.		A. Saucier, So. Framingham, Mass.	Baker & Judson, Gloversville, N. Y.	C. E. Trumbull & Co., Boston, Mass. Chas. G. Craib, Winthrop, Mass.	Newell & Snowling Cons. Co., Uxbridge, Mass.	E. W. Everson, Providence, R. I. J. J. Everson, Newtonville, Mass.	Long & Little, Leominster, Mass.	Cenedella Bros., Milford, Mass.	The United Co., New York, N. Y.
Earth excavation, Class A	19,000 cu. yds.	$0.60	$0.70	$0.66	$0.66	$0.65	$0.95	$1.00	$1.41
" " " B	6,000 "	.50	.60	.60	.66	.60	.75	.80	1.36
" " " C	69,000 "	.21	.20	.21	.26	.30	.28	.40	.32
Rock "	200 "	.50	3.00	.75	1.50	3.00	2.00	.40	2.25
Portland cement concrete masonry	660 "	7.00	7.00	6.25	7.00	7.00	6.00	6.25	6.75
Brick masonry laid in Port. cem. mortar	35 "	14.00	12.00	12.00	15.00	15.00	15.00	15.00	14.00
Dimension-stone masonry	12 "	28.00	25.00	35.00	25.00	35.00	30.00	17.50	25.00
First class stone paving	50 "	3.50	5.00	7.00	8.00	6.00	6.00	4.00	2.50
Second-class stone paving	105 "	1.50	2.50	3.50	4.00	3.50	2.75	1.25	1.50
6 inch vitrified pipes laid with open joints	1,070 lin. ft.	.20	.15	.21	.14	.15	.15	.12	.10
" " " " cement "	60 "	.20	.17	.23	.15	.15	.15	.12	.13
8-inch " " " open "	970 "	.24	.20	.25	.18	.18	.18	.18	.14
" " " " cement "	110 "	.24	.22	.27	.19	.20	.20	.18	.17
10-inch " " " open "	1,270 "	.35	.25	.30	.24	.25	.23	.27	.20
" " " " cement "	660 "	.35	.27	.32	.25	.25	.25	.27	.25
" " " " filter "	1,110 "	.42	.28	.40	.28	.25	.30	.32	.26
12-inch " " " open "	960 "	.50	.30	.38	.31	.40	.34	.32	.28
" " " " cement "	300 "	.50	.30	.40	.32	.40	.35	.32	.34
" " " " filter "	960 "	.50	.32	.53	.35	.40	.40	.37	.35
15-inch " " " open "	280 "	.60	.45	.50	.42	.50	.50	.47	.38
" " " " cement "	370 "	.60	.45	.52	.43	.50	.50	.47	.44
" " " " filter "	970 "	.69	.47	.80	.48	.50	.55	.50	.45
18-inch " " " " "	270 "	.80	.60	.92	.60	.65	.65	.66	.62
20-inch " " " cement "	360 "	1.25	.70	1.05	.67	.80	.75	.87	.78
" " " " filter "	500 "	1.25	.75	1.12	.72	.80	.85	.90	.79
24-inch " " " cement "	100 "	1 50	1.00	1.25	.97	1.10	1.25	1.25	1.10
Total		$39,918	$40,671	$41,423	$44,172	$47,280	$51,529	$60,493	$66,350

Derby, Conn.—The following bids were opened May 12 by City Clerk John W. Larkin for 15,700 ft. vitrified pipe sewers, 9 to 24 ins. in diameter; 50 ft. of 24-in. cast-iron pipe sewer, 35 manholes and 25 catchbasins. The trench is expected to average 11 ft. and both rock and earth excavation will be done: A. Brazos & Son, Middletown, Conn., $21,224; A. M. Banker, Gloversville, N. Y., $21.538; C. W. Blakeslee & Sons, New Haven, Conn., $30,538; B. D. Pierce, Jr., Co., Bridgeport, Conn., $21,824; H. Wales Lines Co.; Meriden, Conn.; O'Neil & Co., Hartford, Conn., $21,336; Thomas F. Maher, New Haven, Conn., $22,390; Edward Tracy, Derby, Conn., $24,416; John A. Doolittle & Co., New Haven, Conn., $22,551; Strauss Bros. Co., Wallingford, Conn., $19,604.

Pittsburg, Pa.—The following bids for sewers in several streets were opened March 24 by E. M. Bigelow, Dir. Dept. Pub. Wks.: A, Ott Bros ; B, Evan Jones; C, Geo. F. Egan; D, Sweeney & Houston; E, James H. McQuade; F, Cronin & O'Herron; G, Keeling & Ridge; the first is an Allegheny firm and the others are Pittsburg parties:

Items.	A	B	C	D	E	F	G
12-inch	$0 59	$1.25	$1.71	$0.85	$0.84	$1.00	$1.05
15-inch	1.08	1.85	1.89	.95	1.29	1.27	1.35
18-inch	1.17	2.28	2.39	1.25	1.33	1.35	1.75
20-inch	1.93	2.68	2.89	1.65	1.55	2.80	1.60
Drops	55.00	80.00	65.00	60.00	55.00	55.00	65.00
Manholes	25.00	40.00	35.00	30.00	30.00	27.00	40.00

BRIDGES.

Dayton, O.—Bids are wanted May 31 for a steel girder bridge across the Miami and Erie canal at Wayne Ave.; also for 2 stone abutment walls for the same. P. E. Gilbert, Pres. Bd. City Affairs.

Canonsburg, Pa.—The construction of a bridge across Chartiers Creek at Jefferson Ave. is stated to be under consideration.

Cleveland, O.—Bids are wanted May 24 (re-advertisement) for a masonry arch under St. Clair St. for the main drive of the Brookway division of Rockefeller Park (span 65 ft., length 100 ft.). C. W. Pratt, Jr., Ch. Engr., Bd. Park Commrs.

Lodi, Wis.—The construction of an iron bridge at Main St. is said to be under consideration.

Gallatin, Mo.—It is stated that bids are wanted June 5 by Geo. W. Lockridge, Bridge Commissioner, for a bridge across Grand River.

Adrian, Mich.—A bill has passed the House permitting Palmyra township to build a $7,000 bridge over Raisin river.

Elkhorn, Ore.—It is stated that bids are wanted by the Clerk of the County Commissioners June 7 for a bridge across the north fork of the Santiam river.

Johnstown, N. Y.—City Engineer Miller has submitted plans and specifications for an iron bridge at North Perry St.

St. Paul, Minn.—It is stated that bids will soon be asked by the Great Northern Ry. Line for 2 bridges over Cut Bank and Two Medicine rivers to cost about $150,000. N. D. Miller, Ch. Engr.

Lockport, N. Y.—The Governor has signed a bill for rebuilding the bridge over the canal, at Chapel St.

New Kensington, Pa.—It is stated that a company, including T. A. Mellon and others, has applied for a charter to build a bridge across the Allegheny river from this place to Valley Camp; estimated cost, $150,000.

Somerville, O.—Bids will soon be asked for an iron bridge over Seven Mile creek to cost about $21,000. Bids are wanted by the County Commissioners June 6 for the bonds.

Novelty, Wash.—Local press reports state that bids are wanted by the County Commissioners June 16 for a bridge across the Snoqualmie river.

Fullerton, Neb.—Plans, specifications and bids are wanted June 16 for a steel bridge. G. W. Ellsworth, Co. Clk.

Gibson, Ga.—It is stated that bids are wanted June 6 for a bridge. B. F. Walker, Co. Clk.

Philadelphia, Pa.—See "Paving and Road Making."

Milwaukee, Wis.—The construction of a viaduct and roadway over Menomonee valley, connecting Grand Ave. and the Blue Mound road, to cost about $80,000, is said to be under consideration.

Biloxi, Miss.—Bids are soon to be asked for $40,000 bonds, $15,000 to be used for bridging Back Bay and $25,000 for paving.

Aberdeen, Miss.—The Southern Bridge Co., Birmingham, Ala., is stated to have received the contract for an iron bridge across the Tombigbee river, for $15,775.

Rochester, N.Y.—The Governor has signed a bill appropriating $75,000 for a steel bridge over the canal at West Ave.

Minden, N. Y.—The Governor has signed a bill appropriating $5,500 for a steel bridge over the Erie Canal.

Towanda, Pa.—It is stated that bids are wanted June 1 for 3 bridges. David A. Keefe, Designing Engr., Athens.

Rodney, Miss.—Bids are wanted in June for rebuilding the bridge over Flatland Bayou. S. D. McNair, Clk. Bd. Superv.

Wyalusing, Pa.—It is stated that bids are wanted June 2 for a steel highway bridge. David A. Keefe, Designing Engr., Athens.

Woonsocket, S. D.—Bids are wanted May 31 for a steel bridge across the James River. C. B. Stuart, Co. Aud.

Mansfield, O.—It is stated that bids are wanted May 29 for constructing wing walls to the arch across Ritter's Run on Ritter St. F. W. Remy, City Clk.

Hillsboro, N. D.—Bids are wanted June 14 for constructing, repairing and completing several bridges. Oluf Hagen, Co. Aud.

Trenton, N. J.—The board of Freeholders has appointed a committee to prepare plans for a jack-arch bridge in the Upper Ferry road.

Glens Falls, N. Y.—The Highway Commissioners have been authorized to prepare plans and specifications for 2 iron bridges over Halfway Brook.

Sauk Rapids, Minn.—The County Commissioners have voted to erect a steel bridge across the Mississippi river, to cost about $12,500.

Baltimore, Md.—The County Commissioners have directed B. H. Mays, Supt. of Bridges, to prepare specifications for 2 bridges.

Chicago, Ill.—The following bids were opened May 10 by the Sanitary District Trustees for a four-track bridge across the main channel near 31st St: C. L. Strobel, $181,218; The King Bridge Co., $190,272; Chicago Bridge & Iron Co., $199,062; Massillon Bridge Co., $180,400; Pennsylvania Steel Co., $181,992; The Toledo Bridge Co., $167,292; J. G. Wagner & Co., $176,270.

Birmingham, O.—The following bids for the superstructure of the Vermilion River bridge were opened May 9 by Pres. J. C. Hauser of Bd. of County Com., Sandusky. The bids for bridge with wood floor are marked, *a*, those including paved roadway *b*. Massillon Bridge Co., Massillon, O., *a*, $13,275; *b*, $19,875. Toledo Bridge Co., Toledo, *a*, $10,750; *b*, $21,500. Canton Bridge Co., Canton, O., *a*, $12,500 and $16,000. Brackett Bridge Co., Cincinnati, *a*, $10,600. Wrought Iron Bridge Co., Canton, O., *a*, $10,650 and $12,400. Iron Substructure Co., Columbus, *a*, $12,780 and $8,375. Variety Iron Works, Cleveland, *a*, $14,443; *b*, $20,816. Groton Bridge Co., Groton, N. Y., *a*, $14,891. Youngstown Bridge Co., Youngstown, O., *a*, $10,648 to $17,322. King Bridge Co., Cleveland, *a*, $12,200 to $16,400. Lafayette Bridge Co., Cincinnati, *a*, $12,500. Mt. Vernon Bridge Co., Mt. Vernon, O., *a*, $11,000 to $14,200. Oregonia Bridge Co., Lebanon, O., $17,850 for Melan arch.

Bids for the masonry abutments and piers were opened at the same time; they were: Rikeman & Croft, Milan, O., $3,300. J. O. Parker, Sand Hill, O., $2,950. Truitt & Britton, Milan, $2,243. E. B. Page, Birmingham, O., $2,801. Garland & Robertson, Birmingham, $3,367.

Binghamton, N. Y.—The following bids for the Tompkins St. Bridge are reported to have been received May 9. The items were as follows: *a*, superstructure; *b*, embankment; *c*, loose stone and brush; *d*, concrete; *e*, masonry in abutments; *f*, masonry in piers, iron clamps, and removal of existing wall; *g*, piles, per foot; *h*, hemlock timber; *i*, drift bolt and spikes.

Elmira Bridge Co., Elmira, N. Y.; *a*, $22,500; *b*, 30 cts.; *c*, $1.25; *d*, $7; *e*, $10; *f*, $11; *g*, 26 cts.; *h*, $21; *i*, 4 cts.

Owego Bridge Co., Owego, N. Y., *a*, $19,400; *b*, 25 cts.; *c*, 50 cts.; *d*, $4.25; *e*, $8; *f*, $12.50; *g*, 26 cts.; *h*, $22; *i*, 2½ cts.

Toledo Bridge Co., Toledo, O., *a*, $20,885; *b*, 38 cts.; *c*, $1.10; *d*, $8.60; *e*, $9.85; *f*, $11.90; *g*, 46 cts.; *h*, $18; *i*, 5 cts.

Youngstown Bridge Co., Youngstown, O., *a*, $22,641; *b*, 40 cts.; *c*, $2.50; *d*, $6; *f*, $13; *g*, 50 cts.; *h*, $20; *i*, 5 cts. The item *c* is not given in the report at hand.

Brackett Bridge Co., Cincinnati, *a*, $18,890; *b*, 35 cts.; *c*, $1; *d*, $5; *e*, $10.50; *f*, $14; *g*, 30 cts.; *h*, $25; *i*, 3 cts.

Pittsburg Bridge Co., Pittsburg, Pa., *a*, $28,300; *b*, 60 cts.; *c*, 50 cts.; *d*, $7; *e*, $11; *f*, $11; *g*, 45 cts.; *h*, $22; *i*, 5 cts.

Groton Bridge Co., Groton, N. Y., *a*, $21,331; *b*, 30 cts.; *c*, $1.50; *d*, $2.50; *e*, $6.50; *f*, $9; *g*, 24 cts.; *h*, $17; *i*, 2 cts.

PAVING AND ROADMAKING.

Rochester, N. Y.—Bids are wanted May 25 for improving Ridge Road, between Rochester and Greece. Edw. A. Bond, State Engr. and Surveyor, Albany.

Brooklyn, N. Y.—The contract for paving Bush St. is said to have been let to John Kuper for $15,100.

Jersey City, N. J.—Bids are wanted May 23 for 3,194 sq. yds. asphalt paving on Kensington Ave. Geo. T. Bouton, Clk. Bd. St. & Water Commrs.

Indianapolis, Ind.—Bids are wanted May 24 for asphalt paving on 21st St. M. A. Downing, Chmn. Bd. Pub. Wks.

Newark, N. J.—Bids are wanted by the Board of Street & Water Commissioners May 25 for 59,500 sq. yds. asphalt paving on 7 streets. J. Crowell Mundy, Gen. Supt. Wks.

Bloomfield, N. J.—Bids are wanted May 22 for Telford paving on about 15 miles of road. Jas. H. Moore, Chmn. Road Com.

Orrville, O.—Bids are wanted June 2 for improving Main St. with limestone, gravel and paving blocks, probable cost $30,000. J. M. Fiscus, Mayor.

Hackensack, N. J.—A $75,000 contract for 6-inch macadam roads 14 and 16 ft. wide in Franklin Township has been awarded to the Silk City Construction Co., John M. Orr, Manager, of Paterson, N. J.

Biloxi, Miss.—See "Bridges."

New York, N. Y.—Bids are wanted May 25 for 3 10-ton steam road rollers in the Borough of Queens. James P. Keating, Commr. of Highways.

Augusta, Me.—M. S. Campbell, Treas. Maine Insane Hospital, writes that bids are wanted for a rock crusher, to cost from $700 to $1,000.

Jackson, Miss.—The Council is said to have voted an issue of $20,000 paving bonds.

San Antonio, Tex.—Bids are wanted June 1 for a steam rock crusher, elevator and screen. Marshall Hicks, Mayor.

Athens, Ga.—The Keystone Granite Co., Pacolet, S. C., is stated to have received the contract to furnish 368,000 Belgian blocks.

Jackson, Mich.—See "Sewers."

Hopkinsville, Ky.—It is stated that $10,000 has been appropriated for road improvement.

Alexandria, La.—The City Council is reported to have employed I. W. Sylvester, as City Engineer to investigate paving, drainage and other contemplated improvements.

Saginaw, Mich.—The House has passed a bill establishing a system of roads in Saginaw County.

Lowell, Mass.—The Council is stated to have authorized a loan of $81,750, of which $30,000 is for sewers and $17,500 for asphalt pavement.

North Adams, Mass.—Press reports state that the Council has made an appropriation of $22,000 for paving.

Buffalo, N. Y.—The Board of Public Works has been directed to investigate the practicability of establishing a municipal paving plant for repairing asphalt streets.

The following are reported lowest bidders for two asphalt paving jobs: Barber Asphalt Co., 11 B'way, N. Y. City, $22,071; Henry P. Burgard, Buffalo, N. Y., $28,475.

Norwich, N. Y.—The village board, it is said, has decided to expend $80,000 in brick paving.

Grand Rapids, Mich.—A bond issue of $200,000 for street improvements for the coming year is said to be under consideration.

Detroit, Mich.—The lowest bid for paving Russell St., with brick, with concrete foundations, and Medina curb, according to reports, is that of Archibald Grant, 141 Griswold St., for $26,587.36, at the rate of $1.79 per sq. yd.

White Plains, N. Y.—It is stated that the town has been authorized to issue $80,000 for macadamizing several streets.

Orange, N. J.—The Mayor has recommended paving Cone St.

Houston, Tex.—The Municipal Improvement Co. has been awarded two contracts for rock asphalt, reported as amounting to $33,467.30, and Hipp & Key one, for sheet asphalt, $22,410.60, and one for brick, $6,972.

Nashua, N. H.—It has been voted to pave Temple St., at a cost of $6,000.

Somerville, N. J.—Petitions are reported filed for over 61 miles of stone roads in Somerset County, costing $227,527.

Jamaica (L. I.), N. Y.—It is reported that a contract has been signed between P. H. Flynn, Brooklyn, and the New Jersey Construction Co., for the construction of a boulevard 6 miles long and 70 ft. wide, from Brooklyn to Rockaway, across Jamaica Bay.

Bloomfield, N. J.—The $75,000 street improvement bonds have been sold.

Muncie, Ind.—Bids are wanted June 12 for improving Jefferson and 6th Sts. F. W. Clevenger, City Clk.

Elizabeth, N. J.—It is stated that bids are wanted June 1 for paving 8 streets with trap rock, lake or rock asphalt, brick or Telford macadam. N. K. Thompson, St. Commr.

Des Moines, Ia.—Bids are wanted May 30 for 2,660 sq. yds. brick paving. G. A. Eberhart, Pres. Bd. Pub. Wks.

Peru, Ind.—It has been voted to pave Broadway with asphalt.

Bond Hill, O.—It is stated that bids are wanted June 5 for improving Paddock road. A. J. Kiphart, Village Clk.

Hasbrouck Heights, N. J.—Bids are wanted June 5 for macadamizing and improving about 7,475 ft. on Terrace Ave. W. S. Lawrence, Mayor.

Bethlehem, Pa.—It is stated that bids are wanted by the County Commissioners June 2 for constructing a road between Bethlehem and Nazareth.

Rochester, N. Y.—Bids are wanted May 24 for asphalt paving on Childs St. and Irving Place. Chas. M. Beattie, Clk. Executive Bd.

St. Paul, Minn.—Press reports state that the Board of Public Works has decided to pave Nelson St. with brick. Estimated cost, $15,-820.

St. Louis, Mo.—It is reported that the Board of Public Improvements has decided to approve ordinances for asphalt paving of Grand Ave. Estimated cost, $45,077.

Menominee, Mich.—Press reports state that the County Road Commissioners have decided to build a road to Cedar River, 32 miles long, at an estimated cost of $10,000.

Elkhart, Ind.—It has been decided to pave a portion of the streets with asphalt, and others with brick.

Gallipolis, O.—Several streets are to be surveyed for paving.

Mount Vernon, N. Y.—The State bill providing for the issue of $350,000 bonds has been approved. Two-thirds of the amount is said to be for paving, $25,000 each year.

Rochester, N. Y.—The Board of Aldermen has voted for a considerable amount of paving, asphalt, trap rock and Medina block.

Tampa, Fla.—The House has passed a bill for improving streets, parks, sidewalks and other public places, and constructing sewers.

East Liverpool, O.—Bids are wanted May 27 for grading and paving 2,000 sq. yds. on Franklin St. and grading 30,000 cu. yds. on Trentvale and West Market Sts. Jas. A. George, City Engr.

Buffalo, N. Y.—Bids are wanted June 1 for repaving Michigan and Exchange Sts. R. G. Parsons, Secy. Bd. Pub. Wks.

McConnellsville, O.—Bids are wanted June 7 for paving Center St. Geo. Birch, Village Clk.

Greensburg, Ind.—It is stated that bids are wanted May 22 for improving North Anderson St. Wm. Brazelton, City Clk.

Albany, N. Y.—The following bids are reported for brick paving on Lexington and New Scotland Aves.: Mulderry Bros., $26,922.36; Edw. F. Dillon, *$24,680.45; Frank Pidgeon, $32,-275.55.

*Contract awarded.

Bridgeport, O.—J. A. Fawcett, Village Clk., states that the following contracts have been awarded: Davis & Archer, Bellaire, Berea or Cleveland curb, 48½c. per lin. ft. Berry & Keohuline, 68,000 sq. yds. paving, including excavation, foundation of gravel and broken stone, and brick-laying, $20,240. Harris Brick Co., Zanesville, O., 68,000 sq. yds. of brick, delivered on street, at 58.08c., measured after laying.

Rochester, N. Y.—The following contracts are reported awarded: Front St., Medina block, Whitmore, Rauber & Vicinus, of Rochester, $18,542.40; Reynolds St., macadam, and Brooks Ave., Medina block, Wm. Fuller, $10,086.15. Fourth St., asphalt, Rock Asphalt Pavement Co., Rochester, $11,512.60. The lowest bid for brick paving of Jefferson Ave. was $30,276, by H. B. Hooker; for asphalt paving, $34,749, by Warren-Scharf Asphalt Pavement Co.

Quincy, Ill.—Bids for brick paving were opened by the Board of Local Improvements, and according to press reports are as follows: *a*, comprising 11 blocks, *b*, 6 blocks; Campbell & Wall, *a*, $1.10 per sq. yd.; *b*, $1.11. Peter Simons, *a*, $1.07¾*; *b*, $1.10¾. Ebert & Shanahan, *a*, $1.11½; *b*, $1.11½. Henry Rees, *a*, $1.11; *b*, $1.09½*. Neich, Patterson & Co., Springfield, Ill., *a*, $1.08; *b*, $1.12. Bids for curb were all 36 cts. per ft. except Neich, Patterson & Co., who bid 38 cts. *Awarded contract.

Erie, Pa.—The following bids were opened May 15 by City Eng. B. E. Briggs for about 4,400 sq. yds. asphalt pavement; *a*, paving; *b*, 6-inch pipe connections; *c*, total. Cleveland Trinidad Paving Co., Cleveland, O.; *a*, $2.33; *b*, 40 cts.; *c*, $10,300. Alcatraz Construction Co., New York; *a*, $2.29; *b*, 36 cts.; *c*, $10,110. Mayer Bros., Erie; *a*, $2.23; *b*, 45 cts.; *c*, $9,866. Work includes 1,145 cu. yds. grading and 2,640 lin. ft. curbing.

Union City, Pa.—The following bids for vitrified brick paving were received May 15 by City Clk. J. E. Gillett: John McCormick & Son, Erie, Pa., $1.89, using Jamestown block; Thos. McGuigan, Meadville, Pa., same block, $1.88; Thos. Mahoney, Jamestown, N. Y., same block, $1.92; Paskitt & Lehman, Erie, Brady Run block, $1.95.

Pittsburg, Pa.—The following bids for paving, repaving, grading and curbing in numerous streets were opened May 5 by E. M. Bigelow, Dir. Dept. Pub. Wks.:

	Grading.	Asphalt.	Block-stone.	Curb.	Crossings.	Flag side-walks.
Alcatraz Paving Co., Philadelphia	$0.33	$1.80	....	$0.58	....	$0.18½
Pa. Asphalt Pav. Co., Pittsburg	.39	1.85	....	.60	....	.20
Sloan & McIlvain, Allegheny	.40	1.90	$2.00	.60	....	.22
Booth & Flinn, Pittsburg	.37	....	1.93	.57	$0.55	.17
Ott Bros. Allegheny	.38	....	2.10	.65	.65	.22
Thos. McNally, Pittsburg	.40	....	2.46	.60	....	.28
James H. McQuade, Pittsburg	.40	....	2.30	.72	.71	.23
Keeling & Ridge, Pittsburg	.30	....	1.59*	.65	.55	....
Evan Jones, Pittsburg	.49	....	1.66	.57	.60	....

* This bid was for No. 2 blockstone and the others for No. 1.

POWER PLANTS GAS AND ELECTRICITY.

Racine, Wis.—Wm. Mainland with others are stated to have applied for a franchise for a gas plant.

Santa Rosa, Cal.—The Clear Lake Electric Light & Power Co. has received a franchise.

Sidney, O.—Louis Kah, Jr., has received a franchise to construct and maintain an electric light plant.

Augusta, Ga.—Nisbet Wingfield, Commr. Dept. Pub. Wks., has been instructed to prepare plans for a municipal electric light plant.

Elkton, Md.—See "Water."

El Paso, Tex.—A. Krakauer, J. P. Dieter, A. Courchesne and others are stated to have organized a stock company to construct an electric light plant.

Monroe, N. C.—See "Water."

Waterford, N. Y.—The citizens on May 9 voted to appropriate $3,600 for street lighting.

New Orleans, La.—See "Government Work."

Mayville, N. D.—See "Water."

Waterville, Minn.—Brown & Co. of Knoxville, Tenn., are stated to have received a franchise for an electric light plant.

Winchester, Ind.—See "Water."

Austin, Minn.—It is stated that the Council will secure estimates for an electric light plant.

Paonia, Colo.—See "Water."

Durant, Miss.—W. C. Porter of McComb, Miss., has been employed to prepare plans for an electric light plant.

Yates Center, Kan.—See "Water."

Falconer, N. Y.—Gerald E. Mix of Dunkirk, N. Y., writes that it is proposed to construct a $5,000 electric light plant.

Vineland, N. J.—See "Water."

Ruston, La.—J. D. Peace of Shreveport is interested in the construction of an electric light plant.

Belgrade, Minn.—See "Water."

Darby, Pa.—Bids are wanted June 5 for lighting the streets. J. F. Wilby, Clk. of Boro. Council.

Westfield, Mass.—Electric light and gas bonds to the amount of $120,000 have been sold.

Spartanburg, S. C.—F. D. McEwen is stated to have received the contract for lighting the city for 10 years and a franchise for an electric railway.

Pekin, Ill.—It is stated that bids are wanted for lighting the city for ensuing year.

Granville, N. Y.—A charter has been granted to the Granville Electric Light & Power Co., capital $80,000. Directors: Adolph Reimer, Dover Plains; Eugene R. Norton, Emmett W. Wyman and others of Granville.

Richmond, Va.—The lowest bid received May 17 for the construction of dams across James River for enlarging the water-power of the Virginia Electric Ry. and Development Co. is reported to have been that of Martin & Co. of Louisa county, Va., at $128,930.

Florence, Ala.—The Welsbach Street Lighting Co., Cincinnati, has been awarded a 5-year contract for furnishing 50 gas lamps on the moonlight schedule at $24.

Syracuse, N. Y.—It is stated that the Council Committee on City Hall and City property will receive bids for an electric plant for the city hall.

Nicholasville, Ky.—O. C. Irwin & Co. have received a franchise for an electric light plant.

Peoria, Ill.—The contract for constructing the power house for the Peoria & Pekin Terminal Co. is stated to have been let to J. J. McDonald of Peoria; to cost about $13,000.

Des Moines, Ia.—The Gas Co. is said to have decided to expend about $11,278 in extensions.

Canon City, Colo.—C. C. Conkle, with others, is stated to have applied for a franchise for an electric light, heat and power plant.

Falls City, Neb.—It is stated that the Council will receive estimates of cost for a 1,500-light dynamo and engine to replace the present plant.

Athens, N. Y.—The Columbia & Rensselaer Electric Light & Power Co. is stated to have applied for a franchise for lighting, to furnish motive power and to operate an electric railroad.

Hazleton, Pa.—The citizens are said to be discussing the advisability of erecting a municipal electric light plant.

Vassar, Mich.—Balbian Bros., proprietors of the Vassar Woolen Mills, have received a franchise for electric lighting.

Racine, Wis.—It is stated that the Badger Electric Co. will expend $10,000 in improving its plant.

White Cloud, Mich.—L. A. Bracy, Village Clk., writes that the citizens have voted to issue $4,500 bonds for an electric light plant.

Monticello, Minn.—The Village Council is stated to have decided to put in a new system of street lighting and extend the sewerage system.

Pipestone, Minn.—The Electric Light Co. will, it is reported, put in new transformers and make other improvements.

Duluth, Minn.—Thos. McGilvray, City Engr., writes that an electric plant of a capacity of 500 2,000-c. p. arc lights will be installed at the old pumping station.

New York, N. Y.—See "Schools."

Danville, Ky.—Bids are wanted June 20 for lighting the streets with 32 or more 2,000 c. p. arc lights. Henry E. Woolfolk, Chmn. Special Light Com.

ELECTRIC RAILWAYS.

Scarsdale, N. Y.—The Tarrytown, White Plains & Mamaroneck Electric Ry. Co. has received a franchise.

Monaca, Pa.—The Beaver Valley Traction Co. is stated to have petitioned the Council for permission to extend its lines to this place.

Logansport, Ind.—The Indianapolis & Logansport Traction Co. is stated to have received a right of way from this place to Indianapolis.

Silver Springs, N. Y.—A charter is stated to have been granted to the Perry, Silver Springs, Castile & Pike Ry. Co. to operate an electric railway in Wyoming county, through Pike Genesee Falls, Gainesville, Castile, Silver Springs and Perry; capital, $200,000. Directors: G. S. Van Gorder, Albert O. Skiff, of Pike, Mortimer N. Cole, Jas. H. Van Arsdale, of Castile; John H. Duncan, of Silver Springs, and others.

Clyde, N. Y.—The Village Trustees on May 10 granted a franchise to L. L. Moses and others for a trolley line from Clyde to Bonnecastle.

Elizabeth, N. J.—The Council on May 15 passed an ordinance granting a franchise to John Kean.

New Brunswick, N. J.—It is stated that the New Brunswick Traction Co. will extend its line to South Amboy. Ed. H. Radel, Gen. Mgr.

Chattanooga, Tenn.—Neely & Smith, 122 E. 7th St., have recived the contract for constructing the Chickamauga Park extension of the Rapid Transit line, about 5 miles long.

St. Augustine, Fla.—The Southeastern Ry. Co. has been incorporated with a capital of $75,000 to build a road about 50 miles long. Incorporators: J. R. Parrott, A. G. Hamlin, J. P. Beckwith and others.

Spartanburg, S. C.—See "Power Plants, Gas and Electricity."

Toledo, O.—Saml. F. Angus and Henry A. Haigh have petitioned the County Commissioners for right of way for an electric road over the old Woodville road, to connect with Fremont, Cleveland and Sandusky.

Lexington, Ky.—Williams & Sons are said to be considering plans for an electric railway between this place and Frankfort.

Jefferson, O.—The Burton, Jefferson & Andover Electric Ry. Co. has been incorporated; capital, $10,000. Incorporators: E. L. Lampson, Jefferson; Clif Meigs, Lenox; W. H. Dodge, New Lyme, and others.

Hamilton, O.—The Board of Control is stated to have granted permission to the Cincinnati & Hamilton Electric R. R. Co. to extend its line.

Lancaster, Pa.—A charter has been granted to the Lancaster, Mechanicsburg & New Holland Ry. Co. to build a line 12 miles long in Lancaster county; capital, $150,000. Incorporators: W. B. Given, Columbia; Saml. R. Shipley, Philadelphia; B. J. McGrann, Lancaster, and others.

Hannibal, Mo.—The Hannibal Traction Co. is stated to have been organized with a capital of $75,000 to operate and extend the Hannibal St. Railway. Directors: R. H. Stillwell, E. D. Brewington and others, of New York City.

St. Joseph, Mo.—The St. Joseph Ry., Light, Heat & Power Co. has received a franchise in the northeast part of the city.

Elmira, N. Y.—The Elmira & Corning St. Ry. Co. has been incorporated with a capital of $200,000. Directors said to be: Hiram B. Rhyner of Elmira, Peter Marshall of Horseheads and others.

Knightstown, Ind.—The Council, on May 5 granted a franchise to the Indianapolis, Greenfield & Knightstown Rapid Transit Co. through the city; also to the New Castle & Knightstown Electric Co. through this place to build from Indianapolis to New Castle.

Cincinnati, O.—Merchants are said to be interested in the construction of an electric railway from Covington to Big Bone, Ky., a distance of 21 miles, to pass through Erlanger, Florence and Union.

Calumet, Mich.—The Calumet & Hecla Mining Co. has granted a franchise to John D. Cuddihy and Edw. Ryan of Calumet to build an electric railway through its property and connecting Laurium and Red Jacket.

North Manchester, Ind.—Isenberger & Arnold are stated to have applied for a franchise.

Riverside, Cal.—The Riverside & Arlington Ry. Co. has received a franchise.

Athens, N. Y.—See "Power Plants, Gas and Electricity."

Dover, Del.—The Dover & Milford Electric Ry. Co. is being formed here to build a line to connect the towns in Kent County with Bower's Beach and Woodland Beach on the Delaware Bay. The American Electric Ry. Co. is said to be promoting the project. Wm. P. Harrity, Treas., Philadelphia.

Cleveland, O.—The Cleveland Electric Ry. Co. has petitioned the Board of Control for a franchise to construct a belt line.

Indianapolis, Ind.—The Chicago, Richmond & Cincinnati Ry. Co. has been incorporated with a capital of $100,000, to construct a line 192 miles long. Incorporators: John D. Parker, Chicago; Wm. J. Hendrick, New York; Saml. E. Swayne, Richmond, Ind., and others.

Steubenville, O.—It is stated that a company of New York capitalists proposes to build an elevated electric line between Steubenville and Toronto. Wm. Freuderberger is the agent for the company.

RAILROADS.

Pueblo, Colo.—The Colorado & Wyoming R. R. Co. has been incorporated with a capital of $100,000 to operate between this point and Harterville, Wyo., running through Pueblo, El Paso, Douglas and Arapahoe counties in Colorado, and Laramie County, Wyoming. Incorporators: J. L. Beeman, Fred Wild, Jr., and others of Denver.

Newport, Tenn.—The Directors of the East Tennessee Lumber & Mining R. R. Co. met here May 1 and decided to build a railroad from Newport to the Sevier County line. Bonds to the amount of $200,000 were voted for the purpose.

Morgantown, W. Va.—An election will be held in Monogalia County June 10 to vote on issuing bonds to aid in the construction of an extension to the West Virginia & Northern Railroad.

PUBLIC BUILDINGS.

(See also Schools and Government Work.)

Philadelphia, Pa.—Doyle & Doak, 1509 Sansom St., have received the contract to erect the First Baptist Church building at 17th and Sansom Sts; cost, $132,000. Edgar V. Seeler, 4th and Chestnut Sts., Archt.

Parkersburg, W. Va.—Bids are wanted June 3 for a court house. B. F. Stewart, Clk. Co. Court.

Francis Bros. & Jellett, 706 Arch St., have the contract to install a heating and power plant at 701 to 711 Arch St.; cost, $45,000.

Akron, O.—It is stated that plans have been prepared for a $60,000 edifice for the St. Bernard R. C. Church. Rev. Mr. Broun, Pastor.

Evansville, Ind.—Bailey & Koerner of Evansville have received the contract for a new wing at the Hospital for Insane, at $32,869.

Iowa City, Ia.—Bids are wanted May 24 for a jail and jailor's residence. T. L. Crowley, Co. Aud.

Whitehall, Wis.—The Hackworthy Construction Co. of Appleton is stated to have received the contract for the county insane asylum at $35,700.

Winfield, Kan.—Wm. E. Harris of Kansas City, Kan., has been authorized by the Kansas State Board of Charities to prepare plans for a building at the Osawatomie Insane Asylum and also a building at the Imbecile Asylum at Winfield. The appropriations for the two buildings are $50,000 and $40,000 respectively.

Charleston, W. Va.—Bids are wanted June 15 for an annex to the State Capitol, to cost $60,000. Harrison Albridge, Archt.

Idlewood, Pa.—The Board of Managers of St. Paul's R. C. Orphan Asylum are stated to have selected the plans of Edw. J. Stotz of Pittsburg for the new asylum to be erected here, to cost $100,000.

Huntington, W. Va.—Harrison Albright of Charleston, W. Va., is stated to have prepared plans for a $25,000 building for the Home for Incurables.

Marshall, Minn.—Bids are wanted June 6 for a jail. Thos. McKinley, Co. Aud.

Newport News, Va.—Bids are wanted June 1 for a church; separate bids are wanted for an indirect hot air heating system. P. T. & E. A. Marye, Archts.

Albany, N. Y.—Patrick McCann, Dove, cor. Canal St., has received the contract for a building for St. Vincent's Male Orphan Asylum, at $23,000.

Chicago, Ill.—It is stated that plans have been completed for a $20,000 edifice for the Lexington Ave. Baptist Church. Rev. M. P. Boynton, Pastor.

Fall River, Mass.—Louis G. Destremps of Fall River has prepared plans for a $20,000 edifice for St. Roch Church. Rev. T. Giguere, Pastor.

Boston, Mass.—Bids are wanted May 24 for a chapel, administration building and gateway at Mt. Hope Cemetery. J. Albert Brackett, Chmn. Cemetery Trus.

Columbia, S. C.—It is stated that a $20,000 city hall will be erected.

Herring, O.—Bids are wanted June 10 for a town hall. C. N. Piteman, Clk.

Ellsworth, Me.—It is proposed to erect an extension to the court house to cost about $12,000.

Little Rock, Ark.—Bids are wanted June 3 for a building at the State Lunatic Asylum. S. P. Turner, Secy. Bd. State Charitable Institutions.

Redwing, Minn.—Bids are wanted May 25 for remodeling interior in court house. Carl N. Lien, Co. Aud.

Sandusky, O.—It is stated that the First Baptist Society will erect a $15,000 church.

Middletown, Conn.—It is stated that bids are wanted May 27 for a combination fire house on Main St. J. D. Sibley, Archt.

Somerville, Mass.—The Aldermen are stated to have accepted the plans of Loring & Phipps, 53 State St., Boston, for a $15,000 addition to the public library.

Memphis, Tenn.—Plans will soon be wanted for a $50,000 police station. J. J. Williams, Mayor.

Cincinnati, O.—David Hummel & Co. are stated to have received the contract for the new library for the Cincinnati University; estimated cost, $50,000.

Montello, Wis.—The Supervisors have voted to issue $10,000 bonds for a court house.

Redfield, S. D.—Joseph Schwarz of Sioux Falls is said to be preparing plans for an asylum for the feeble minded to cost about $21,000.

Boulder, Mont.—Bids are wanted June 5 for 3 jails. Eugene Picot, Co. Clk.

Williston, N. D.—Bids are wanted June 14 for a court house. H. V. Smith, Co. Aud.

BUSINESS BUILDINGS.

Fall River, Mass.—John Westwood has prepared plans for a $15,000 addition to office building of M. T. Hudner on So. Main St.

Canton, O.—A $20,000 stone and brick block is to be erected for W. E. Homer on Market and 4th Sts.

Columbia City, Ind.—J. M. E. Riedel has prepared plans for a $17,000 store building.

Newark, N. J.—It is stated that J. Herbert Ballantine will erect a 10-story building at 783 Broad St.

Newport News, Va.—Bids are wanted June 3 for a business block; separate bids are wanted for elevators and steam heating apparatus. P. T. & E. A. Marye, Archts.

Newton, Ia.—Garthwaite & Co. of Chicago are stated to have received the contract for a building for the Iowa Mercantile Co. at $20,250.

Chicago, Ill.—D. H. Burnham & Co., Rookery Bldg., are stated to have received the contract to erect a 10-story building on Clark and Adams Sts. to cost $700,000.

Antigo, Wis.—It is stated that John Friend of this city will erect a $20,000 hotel here this summer.

Batavia, N. Y.—Leon H. Lempert & Son of Rochester are stated to have prepared plans for a $35,000 opera house.

St. Paul, Minn.—It is stated that bids will soon be wanted for an office building, to be erected on Third St., by the Great Northern R. R. Co. Jas. J. Hill, Pres., St. Paul.

NEW YORK CITY.

Permits for the following buildings have been issued; o, signifies owner; a, architect; b, builder, and c, contractor.

206 Madison st, br stores & tenem't, cost, $30,000; o, Isidor Mishkind; a, M Bernstein.

252 & 254 E 3d st, 2 br stores & flats, cost, $55,000 all; o, Samuel Michelson; a, Horenburger & Straub.

East Broadway & Montgomery st, br stores & tenem't, cost, $40,000; o, A Goodman; a, M Bernstein.

Oak & Oliver sts, br stores & flat, cost, $30,000; o, Golden & Rosenberg; a, M Bernstein.

118 to 122 Sheriff st, 3 br stores & flats, cost, $81,000 all; o, Adolf Mandel; a, G F Pelham.

Hancock & West Houston sts, br stores & tenem't, cost, $32,000; o, Leon Lanrowitz & Morris Fine; a, Geo F Pelham.

95 5th ave, br stores & loft, cost, $125,000; o, Henry Corn; a, Robt Maynicke.

128 to 132 E 18th st, br factory, cost, $100,000; o, John S Huyler; a, John W Marshall.

Madison ave & 66th st, br hotel, cost, $350,000; o & a, Louis Korn.

Park ave & 88th st, br stores & flat, cost, $30,000; o, Higgins & King; a, Neville & Bagge.

92d st & 2d ave, 4 br stores & flats, cost, $92,000 all; o, F J Schnugg; a, G M Robinson.

80th st & Columbus ave, br stores & flat, cost, $180,000; o, A E & M A Bingham; a, A M Healey.

8th ave & 137th st, br stores & flat, cost, $40,000; o, M J Keeran; a, S B Ogden & Co.

Dawson & Beach sts, br store & flat, cost, $23,000; o, John McLean; a, F J Miller & Co.

Plans were filed May 16 for a 16-story building to be erected by the American Exchange National Bank at Broadway and Cedar Sts., to cost about $400,000. Clinton & Russell, Archts., 32 Nassau St.

Andrew J. Connick will erect an 11-story building, 244 5th Ave. Robt. Maynicke, Archt., 725 B'way.

The addition of two stories and other alterations, to cost $50,000, have been planned for the buildings owned by the Roosevelt estate at 5th Ave. and 35th St.

DWELLINGS.

Worcester, Mass.—Wm. H. Harvey, 311 Main St., has prepared plans for a $20,000 apartment house for Vernon St.

Kansas City, Mo.—Geo. Matthews, 204 W. 7th St., has completed plans for the Maryland flats, to be erected on 10th and Penn Sts., for I. J. Hedrick, to cost about $200,000.

NEW YORK CITY.

Permits for the following buildings have been issued; o, signifies owner; a, architect; b, builder, and c, contractor.

293 Henry st, br flat, cost, $20,000; o, Weinstein & Dworsky; a, M Bernstein.

610 to 616 E 11th st, 3 br tenem'ts, cost, $75,000 all; o, Harris Goldberg; a, Schneider & Herter.

12 & 14 W 56th st, br dwell'g, cost, $75,000; o, H B Hollins; a, McKim, Mead & White.

39 to 43 E 27th st, 2 stone flats, cost, $330,000 all; o, Edw W Candy; a, Brun & Hauser.

15th st & 2d ave, 3 br tenem'ts, cost, $81,000 all; o, Julius Dreyfus; a, Geo F Pelham.

54th st & Broadway, br flat, cost, $55,000; o, Francis S Kenney; a, Howard, Cauluwell & Morgan.

101st st & Madison ave, 3 br flats, cost, $60,000 all; o, Kapelansky & Kronenberg; a, Tnos Graham.

95th st & 1st ave, 2 br flats, cost, $60,000 all; o, C M Silverman; a, Neville & Bagge.

93d st & Madison ave, br flat, cost, $80,000; o, Jas Kilpatrick; a, Fredk Jacobson.

100th st & 3d ave, 4 br flats, cost, $104,000 all; o, John D Mennie; a, Edw Wenz.

5th ave & 82d st, stone dwell'g, cost, $50,000; o, Kath T Gelshenen; a, R W Buckley.

105th st & West End ave, 4 br dwell'gs, cost, $100,000 all; o, H M Weed; a, Janes & Leo.

109th st & Broadway, 5 br dwell'gs, cost, $112,000 all; o, E M Stavey; a, Brower & Gayle.

19 & 21 W 118th st, 2 br flats, cost, $44,000 all; o, Katz & Abelman; a, F C Browne.

115th st & Lenox ave, 5 br flats, cost, $124,000 all; o, Schmidt Bros; a, Edw Wenz.

111th st & 5th ave, 2 br flats, cost, $52,000 all; o, Max Schaef; a, Edw Wenz.

112th st & Lenox ave, br flat, cost, $20,000; o, Ast & Exner; a, John Hanser.

5th ave & 127th st, br flat, cost, $100,000; o, Wm Drought; a, Neville & Bagge.

Washington ave & 166th st, 3 br flats, cost, $60,000 all; o, John Immel; a, David W King.

NEW INDUSTRIAL PLANTS.

The Leicester & Continental Mills Co., Germantown, Philadelphia, is building a four-story 60x200-ft. mill and a 40x100-ft. dye house. It expects to use an electric power plant of about 150 H.-P.

Garnett Andrews, Jr., Gen. Man. Richmond Hosiery Mills, Rossville, Ga., states that a 10,000-spindle mill will be erected at Chattanooga, Tenn. It will be a three-story 75x250-ft. building using a power plant of about 500 H.-P.

H. Greve, Clinton, Ia., will put up a two-story 22x30-ft. machine shop, a 22x22-ft. log kiln 32 ft. high, with 16x22-ft. wings, and a boiler room 30 ft. square; the power plant will be 40 H.-P.

J. C. McKennie, Herald Building, Baltimore, Md., is organizing a company for the manufacture of non-alcoholic beverages, which will erect a plant for the purpose.

B. A. Summers, Buford, Miss., will put up a small saw mill and install a 30-H.-P. power plant to operate it.

The D. W. Alderman & Sons Co., Alcolu, S. C., is putting up a three-story 40x215-ft. band mill. About 600 H.-P. will be required; everything has been bought except a boiler of 100 to 125 H.-P. The company wishes to dispose of its steam feeds, stationary engines and general circular saw mill equipment, which are no longer adapted to its needs.

William M. Reid states for the Bishopville, S. C. Cotton Oil Co. that the company will need a 120-H.-P. boiler, a 65-H.-P. engine and a 35-H.-P. engine.

The Steel Storage & Elevator Construction Co., Buffalo, has prepared plans for a 1,000,000-bushel pneumatic elevator to be erected in that city.

The Springfield Machine Tool Co., Springfield, O., P. E. Montanus, Pres., is contemplating the erection of a 40x240-ft. building, and another 50x225 ft., which will form wings of its present main shop. One of these wings will be equipped with an electric traveling crane of about 10 tons capacity. The company will probably install a 150-H.-P. engine and two boilers of proportionate capacity.

Gaines & Lewis, Cave, Bartow Co., Ga., are erecting a three-story and basement 46x36-ft. flour mill, and will install a 60-H.-P. power plant.

Loomis F. Irish, Pine Island, Minn., has purchased the Pine Island Roller Mill, which will be enlarged and fitted with an electric plant for lighting and the operation of water-works, which will be built soon.

The Botsford-Jenks Co., Port Huron, Mich., will build a 251x75-ft. steel elevator 140 ft. high for the McReynolds Elevator Co., Chicago. The engine will probably be of the Corliss type, with a 26x48-in. cylinder. Further information may be had from J. E. Botsford, care McReynolds & Co., Western Union Bldg., Chicago.

A cotton mill with 15,000 spindles and looms in proportion will be erected at Belton, S. C., by a company in which Ellison A. Smyth of Pelzer, S. C., and F. J. Pelzer of Charleston are interested. Plans will be drawn by Lockwood, Green & Co., Boston.

Crawley & Johnston, Cincinnati, general machinists and dealers in machinery, will put up a 4-story factory.

The American Pulley Co., 18th and Hamilton Sts., Philadelphia, will put up 1-story brick and iron shops covering 50,000 sq. ft. and install a 200-H.-P. power plant.

The Globe Sign Co., Akron, O., is putting up a 3-story 40x100-ft. addition to its plant and a 39x42-ft. engine and boiler house, all of brick with steel roofs. There will be no addition to the motive power except two tubular boilers of 50 H.-P. each and a fire pump. The company will erect a water tower for its fire protection plant.

E. de La Chapelle & Co., Ottawa, Ill., have completed plans for new glass works which will include a 255x100-ft. main building 14 to 50 ft. high and a number of storage buildings, one of which will be 200x100 ft. Two 12-pot furnaces are to be built and a plant of about 50 H.-P. with two boilers will be installed.

The Munising Furnace Co. has been formally organized at Cleveland with the following officers: Prest., W. H. Hinkle of the Ashland Iron & Steel Co., Ashland, Wis.; Vice-Pres., R. J. Gaffney of the American Charcoal Co., Bradford, Pa.; Treas., N. B. Bubb of the American Charcoal Co.; directors, Thomas Keery, Hancock, N. Y., Harvey H. Brown, Cleveland, R. E. Morrison, Munising, Mich., E. H. Scott, La Porte, Ind., and H. J. Pierce, Buffalo, N. Y. It is the intention of the company to erect its furnace and by-product charcoal chemical plant as soon as possible. The furnace will have about 125 tons capacity and its construction, as well as the management of the business will be in Mr. Hinkle's hands. Plans and specifications for plant are now being prepared by Julian Kennedy of Pittsburg. Mr. Thomas Keery will have special charge of the erection of the chemical works and their management. Communications should be addressed to W. H. Hinkle, Pres. Munising Furnace Co., Ashland, Wis.

BUSINESS NOTES.

The Groton Bridge & Manufacturing Co., Groton, N. Y., has recently completed additions to its plant which will enable its output to be increased about one-third. Among recent contracts secured by the company is one for extensive additions to the plant of the Ithaca, N. Y., Water & Gas Co., including a bridge and an entirely new gas house.

The Shone Co. announces the removal of its offices from the Isabella Building to its works at 445 W. 46th St., Chicago.

The Berlin Iron Bridge Co., East Berlin, Conn., has received an order from the Capital Tramway Co., Buenos Ayres, Argentine Republic, for a 7,000-gallon steel water tower, the fifth order received from this company.

The Stilwell-Bierce & Smith-Vaile Co., Dayton, O., has established a branch office at the Burlington Building, St. Louis, Mo., under the management of Louis Bendit.

PROPOSALS OPEN.

WATER-WORKS.

Bids Close		See Eng. Record
May 22.	Cullman, Ala	Apr. 29
	Adv., Eng. RECORD, Apr. 29.	
May 22.	Pine Island, Minn	May 13
	Adv., Eng. RECORD, May 13	
May 22.	Pipe, etc., Schenectady, N. Y.	May 20
May 25.	Tacoma, Wash	May 6
May 26.	Cincinnati, O	Apr. 29
May 26.	Supplies, St. Louis, Mo	May 20
May 27.	Washington, D. C	Apr. 29
	Adv., Eng. RECORD, Apr. 29.	
May 27.	Pipe, Washington, D. C	May 6
	Adv., Eng. RECORD, May 6.	
May 29.	Allentown, Pa	May 6
	Adv., Eng. RECORD, May 6, 20.	
May 31.	Gaffney City, S. C	May 6
	Adv., Eng. RECORD, May 6 to 20.	
May 31.	Pendleton, Ore	May 6
June 1.	Pipe, Tupper Lake, N. Y	May 20
June 1.	Reservoir, Media, Pa	May 20
	Adv., Eng. RECORD, May 20.	
June 1.	North Braddock, Pa	May 20
	Adv., Eng. RECORD, May 20.	
June 5.	Well, Indianola, Miss	May 20
June 5.	Winnipeg, Man	May 6
	Adv., Eng. RECORD, May 6 to 20.	
June 6.	Tyler, Minn	May 20
June 6.	Pipe, etc., New York, N. Y	May 20
June 6.	Pipe, etc., Albany, N. Y	May 20
June 9.	Water Tower, Murphysboro, Ill	May 20
	Adv., Eng. RECORD, May 20.	
June 13.	Pipe, Cincinnati, O	May 13
	Adv., Eng. RECORD, May 13, 20.	
June 27.	St. Louis, Mo	May 6
——	Grand Forks, N. D.	Apr. 22
——	Peekskill, N. Y	Apr. 15
	Adv., Eng. RECORD, Apr. 15, 22.	
——	Napoleonville, La	Mar. 25
——	Corinth, Miss	Mar. 25

SEWERAGE AND SEWAGE DISPOSAL.

May 22.	Muncie, Ind	May 6
May 25.	Tacoma, Wash	May 6
May 25.	Buffalo, N. Y	May 13
May 26.	Wahpeton, N. D	May 13
May 29.	Muncie, Ind	May 13
May 29.	Carrollton, Mo	May 20
	Adv., Eng. RECORD, May 20.	
May 30.	Des Moines, Ia	May 20
May 31.	Frankfort, Ind	May 20
June 1.	Brussels, Ont.	May 20
June 1.	Honolulu, H. I	May 13
June 2.	Cincinnati, O	May 13
June 5.	Jamestown, N. D	May 13
June 5.	Hillsboro, N. D	May 13
June 5.	Albany, N. Y	May 20
June 5.	Hackensack, N. J	May 20
	Adv., Eng. RECORD, May 20.	
June 6.	Pipe, Oberlin, O	May 13
June 6.	Trenton, N. J	May 20
June 6.	Stoneham, Mass	May 20
	Adv., Eng. RECORD, May 20.	
June 7.	Elkhart, Ind	May 20
June 12.	Muncie, Ind	May 20
June 15.	Glenville, O	May 20
July 5.	New Orleans, La	Apr. 29
	Adv., Eng. RECORD, May 6 to 20.	

BRIDGES.

May 22.	Algona, Ia	May 13
May 22.	Toronto, Ont	Apr. 29
	Adv., Eng. RECORD, Apr. 29, May 6.	
May 22.	Hailey, Idaho	May 6
May 24.	Aberdeen, S. D	Apr. 29
May 24.	Cleveland, O	May 20
May 27.	Washington, D. C	Apr. 29
	Adv., Eng. RECORD, Apr. 29.	
May 29.	Mansfield, O	May 20
May 31.	Woonsocket, S. D	May 20
May 31.	Dayton, O	May 20
May 31.	Chicago, Ill.	Apr. 8
	Adv., Eng. RECORD, Apr. 15.	
June 1.	Hot Springs, Ark	May 13
June 1.	Brookings, S. D	May 13
June 1.	Towanda, Pa	May 20
June 2.	Wyalusing, Pa	May 20
June 5.	Gallatin, Mo	May 20
June 6.	Humboldt, Ia	May 13
June 6.	Cumberland, Md	May 13
June 6.	Gibson, Ga	May 20
June 7.	Elkhorn, Ore	May 20
June 8.	Plymouth, Ind	May 13
June 14.	Hillsboro, N. D	May 20
June 16.	Fullerton, Neb	May 20
June 16.	Novelty, Wash	May 20
June —.	Rodney, Miss	May 20
——	Quincy, Ill	Feb. 25
	Adv., Eng. RECORD, Feb. 25.	
——	Bradford, Pa.	Apr. 15
——	Randolph, Utah	Apr. 15

PAVING AND ROADMAKING.

May 20.	San Antonio, Tex	May 6
	Adv., Eng. RECORD, May 6, 13.	
May 20.	Washington, D. C	Apr. 22
	(2 advts.) Adv., Eng. RECORD, Apr. 22.	
May 22.	Cincinnati, O	Apr. 29
May 22.	Glens Falls, N. Y	Apr. 22
	Adv., Eng. RECORD, Apr. 29 to May 13.	
May 22.	Risingsun, Ind	May 13
May 22.	St. Paul, Minn	May 20
May 22.	Bloomfield, N. J	May 20
May 22.	Greensbury, Ind	May 20
May 23.	Riley, Ind	May 20
May 23.	Jersey City, N. J	May 20
May 23.	Binghamton, N. Y	May 13
May 23.	Watertown, Wis	Apr. 29
	Adv., Eng. RECORD, Apr. 29 to May 13.	
May 24.	Veedersburg, Ind	May 6

May 24. Indianapolis, Ind.... ....May 20
May 24. Rochester, N. Y.........................May 20
May 25. Alliance, O.............................May 6
May 25. Buffalo, N. Y...........................May 13
May 25. Road Rollers, New York, N. Y......May 20
May 25. Newark, N. J...........................May 20
May 25. Rochester, N. Y........................May 20
May 26. Cincinnati, O...........................May 6
May 27. East Liverpool, O......................May 20
May 29. Bowling Green, O.......................May 6
May 30. Des Moines, Ia..........................May 20
May 31. West Boylston, Mass...................May 20
Adv., Eng. RECORD, May 20.
May 31. Frankfort, Ind...........................May 20
June 1. Rock crusher, San Antonio, Tex....May 20
June 1. Owosso, Mich...........................May 20
Adv., Eng. RECORD, May 20.
June 1. Elizabeth, N. J.........................May 20
June 1. Buffalo, N. Y.............................May 20
June 1. North Adams, Mass.....................May 20
Adv., Eng. RECORD, May 20.
June 2. Shelby, O..................................May 13
Adv., Eng. RECORD, May 13.
June 2. Bethlehem, Pa............................May 20
June 2. Orville, O..................................May 20
June 5. Bond Hill, O...............................May 20
June 5. Hasbrouck Heights, N. J..............May 20
June 5. Muncie, Ind................................May 13
June 6. Portsmouth, O.............................May 13
June 6. Maintenance, Terre Haute, Ind....May 20
Adv., Eng. RECORD, May 20.
June 7. McConnelsville, O.......................May 20
June 12. Muncie, Ind...............................May 20

POWER, GAS AND ELECTRICITY.

May 22. Vincennes, Ind...........................Apr. 8
Adv., Eng. RECORD, Apr. 8, 22, May 6.
May 22. Cullman, Ala..............................Apr. 29
Adv., Eng. RECORD, Apr. 29.
May 22. New York, N. Y..........................May 13
May 26. Newport News, Va.......................May 13
May 26. New York, N. Y..........................May 20
May 26. Gas franchise, Danville, Ill..........May 13
June 1. Prineville, Ore............................Apr. 15
June 1. Mechanicsville, Ia.......................May 13
June 5. Darby, Pa..................................May 20
June 15. Petrolia, Ont............................May 13
—— Pleasantville, O...........................Dec. 24
June 20. Danville, Ky.............................May 20

GOVERNMENT WORK.

May 22. Ellis Island, N. Y.......................Apr. 29
Adv., Eng. RECORD, Apr. 29, May 6.
May 22. Oswego, N. Y............................Apr. 29
Adv., Eng. RECORD, Apr. 29 to May 20.
May 22. Cement, Louisville, Ky................Apr. 29
Adv., Eng. RECORD, Apr. 29 to May 20.
May 22. Bldg., Washington, D. C.............May 13
May 24. Wrecks, Mobile, Ala....................May 20
May 25. Tompkinsville, N. Y....................May 13
May 25. Storehouse, Baltimore, Md..........Apr. 29
May 25. Milwaukee, Wis..........................Apr. 29
Adv., Eng. RECORD, Apr. 29 to May 20.
May 25. Mobile, Ala...............................Apr. 29
Adv., Eng. RECORD, Apr. 29 to May 20.
May 25. Chicago, Ill...............................Apr. 29
Adv., Eng. RECORD, Apr. 29 to May 20.
May 25. Hospital, Chicago, Ill.................May 6
Adv., Eng. RECORD, May 6, 13.
May 25. Tacoma, Wash............................May 6
May 27. San Francisco, Cal......................Apr. 29
Adv., Eng. RECORD, Apr. 29, May 6.
May 29. Dredging, San Francisco, Cal......May 6
May 29. Louisville, Ky.............................May 6
May 31. Armor plate, Washington, D. C....Apr. 8
May 31. St. Louis, Mo..............................Apr. 22
Adv., Eng. RECORD, Apr. 22, 29, May 13.
May 31. Rock Island, Ill...........................Apr. 29
Adv., Eng RECORD, Apr. 29 to May 13.
May 31. St. Augustine, Fla.......................May 6
Adv., Eng. RECORD, May 6, May 20.
May 31. Bldgs., Atlanta, Ga......................May 13
May 31. Bldg., etc., Spokane, Wash..........May 13
June 3. Excavating, etc., New York City..May 6
Adv., Eng. RECORD, May 6 to 20.
June 3. Dredging, New York City.............May 6
Adv., Eng. RECORD, May 6 to 20.
June 5. Hospital, Shoshone Agency, Wyo..May 20
June 5. Hospital, etc., Madison Barracks, N. Y.............................May 13
June 7. Repairing Custom House, Detroit, Mich..................................May 13
Adv., Eng. RECORD, May 13, 20.
June 8. Dredging, New London, Conn......May 6
June 8. Dredging, Newport, R. I..............May 13
Adv., Eng. RECORD, May 13, 20.
June 8. Levee work, New Orleans, La......May 13
Adv. Eng. RECORD, May 13, 20.
June 8. Wreck and dredging, Philadelphia, Pa.......................................May 13
June 9. Piers, Holland, Mich....................May 13
June 9. Dredging, Cleveland, O...............May 13
June 9. Dredging, Mobile, Ala..................May 13
Adv., Eng. RECORD, May 13, 20.
June 9. Dredging, New London, Conn......May 6
June 10. Bremerton, Wash.......................May 6
June 10. Dry dock, San Francisco, Cal.......Apr. 15
June 10. Dredging, Grand Haven, Mich.....May 20
June 12. Breakwater, New York, N. Y.......May 13
Adv., Eng. RECORD, May 13, 20.
June 12. Dredging, Portland, Me.............May 13
Adv., Eng. RECORD, May 13, 20.
June 12. Excavation, Portland, Me...........May 13
Adv., Eng. RECORD, May 13, 20.
June 12. Breakwater, Cleveland, O...........May 20
June 14. Piers, Muskegon, Mich...............May 20
June 14. Post office, Newport, Ky............May 20
Adv., Eng. RECORD, May 20.
June 15. Dredging, Portland, Me.............May 13
Adv., Eng. RECORD, May 13, 20.
June 15. Htg., etc., Washington, D. C.......May 13
June 15. River Work, Galveston, Tex.........May 20
June 15. Dredging, Sabine Pass, Tex..........May 20
June 15. Dredging, Tampa, Fla.................May 20
Adv., Eng. RECORD, May 20.
June 15. Dredging, Chicago, Ill.................May 20
Adv., Eng. RECORD, May 20.
June 15. Dredging, etc., Newport, R. I.......May 20
Adv., Eng. RECORD, May 20.
June 15. Power Plant, New Orleans, La.....May 20
Adv., Eng. RECORD, May 20.
June 15. Dredging, New Orleans, La.........May 20
Adv., Eng. RECORD, May 20.
June 17. Dump Scows, Chattanooga, Tenn..May 20
Adv., Eng. RECORD, May 20.
June 20. Bldg., Helena, Mont...................May 20
Adv., Eng. RECORD, May 20.

BUILDINGS.

May 22. School, Canton, O.......................May 13
May 22. Temple, Eagle Grove, Ia..............May 13
May 22. Schools, Bottineau, N. D.............May 6
May 22. School, Oskaloosa, Ia..................May 6
May 22. Schools, New York, N. Y.............May 13
May 22. School, Paulding, O....................May 13
May 22. School, Glenwood, Minn..............May 13
May 22. Plumbing in school, Boston, Mass..May 20
May 23. School, Syracuse, N. Y................May 20
May 23. Schools, Detroit, Mich.................May 13
May 23. Dormitory, Washington, D. C.......Apr. 29
May 23. School, Arkansas City, Kan.........May 6
May 24. Hospital, Ft. Steilacoom, Wash.....May 6
May 24. Dormitory, Grand Forks, N. D.....May 6
May 24. School, Des Moines, Ia...............Apr. 29
May 24, School, Auburn, O.....................May 13
May 24. Dormitory, Orting, Wash............May 13
May 24. Court house, Springfield, Mass.....May 13
May 24. School, Mapleton, Utah...............May 13
May 24. Jail, Iowa City, Ia......................May 20
May 24. Chapel, Boston, Mass..................May 20
May 24. School, Norristown, Pa................May 20
May 25. Plans, etc., schools, Indianapolis, Ind. May 20
May 25. Remodeling court-house, Redwing, Minn..................................May 20
May 25. School, Warrensburgh, N. Y..........May 20
May 26. Vent., etc., schools, New York, N.Y. May 20
May 26. Engine house, Erie, Pa................May 13
May 27. School, Hinton, Ia.....................Apr. 29
May 27. School, Pleasant City, O.............May 6
May 27. School, Landis, O.......................May 13
May 27. School, Wellsbury, Ia..................May 20
May 27. Fire-house, Middletown, Conn......May 20
May 29. School, New Knoxville, O.............May 20
May 29. School, Toledo, O........................May 13
May 29. Minneapolis, Minn......................May 13
May 29. School, Keswick, Ia......................May 13
May 29. Court house, Salisbury, N. C.......May 13
May 30. School, Tehamah, Neb.................May 13
May 30. Drill hall, Vancouver, B. C..........May 13
May 30. Elevator, Hamilton, O..................May 13
May 31. School, Pleasantville, Ia..............May 13
May 31. Home, Danville, Ill.......................May 13
Adv., Eng. RECORD, May 13, 20.
May 31. Sitka, Alaska..............................May 13
May 31. Heating, etc., court house, Dartford, Wis.......................................May 13
May 31. Steam mains, etc., Danville, Ill.....May 20
Adv., Eng. RECORD, May 20.
June 1. Htg. school, Ellendale, N. D.........May 6
June 1. School, Beattyville, Ky...............Apr. 22
June 1. Town hall, Utica, Ia....................Apr. 29
June 1. Htg. school, Ludden, N. D...........May 13
June 1. School, Lima, O..........................May 20
June 1. Church and htg., Newport News, Va. May 20
June 2. School, Pomeroy, Ia.....................May 20
June 3. School, Mayfield, O......................May 13
June 3. School, Ames, Ia..........................May 20
June 3. School, Marblehead, O..................May 20
June 3. Bus. bldg, Newport News, Va.......May 20
June 3. School, Millbury, O......................May 20
June 3. Court-house, Parkersburg, W. Va..May 20
June 3. Asylum, Little Rock, Ark.............May 20
June 3. School, Ellerton, O......................May 20
June 5. School, Murray, Utah...................May 20
June 5. School, Marietta, O.....................May 20
June 5. School, Ely, N. D.........................May 20
June 5. Market house, San Antonio, Tex....May 13
June 5. Schools, Pullman, Wash...............May 20
June 5. Jails, Boulder, Mont.....................May 20
June 6. Jail, Marshall, Minn.....................May 20
June 6. Htg. School, Devil's Lake, N. D....May 20
June 6. Htg. College, Corvallis, Ore.........May 20
Adv., Eng. RECORD, May 20.
June 6. Hospital, Auburn, Cal..................Apr. 29
June 10. Town hall, Herring, O..................May 20
June 10. School, Cleveland, O...................May 20
June 12. Htg. asylum, New Albany, Ind.....Apr. 29
June 13. School, Bottineau, N. D.............May 20
June 14. Court house, Williston, N. D.......May 20
June 15. Capitol Annex, Charleston, W. Va..May 20
June 15. Plans, school, Madison, Wis.........Apr. 29
June 22. Remodeling court house, Marietta, Ga..May 13

MISCELLANEOUS

May 23. El. Ry. franchise, Riverside, Cal....May 6
May 24. Dredging, Brooklyn, N. Y............May 13
May 24. Rails, Santiago, Chile..................Apr. 22
May 26. Garbage disposal, Binghamton, N.Y. May 6
May 26. Cement, etc., New York, N Y........May 20
May 29. Fire Alarm, New Orleans.............May 6
Adv. Eng. RECORD, May 6.
May 31. Coal and ash conveyor, Danville, Ill. May 13
Adv., Eng. RECORD, May 13, 20.
May 31. El. Ry. franchise, Redlands, Cal....May 13
June 1. Street cleaning, Utica, N. Y.........May 13
June 1. Garbage collection, West Springfield, Mass....................................May 20
June 9. Excavation, etc., Boston, Mass......May 20
Adv., Eng. RECORD, May 20.
June 30. El. Ry., Shanghai, China.............Mar. 4
Oct. 1. Railroad, Moscow, Russia............Feb. 25
—— Garbage plant, Savannah, Ga........Apr. 29
Adv., Eng. RECORD, Apr. 29, May 6.

SCHOOLS.

Columbia, Pa.—It is stated that the School Board proposes to build a $35,000 school.

Pawtucket, R. I.—Robt. Wilson of Providence is stated to have received the contract for erecting two schools, for $36,968.

Butte, Mont.—The contract for erecting two dormitory buildings and sewer and water system for the Ft. Peck Indian School is stated to have been awarded to Edw. Wagner of Helena at $34,015.

Millbury, O.—Bids are wanted June 3 for a school in Lake township. H. D. Grove, Clk. of Bd.

Montpelier, Vt.—The School Commissioners are stated to have decided to erect a school, to cost about $15,000.

Charles City, Ia.—It is stated that a $30,000 high school will be erected.

East Liverpool, O.—The Board of Education is stated to have decided to submit to the voters the question of erecting a $16,000 school.

Cranston, R. I.—The plans of Edwin T. Banning of Providence have been accepted for a $20,000 school.

Marietta, O.—Bids are wanted June 5 for a school in Newport township. Sereno Rightmire, Clk.

Pima, A. T.—See "Water."

Grinnell, Ia.—The citizens have voted to erect a $14,000 school.

Lima, O.—Bids are wanted June 1 for a school in Shawnee township. Silas Bowsher, Clk. of Bd.

Lowell, Mass.—The Council has appropriated $30,000 for an annex to the high school.

Northampton, Mass.—It is stated that the Council will receive plans about May 24 for an addition to the Florence school, to cost about $15,000.

Cambridge, Mass.—G. Fogarty has prepared plans for a $45,000 school for Harvard St.

Marblehead, O.—Bids are wanted June 3 for a school in Danbury township. Louis St. Marie, Clk. Bd. Educ.

Pomeroy, Ia.—Bids are wanted June 2 for a school. E. B. Larmon, Secy.

Minneapolis, Minn.—Bonds to the amount of $200,000 have been sold.

Ely, N. D.—Bids are wanted June 5 for 2 schools. Hugh Abercrombie, Clk. Monse River School Dist., No. 14.

Washington, Pa.—It is stated that the Catholic Society will build a $30,000 parochial school. Rev. John Faughnan, Rector.

Pullman, Wash.—Bids are wanted June 5 for 2 buildings on the grounds of the State Agricultural College and School of Science. G. W. Bullard, Archt., Tacoma.

Durham, N. C.—The citizens are stated to have voted to build a $16,000 school.

Bottineau, N. D.—Bids are wanted June 13 for a school. N. Meighen, Clk. School Dist.

Ames, Ia.—Bids are wanted June 3 for a school in Franklin township. O. D. Freed, Chmn. Bldg. Com.

Devil's Lake, N. D.—It is stated that bids are wanted June 6 for a heating plant in the school for the Deaf. L. H. Larson, Secy. Bd. Trustees.

Ellerton, O.—It is stated that bids are wanted June 3 for a school. A. L. Eberly, Clk. Bd. Educ.

New Knoxville, O.—Bids are wanted May 29 for a school in Washington township. H. B. Eversman, Clk.

Lagrande, Ore.—D. D. Neer of Portland is said to be preparing plans for a $20,000 school.

Salt Lake City, Utah.—It is stated that a $30,000 school will be erected. Wm. Plinney, Supt.

Murray, Utah.—Bids are wanted June 5 for a school. A. C. Staten, Trustee.

Norristown, Pa.—It is stated that bids are wanted May 24 for a high school. Geo. R. Kite, Chmn.

Corvallis, Ore.—Bids will be received June 6 at the office of the Architect, Edgar M. Lazarus, Portland, for a heating plant for the State Agricultural College, as advertised in "The Engineering Record."

Syracuse, N. Y.—Bids are wanted May 23 for remodeling Willard school. P. D. Cooney, Clk. Bd. Educ.

Boston, Mass.—Bids are wanted May 22 for a plumbing system in the Mechanic Arts high school. Edw. I. Aldrich, Chmn. Com. on New Bldgs., School Com.

Pittsfield, Mass.—School bonds to the amount of $105,500 are stated to have been sold.

Wellsbury, Ia.—Bids are wanted May 27 for a school in Shiloh township. W. J. Schurrman, Secy.

Omaha, Neb.—The plans of John McDonald, 41 Barker Blk., have been accepted for the high school; cost, $147,000. Bids will be received at once for a school at Cass Ave. probable cost, $47,000. John Latenser, Archt., New Gov. Bldg.

Warren, O.—Bids are wanted May 22 for $30,000 school bonds. H. B. Gillmer, Pres. Bd. Educ.

Madison, S. D.—The board of Regents of the State Normal School are stated to have accepted plans for a $22,000 dormitory and will receive bids for same.

Warrensburgh, N. Y.—Bids are wanted May 25 for a school. Isaac S. Woodward, Pres. Bd. Educ.

New York, N. Y.—Bids are wanted May 26 for ventilating, heating, plumbing, electric lighting plants, elevators, etc., in several schools and the new Hall of the Board of Education in the Boroughs of Manhattan and the Bronx. Richd. H. Adams, Chmn. Com. on Bldgs.

Cleveland, O.—Bids are wanted June 10 for a school. H. Q. Sargent, School Dir.

Indianapolis, Ind.—Plans and estimates are wanted by the Board of School Commissioners May 25 for schools for one year.

STREET CLEANING AND GARBAGE DISPOSAL.

Indianapolis, Ind.—The Indianapolis Desiccating Co. was destroyed by fire May 14.

Santa Rosa, Cal.—Press reports state that a committee has been appointed to consider the erection of a crematory for refuse disposal. Councilman J. M. Carter, Chmn.

Buffalo, N. Y.—The Board of Public Works want bids for removing ashes and garbage for a period of 3 years, beginning July 1.

Rochester, N. Y.—Thos. Holahan has received the contract for collecting garbage at $2,000 per month.

West Springfield, Mass.—Bids are wanted June 1 for collecting garbage for one year. S. A. Bragg, Agt. Bd. Health.

GOVERNMENT WORK.

Muskegon, Mich.—Bids are wanted June 14 for repairing government piers. Capt. Chester Harding, Corps. Engrs., U. S. A.

Galveston, Tex.—Bids are wanted June 15 for deepening channel from Galveston harbor to Texas City. Capt. C. S. Riche, Corps. Engrs., U. S. A.

Cleveland, O.—Bids are wanted June 12 for constructing part of west breakwater at Fairmount and Conneaut Harbors. Col. Jared A. Smith, Corps Engrs., U. S. A.

Grand Haven, Mich.—Bids are wanted June 10 for repairing government piers. Capt. Chester Harding, Corps Engrs., U. S. A., Grand Rapids.

Helena, Mont.—Bids are wanted June 20 by the Superv. Archt., Treas. Dept., Washington, D. C., for a post office building, as advertised in "The Engineering Record."

Buffalo, N. Y.—The following bids for the construction of a new superstructure on the breakwater of Buffalo Harbor were opened May 10 by Maj. T. W. Symons, Corps of Engrs.: Frank M. Sylvester, $74,455; James B. Donnelly, $72,488; Buffalo Dredging Co., $70,169; Geo. W. Carter & Sons Co., $73,225; all are Buffalo firms.

The items of the lowest bid were as follows: Removal of 1,015 ft. old superstructure, $6.75; 3,000 ft. new timber in work, $24 per M.; 2,000 tons new stone filling, 66 cts.; 8,900 cu. yds. concrete blocks and concrete in place, $6.64; 1,000 cu. yds. dredging, 30 cts.; 500 tons stone for foundation of crib, 66 cts.; timber crib, complete, $1,475; 100 manhole covers, $1.25; 20 mooring rings, $30.

Mobile, Ala.—The following bids were opened May 12 by Maj. W. T. Rossell, Corps of Engineers, for dredging in Mobile harbor: National Dredging Co., Wilmington, Del., 7 cts.; Rittenhouse Moore Dredging Co., Mobile, 7.3 cts.

Mobile, Ala.—Bids are wanted May 24 for removing wrecks of side dump scow and barge from Mobile river. Maj. W. T. Rossell, Corps Engrs., U. S. A.

Sabine Pass., Tex.—Bids are wanted June 15 for dredging. Maj. James B. Quinn, Corps Engrs., U. S. A., New Orleans, La.

Shoshone Agency, Wyo.—Bids are wanted June 5 for a hospital at the Wind River boarding school. H. G. Nickerson, U. S. Indian Agent.

Birmingham, Ala.—It is reported that the Secretary of War has approved the setting aside of $800,000 for improving the Warrior River.

Ellis Island, New York Harbor.—The following bids for erecting several buildings for the Immigrant Station were opened May 16 by J. K. Taylor, Sup. Arch. Treasury Dept.: L. L. Leech & Son, Chicago, $87,860; John Thacher, Brooklyn, N. Y., $115,790; P. J. Carlin & Co., Brooklyn, N. Y., $104,900; W. G. Triest, New York, $94,500.

Ellis Island, New York Harbor.—The following bids for heating and ventilating plant for the Immigrant Station were opened May 18 by J. K. Taylor, Supervising Archt., Treasury Dept. All bidders but E. P. Bates of Syracuse are New York firms: Gillis & Geoghegan, $72,200; W. N. Tobin, $82,600; Frank Dobson, $78,400; N. Y. Steam Fitting Co., $75,000; Evans, Almirall & Co., $81,521; E. Rutzler, $71,512; Baker, Smith & Co., $73,246; Blake & Williams, $74,545; Francis Bros. & Jellett, $77,300; G. A. Suter & Co., $71,500; Edward P. Bates, $84,000; Walker & Chambers, $79,489.

MISCELLANEOUS.

Toledo, O.—The Harbor Master has been authorized to ask for bids for dredging Swan Creek.

Turtle Bayou, Tex.—The Trinity Rice Land & Irrigation Co., C. F. Blake, St. Louis, Mo., Pres., is said to be purchasing considerable land and has employed engineers to make surveys, intending to build a main irrigating canal, 20 miles long, tapping the bayou.

Providence, R. I.—The following bids for 124,000 cu. yds. dredging were opened May 10 by Jos. D. Grinnell, Chairman Harbor Com., 71 So. Main St. The bids were on 3 classes of dredging, ranging from hard to light, and marked a, b and c. W. H. Richardson, New York, a, 22 cts.; b, 24 cts.; c, 28 cts. P. Sanford Ross, Jersey City, a, 14¾ cts.; b, 14 cts.; c, 15 cts. J. A. Dailey & Son, Providence, 18 cts. for each class. Cole Bros., Fall River, a, 13⅞ cts.; b, 12.9 cts.; c, 15 cts.; awarded contract. Brainard Bros, New York, a, 16⅛ cts.; b, 15¼ cts.; c, 25 cts.

Milwaukee, Wis.—W. F. Goodhue, 204 Grand Ave., has prepared estimates for a canal connecting Green and Puckaway Lakes. The latter is a portion of the government waterway between Portage and Green Bay. The canal is about 4½ miles long and is estimated to cost $58,000 exclusive of right of way. The incorporation of a canal company and other preliminaries are under way and it will be some time before work begins.

New York, N. Y.—Bids are wanted May 26 for granite stones for bulkhead or river wall; also for 10,000 bbls. Portland cement. J. Sergeant Cram, Chmn. Commrs. Bd. of Docks.

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The Engineering Record.

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TABLE OF LEADING ARTICLES.

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THE END OF THE BOSTON SEWER ASSESSMENT SYSTEM.

It is unnecessary to recall to the readers of this journal all the provisions of the peculiar sewer assessment act which was passed by the Legislature of Massachusetts in 1897 at the solicitation of the City of Boston. These provisions were reviewed in these columns in a general way on November 13, 1897, and reference should be made to that issue for further information. Under that act the Street Commissioners adopted a scheme of sewer assessment substantially as follows, and applied it generally throughout the city. They charged as a special tax 3½ cents per $100 of valuation of the land, exclusive of buildings, together with one-fifth of the charge made for the use of water on the estate, with certain deductions from the charge for the use of water where such use was of a peculiar kind, as for raising steam. This item of 3½ cents per $100 was made up of 1½ cents for the construction of sewers in any part of the city and 2 cents for the general maintenance of the system, including salaries, care of sewers, coal and other charges for the pumping plants, and similar items. Several of the leading citizens of Boston protested against this assessment and carried the case into the courts.

Inasmuch as it has lately become a sort of fad to base the charges for sewer construction and maintenance on various forms of so-called special assessments, it is well worth while to notice two sections of the act which the Supreme Court has just declared null and void. These read as follows:

"Section 7. The Board of Street Commissioners, with the approval of the Mayor, shall annually, before the first day of July, determine just and equitable sewerage charges to be paid by estates in said city for the construction, maintenance and operation of the sewerage works, taking into consideration in determining the charges the necessity of the works as caused by each estate, the amount of use thereof, if any, by the estate or its occupants, the benefit received therefrom by the estate, the amount of any assessment for a sewer paid by any owner of the estate, the length of time which has elapsed since such payment, and the use, if any, which has heretofore been made of the sewerage works by the occupants of the estate, and such other matters as they shall deem just and proper. The determination of such charges as aforesaid shall be final in all cases, and the amount thereof as determined for each estate, shall be a lien thereon until paid, and said board shall notify the board of assessors of said city of the amount thereof forthwith after it has been determined, and the same shall be included in the next tax bill on the estate transmitted by said board to the collector, or in a tax bill therefor, if no other tax bill is issued for such estate, and be included as part of the taxes on the estate.

"Section 8. All sewers and connections ordered to be made in constructing any way . . under the authority of this act, and the expenses therefor, shall not be considered in determining the assessable cost of the work to be assessed under the authority of said act."

The court holds that these provisions cannot stand as authorizing the assessment of a general tax because the method of assessment is not proportional and equal. Hence it is necessary to determine if they agree with the recognized principles of special assessment. Taxation of this kind is permissible in Massachusetts only when founded on special and peculiar benefit to the property from the expenditure of the money so raised. Such taxation, moreover, cannot legally exceed the special and peculiar benefits accruing to the several estates assessed. In this particular instance the sewer commissioners are required to consider various subjects, including "such other matters as they shall deem just and proper." The benefits are not special and peculiar, according to the act, but may be those which each estate receives in common with all the others in the city and with the inhabitants generally. This fact in itself is held sufficient to bring the statute within the prohibition of the constitution, inasmuch as it purports to authorize a taking of property to pay a charge which is not founded on a special benefit or equivalent received by the estate or its owner. "Such a taking would be without due process of law." The decision is also very emphatic in denying the justice of any system of assessing all charges of sewer administration on real estate alone.

PROGRESS ON THE METROPOLITAN WATER-WORKS.

The annual report of the chief engineer of the Metropolitan Water Board of Massachusetts, Mr. F. P. Stearns, M. Am. Soc. C. E., is always one of the most interesting documents of the year, and the number covering the work done in 1898, which has just been made public, is even more valuable to engineers than those which have previously appeared. It is now possible to discern in every feature of this great undertaking the result of the admirable engineering organization which Mr. Stearns perfected several years ago; the work is now progressing with the precision of a well-executed military movement, and the fact that the maintenance of a great and still somewhat disjointed agglomeration of independent water plants has been intrusted to the engineering department has caused no delay in the other operations of this staff. It is to be hoped that some day either Mr. Stearns himself or some of the engineers who have been assisting him to accomplish these really notable results will explain in detail the methods employed in perfecting the organization which has made such work possible.

The reservoir department, which has been under the direction of Mr. Hiram A. Miller, M. Am. Soc. C. E., since its organization, has been largely engaged in the construction of one of the great dikes which will bound a portion of the future Nashua reservoir. This dike separates the basins of two ponds which were of considerable size; that lying to the north of the dike, outside of the basin of the future reservoir, is known as Coachlace Pond, while the other, within the site of the reservoir, is known as Sandy Pond. It is intended to utilize the soil stripped from a considerable portion of the reservoir site in the construction of this north dike; and the only available route by which the material can be transported to the place of its use passes along the shore of Sandy Pond some ten feet below its usual level. Both on this account and in order to diminish the amount of water to be handled during the excavations for a part of the north dike, it was decided to lower the level of the water in the pond about 15 feet. This was readily accomplished, because the pond is separated from much lower ground by a very narrow ridge along one portion of its shore. The construction of the railway for handling the earth for the dike was let to Messrs. Moulton & O'Mahoney, of Boston, who also undertook to drain the pond. Their first work was to excavate through the narrow rim nearly to the water level of the pond. It would have been too hazardous an undertaking to attempt to lower the pond by carrying this cut below the water level, as the rush of water would have washed away the material at the bottom of the cut and allowed the pond to drain so quickly that the results would have been disastrous.

The method followed to accomplish the desired end involved the use of a syphon about 360 feet long. A 20-inch cast-iron pipe with a gate at the lower end was laid through the cut and along a pile trestle extending into the pond to a place where the water was about 20 feet deep. From the upper end of this pipe an 18-inch copper pipe, which happened to be available, was lowered into the water nearly to the bottom of the pond. A small boiler and pump were provided and the lower leg of the syphon was pumped full of water; the other leg was filled by exhausting the air with an ordinary boiler injector. The syphon was started on June 10 and ran until June 25, lowering Sandy Pond a little more than 15 feet and Coachlace Pond 8 1-3 feet. The further lowering of the latter could not be made without an inconvenient amount of digging through the ridge between the two ponds. The syphon was removed and subsequently two pipes 6 and 8 inches in diameter were laid through the cut to maintain the water in Sandy Pond at a low level. It is a characteristic feature of the foresight with which everything on these works has been planned that the 6-inch pipe has been so laid that it may be extended to a suitable point for a locomotive water station later on. The 8-inch pipe is for the waste of surplus water.

During the year all the plans and examinations necessary for a thorough understanding of the work on the North Dike were completed. In order to ascertain the nature of the material at the site of this great embankment, 1,131 borings, having an aggregate depth of about 17¾ miles, have been made and careful studies conducted to determine the rate of filtration of water through soils and sand, the stability of soils under heavy loads, and the density of such material when compressed in various ways.

A few hundred feet north of the toe of the northerly slope of the dike, where it crosses Coachlace Pond, a small dam was constructed about 1,200 feet long and 14 feet or so high. This was built in order that the water in the main portion of the pond might not be drawn off in any of the subsequent operations, as it was controlled by a manufacturing corporation. The water between the small dike and the previously mentioned ridge separating the two ponds was pumped into Sandy Pond and drained off from there through the works which have just been described. The work to be done on the main dike is of such a nature that it is impracticable to maintain the roads at its site; and, as the work will continue for several years, a substantial and well graded temporary road was built for use until a permanent highway can be constructed. The stumps, logs and a thin layer of muck or soil on the bottom of Coachlace Pond between the temporary road and the small dike have been removed. Over approximately five acres of this area the muck was underlaid by quicksand, and 6,000 cubic yards of gravel were spread over the quicksand

to prevent horses and carts from sinking into it. Late in the summer a contract was made with Mr. Joseph D. Gennaro, of Boston, for the excavation of 290,000 cubic yards of earth at one end of the North Dike at the rate of 14⅞ cents per yard. This excavation is for the most part from a trench having a bottom width of 30 feet, side slopes of 1 horizontal to 1 vertical, and a depth varying from 30 to 60 feet for a large part of the length. This trench is to be cut through gravel and coarse sand down to a nearly impervious sand stratum and then filled with compacted soil, which has been found by experiment to be very nearly watertight. The sand and gravel removed from the trench are utilized in the construction of portions of the dike.

The dam and aqueduct department, under the charge of Mr. Thomas F. Richardson, M. Am. Soc. C. E., was busily engaged during the year on works connected with the Wachusett aqueduct, the sewerage and sewage disposal system of Clinton, and the drainage of swamps. The first two undertakings have already been described in these columns, as well as the temporary dam by which the water of the Nashua River is directed into the aqueduct. The swamp drainage is an important matter for considerable water reaching the Sudbury Reservoir has been of inferior quality because of its taking up organic matter and acquiring a deep brownish color while passing through these swamps. The latter are generally very nearly level, and frequently there are no well-defined water courses through them, or, if there are any, they are in the middle of the swamps. The general policy of drainage provides for the construction of ditches near the edges of the swamps to intercept the water from the uplands and convey it directly into the reservoir. After completely isolating a swamp by such marginal ditches, it becomes moderately dry, for it receives little water except that which falls directly on it as rain. In some very narrow swamps, only a single main ditch has been provided, instead of two marginal ditches. Where the ditches enter the open channels or other main streams, settling basins are provided to intercept the materials carried along by the current. The ditches so far constructed have a bottom consisting of a one-inch board one foot wide, with triangular rabbeted wooden strips on either side. These strips make wooden sides to the channel about 3 inches high, serving as a footing for a stone pavement at the sides of the channel, and will hold the boards in place after the nails used to hold them at first have rusted away. The side slopes are 1 on 2 and the depth of the ditches is generally from 1½ to 2½ feet. The paving of small stones on the sides is carried somewhat above the ordinary water level.

The Sudbury Department, under the direction of Desmond FitzGerald, Pres. Am. Soc. C. E., has been engaged in completing the works connected with the Sudbury Reservoir and in increasing the capacity of the Rosemary syphon, undertakings with which Mr. FitzGerald's name has been intimately associated for many years. One of the most interesting features of the work on the reservoir proper was the completion of the excavation of a large swamp which has been the cause of serious difficulty. This excavation was done by means of a hydraulic floating dredge which discharged the mud from the bottom of the swamp over large shallow areas enclosed by dikes on the borders of the reservoir. The excavation of the material was carried to a depth of 10 feet or to a sand or gravel bottom if one was encountered at a less depth. In order to float the dredge a temporary dam was built across the portion of the reservoir basin containing this swamp, forming a pond in which the operations could be conducted. A short time before the completion of the dredging an opening was made in the temporary dam farthest from the dredge, and the water in the basin allowed to flow out so as to reduce the amount of pumpage necessary to expose the bottom for a final cleaning. The last part of the dredging was the excavation of a large hole in the bottom of the swamp for the dredge to float in after the removal of the water from the remainder of the basin. After the completion of the dredging, the centrifugal pump on the dredge was used to pump the water from the basin so as to expose the bottom. As the water level sank it was seen that there was a considerable deposit of muck on the sand or gravel shores, and a large force of men and teams was employed to remove it. Some of the material was very soft and had to be collected in small piles and allowed to drain before it could be removed from the reservoir. When the work was finished there were left 30 acres of mud surface instead of the 75 acres in the original swamp. Further removal of mud was considered unnecessary because preliminary studies had shown that the material more than 10 feet below the original surface of the swamp contained much less organic matter than the upper portion, and the excavation increased the depth of water over these places from 12 to 22 feet. The condition of this portion of the basin has also been improved by the deposit of a considerable amount of sand over the mud. This sand was carried over the surface when water was admitted to the reservoir and also by small streams which washed it from the shores during rains. In the work of stripping the basin the surface soil was deposited in the shallow arms so as to form large filled areas raised 2 or 3 feet above the high water line. In order to prevent the upland water from flowing over the surface of this filling, marginal ditches have been constructed to intercept and convey it to the reservoir at definite points which have been protected by paving.

It is particularly interesting to notice that on this reservoir one of the unique engineering works completed by Mr. FitzGerald during his connection with the Boston water-works will be duplicated. Several years ago he built a series of filter beds to purify a feeder of a reservoir which was exposed to the surface wash of the town of Natick, through which it flowed. These filters, known as the Pegan Brooks works, were described in "The Engineering Record" of April 28, 1894. A similar problem has arisen in connection with Walker Brook, a feeder of the Sudbury reservoir passing through the thickly settled portion of the city of Marlborough. The watershed of the brook at its entrance into the reservoir is about 2 square miles, and the quality of the water is so bad that a settling reservoir and filter beds are to be constructed for the purification of this particular supply.

The capacity of the Sudbury aqueduct as originally constructed was limited by the capacity of two 48-inch syphon pipes laid across the valley of Rosemary Brook and recently brought into particular notice among engineers by the series of gaugings of their discharge made by Mr. FitzGerald and described by him in a paper presented to the American Society of Civil Engineers. At the time the aqueduct was constructed, provision was made for the addition of a third pipe of the same size whenever it became necessary. The utmost capacity of the two pipes was found to be about 80,000,000 gallons per day, somewhat less than the maximum consumption of water in the Metropolitan district. It was evident that an additional pipe was needed, and investigation showed that if taper pipes were connected to the 48-inch dead ends left for the third syphon, a 5-foot syphon pipe could be employed instead of the 4-foot main originally projected, and a large quantity of water obtained. It was decided to follow this plan. Consultation with pipe manufacturers developed the fact that it would be more economical to use the outside molds already prepared for making a thick 5-foot pipe, and to produce the thinner pipe desired for the light pressures at the syphon by increasing the size of the cores. The pipe as actually delivered was 61⅛ inches in diameter and had a shell 1¼ inches thick. An account of this pipe and certain tests made in connection with it was printed in "The Engineering Record" of December 17, 1898. After it was laid the inside joints were filled with Portland cement mortar to give a smooth and continuous surface to the interior, and the pipe was tested by filling it with water under a head of 30 feet in excess of the greatest head that can ever be brought upon it. Under these conditions the maximum loss of water was at the rate of 12 gallons per day for the three days the test was continued.

After the pipe was put in use experiments were made to determine its capacity; and it was found that with the normal loss of head, 1.73 feet, the discharge was about 54,600,000 gallons per day. In order to determine the value of c in the Chezy formula, $v = c\sqrt{rs}$, arrangements were made for exact measurements of the loss of head through 1,607.4 feet of the pipe which was laid either on a straight line or with vertical curves having a radius of not less than 1,000 feet. The quantity flowing was determined by the ordinary methods used in measuring the flow through the aqueduct. The value of the coefficient was found to range from 149.6 with a velocity of 4.65 feet per second to 154.3 with a velocity of 6.51 feet.

The distribution department, under the direction of Mr. Dexter Brackett, M. Am. Soc. C. E., has charge of the pipes, distributing reservoirs, pumping stations, and all other works in the Metropolitan District with the exception of Chestnut Hill reservoir and the Sudbury and Cochituate aqueducts. Some of the undertakings of this department have to be executed under conditions where the results would mar the local outlook if careful attention were not given to artistic features. Hence in the design of the pumping stations it was very wisely decided to have the substructures built in accordance with plans prepared by the engineering staff and leave the superstructure to architectural firms. Messrs. Wheelwright & Haven were thus called into consultation in planning additions to a pumping station at Chestnut Hill, and Messrs. Shepley, Rutan & Coolidge were retained for the plans of other stations. For the same reason the engineering staff has been assisted by Messrs. Olmsted Brothers in the design of a high-service reservoir to be built near the highest portion of the south end of the Middlesex Fells Park reservation. This reservoir will be formed by five dams. The natural surface of the rock is to form the shore line of the reservoir except at these dams, where the shore is to be finished as a gravel beach, and the embankments graded so as to give them a natural appearance rather than the usual artificial surfaces of reservoir embankments.

During the year, 14.43 miles of large pipes have been laid, making a total length of 1,244.57 miles of mains in the several cities and towns supplied either wholly or in part from the Metropolitan works. Connected with this system there are 125,578 service pipes, 9,485 water meters, and 10,854 fire hydrants.

THE IMPROVEMENT OF THE GREAT KANAWHA RIVER, W. VA.—I.

The Great Kanawha River empties into the Ohio River at a point 262 miles below Pittsburg and 205 miles above Cincinnati, and is a continuation of the New River which rises in North Carolina between the Blue Ridge and Smoky Range. The Great Kanawha River is commonly regarded as beginning at the Kanawha Falls, which are two miles below the junction of the New and the Gauley Rivers, and its length from the foot of the falls to its mouth, measuring alone a surveyed line on the shore, is 95.25 miles. It flows through a region rich in salt and coal and the government improvements are intended to furnish a depth of at

least 6 feet of water over its entire length throughout the whole of the year.

At low water stages the total descent of the river in its length of 95.25 miles is 107 feet, of which over 46 feet occurs in the first 15 miles. Previous to the improvement the fall in round numbers over different portions of the river, beginning at the upper end, was as follows: In the first 4 2-3 miles, 22 feet; in the next 10½ miles, 24 feet; in the next 21½ miles, 16 feet, and from Charleston to the mouth of the river, a distance of 58½ miles, 45 feet. The most of the fall in low stages occurs at the shoals and ripples, the natural pools between them having but little descent. The bed of the river is composed of boulders and gravel, with some sand and mud, getting finer towards the mouth. It is underlaid with rock at depths of 7 to 18 feet below low-water mark. The banks are from 35 to 50 feet high, composed mainly of heavy clay, but with frequent mixtures and strata of sand. Ordinary floods rise about 30 feet above low-water mark on the upper portion of the river and about 40 feet near the mouth, while in the lower portion an extreme flood in 1884 raised the level over 60 feet. The average width of the river at low water is about 600 feet. The natural low-water depth between shoals is about 3 to 8 feet, but in places it is much deeper. In extreme low water the depth on some of the shoals was originally but a few inches, hardly enough on the shallowest to float a loaded canoe or skiff.

In 1873, when the United States began work on the river, a gauge was set near Charleston to show the available depth of water for open navigation in the river below that point. The zero of the gauge is about 1 foot below ordinary low water; the extreme low water of 1881 fell one-tenth of a foot below zero. The discharge in cubic feet per second of the river at Charleston for various readings of the gauge is as follows:

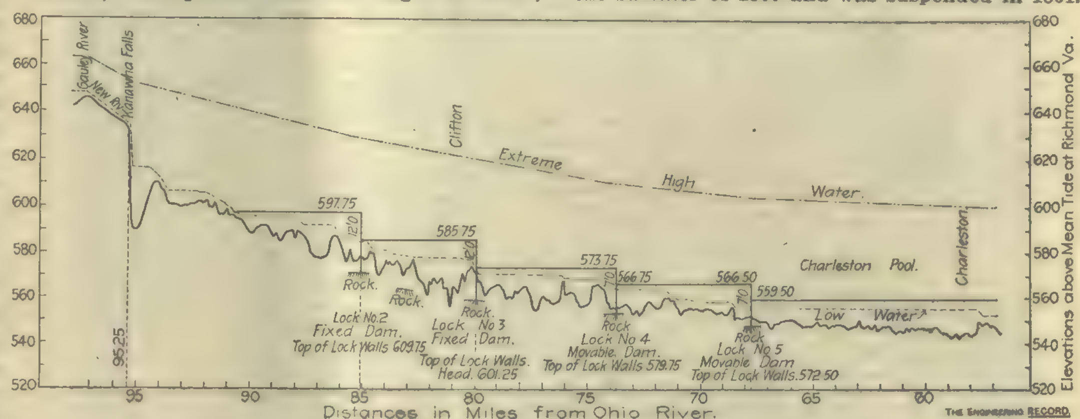
Gauge	3.00	3.90	5.28	6.80	8.10
Discharge	2,912	4,925	8,613	12,733	18,562
Gauge	9.20	14.40	19.60	32.60	34.60
Discharge	28,798	47,120	76,851	118,291	155,388

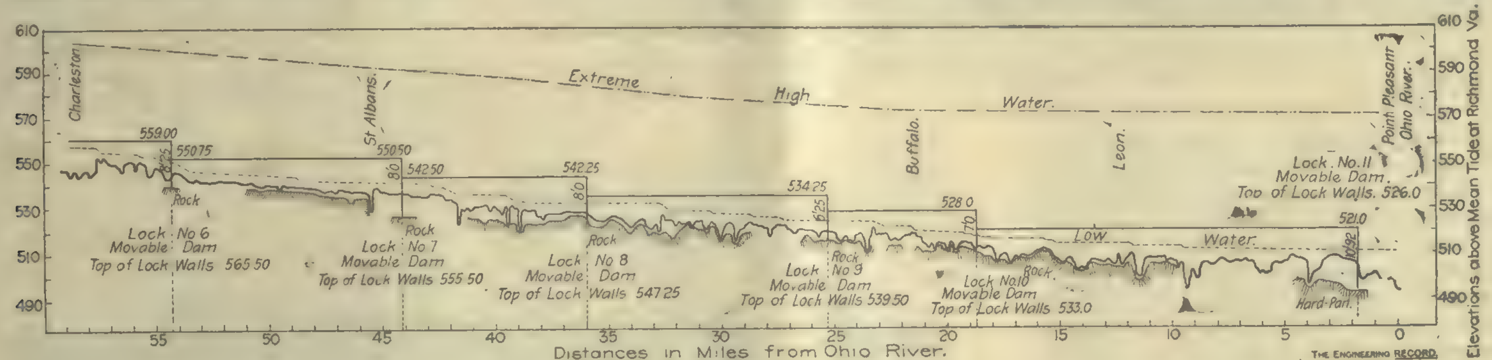
The following figures show the number of days per year that the river was at or above certain heights as marked on the gauge at Charleston. These figures are the averages for a term of 12 years ending July 1, 1895, and being before the completion of the first lock and dam below that point they show the actual condition for the open river:

Days above	337	299	250	146	100	35	6
Gauge reading	2 ft.	3 ft.	4 ft.	6 ft.	7 ft.	10 ft.	20 ft.

The river is obstructed by ice but very little. For 19 years ending in 1892, navigation was suspended by it, wholly or in part, an aggregate of 146 days, or an average of less than eight days per year. Aside from an exceptionally cold winter, accompanied with low stages of water, the river seldom freezes over and the moving ice is rarely more than 2 inches thick.

The shoals were such a marked obstruction to boats of light draught in an otherwise good river during nearly the whole year, that work on them was begun at an early day. The Legislature of Virginia during its session of 1820-21, passed an order directing the James River & Kanawha Company, in which the State was largely interested, to so improve the Kanawha River as to secure not less than 3 feet of water from its mouth to the falls all the year round. The execution of this order was delayed, waiting examinations and surveys, until 1825, when a system of chutes and wing dams was commenced and prosecuted for a number of years. The shipment of coal for commercial purposes began in 1855 and soon increased so rapidly that a better navigation was demanded. After further surveys and examinations, the company decided to construct new chutes through the shoals by dredging. This work was begun in the summer of 1860 and was suspended in 1861.





PROFILE OF THE GREAT KANAWHA RIVER.

VIEW OF LOCK AND MOVABLE DAM NO. 6, GREAT KANAWHA RIVER.

The average coal barge is about 130 feet long, 25 feet wide, and 6½ feet draft, and has a capacity of about 600 tons. The type of tow boat employed is that shown in the illustration.

After the Civil War the State of West Virginia created the Kanawha River Board to continue the improvements which were already begun. But in spite of these works there was much difficulty in navigating the river, especially during times of low water.

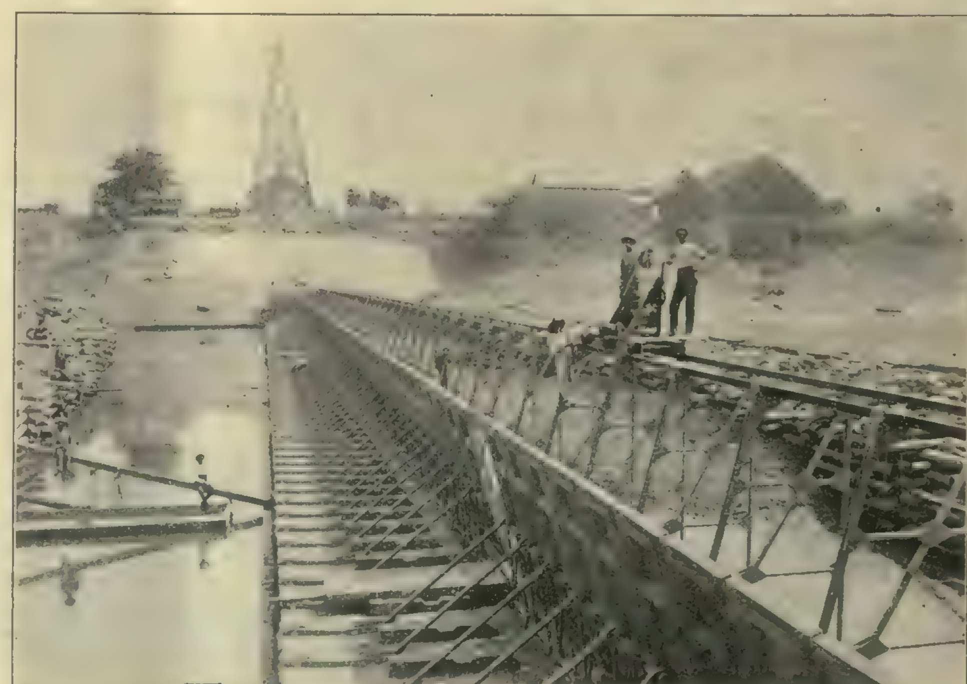
The first appropriation by the United States for the improvement amounted to $25,000 and was made in 1872-73. This was followed by an appropriation of the same amount in 1874. Both of these sums were expended for improvements for open navigation mainly, in building riprap dams and dikes, removing rocks and snags and in widening and improving the channels on the shoals by dredging and cutting down the bars. While this work was in progress the Kanawha River Board continued to act for the State, operating two dredges and collecting tolls, until it was dissolved by an act of the Legislature in 1883 and the improvement of the river wholly turned over to the United States. The first appropriation for the improvement of the river by locks and dams was made by Congress in March, 1875. A board of engineers recommended in that year that nine movable dams be used on the lower portion of the river and three fixed dams on the upper portion. These plans were later modified by reducing the number of fixed and movable dams one each. Two of the movable dams are above Charleston and six below. The locks above Charleston are 50 feet wide in the clear and 300 to 311 feet long between quoins; those below Charleston were made 55 feet wide in the clear and 342 feet long between quoins in order to better accommodate the coal trade. The work of construction of the locks and dams was begun in 1875. Number 2 was completed in 1887, No. 3 in 1882, Nos. 4 and 5 in 1880, No. 6 in 1886, Nos. 7 and 8 in 1893, Nos. 9 and 10 in 1897 and No. 11 in 1898. Dams Nos. 4 and 5 as noted were completed and put in operation in 1880 and were the first movable dams for slack-water improvement built in America.

The movable dams are of the Chanoine wicket type, operated from trestle service bridges. In general features they are all alike. They are easily and rapidly manoeuvered, the expense of operation and maintenance is but little if any more than with fixed dams and they prove highly satisfactory to the river interests. They are kept up when there is not sufficient water in the river for coal-boat navigation and down at other times. Their advantages over the ordinary fixed dams for a commerce and river like the Great Kanawha are decided, furnishing the benefits of the usual slack water without its most serious drawbacks. With fixed dams everything must pass through the locks, and navigation is entirely suspended when the river is near or above the lock walls. With movable dams the locks are used only when the discharge of the river is so small as to make them necessary. At other times the dams are down out of the way, affording unobstructed open navigation. Experience with them has naturally suggested improvements, and those last constructed have considerable advantages over those first built in strength and durability of construction, facilities for rapid manoeuvering and cost of operation and maintenance.

The operation of raising and lowering the dams may be described as follows: In raising the pass the bridge is first put up trestle by trestle, beginning at the lock. As the trestles come up and with them the aprons that make the walk, rails are placed to form a track for a winch used in the work. In raising the trestles the winch is moved by means of a small top crane and sheave. After the bridge is up the wickets are pulled up one by one with the winch and wicket chains until the props drop into the hurter seats. They are not erected as fast as pulled up, but are left on the swing with the horse erect, the end of the prop in the hurter seat and the wicket in a horizontal position at the top of the horse, in which position the water passes freely under them. If righted as fast as pulled up, the head of water becomes so great that the wickets cannot be safely handled with the winch. After being put on the swing clear across, they are all rapidly righted by means of the wicket chain and the drum and the brake on the winch, the butt of the wicket being held against the pressure of the water and let against the sill without shock. In lowering the pass the wickets are pulled upstream a few inches with the winch by a simple line and grab connection at the top of the wicket. This carries the foot of the prop out of the seat into the descending channel of the hurter, when the grab is disengaged and the wicket falls; after the wickets are lowered the bridge is put down. These manoeuvers refer particularly to the navigation pass; the weir is manoeuvered in the same general way, but the wickets being smaller than those of the pass, they can be raised or lowered, put on the swing, or righted with the full head whenever desired. The manoeuver of the weir when the dam is up is governed by the stage of the river, it being kept wholly or partly raised as required to regulate the surface of the pool. A pass wicket is never lowered or swung unless the whole dam is to go down. A light service boat furnished with a derrick, capstan and cabin is required at each movable dam to assist in the manoeuvers, transport bridge rails, tools, etc., and a complete diving outfit is also necessary at each.

VIEW INSIDE COFFER DAM AT LOCK AND DAM NO. 11.
[This is a progress view of the work on the navigation pass and center pier when nearly completed. Part of the wickets are nearly placed.]

Lock and Dam No. 7 are located 14 miles below Charleston and 44¼ miles from the mouth of the river; work here was begun in April, 1889, and was completed in 1893. As this work is typical of the movable dams, a description of this one is given somewhat in detail. (See Report of Chief Engineers, U. S. A., for 1892, page 2,059, etc.) The bed rock at this site was from 11 to 15¾ feet below low water and was overlaid with hard pan from 3½ to 8½ feet deep. On this was the river bed of boulders and coarse gravel mixed with some sand and mud. The foundations of the lock, except the upper cross sill, all extend to solid rock, while those of the dam rest partly on the rock and partly on the hardpan. The lock is 342 feet long between quoins, with a clear width in the chamber of 55 feet. The total length, not including guard cribs, is 411 feet. The walls are uniformly 20 feet above the top of the miter sills, and, including the concrete foundations, they are from 27 to 34¾ feet high. The maximum lift when dam No. 8 is up and the pools are full is about 8 feet; with No. 8 down the lift in low water is about 10 feet. The cofferdam for the lock and guard cribs measured 536 feet up and down stream with shore ends 152 and 134 feet long. It was formed of cribs 15 feet wide, 21 feet long and about 19 feet high, made



PROGRESS VIEW OF WEIR OF LOCK AND DAM NO. 11.
[All but two of the wickets are raised and the bridge trestles are standing, with the manœuvring winch on the track in the foreground. The cableway tower, stone yard and concrete plant are in the background.]

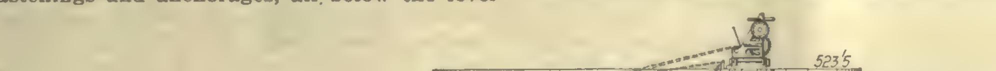
of round timbers and sunk to the hardpan, from which the top boulders and gravel has been removed by dredging. They were then filled with heavy dredged material, sheathed on the outside and banked with clay and gravel. For the foundations the hardpan was excavated to the solid rock and replaced with concrete up to within 5½ feet from the top of the miter sills, where the stone masonry begins. Under a portion of the miter sills concrete was not used and the stone masonry was carried to the rock foundations for the purpose of anchorage.

The stone used on this rock and dam was yellowish and bluish gray, medium and fine grained sandstone obtained from quarries along the river. It weighs about 150 pounds per cubic foot and the crushing load of 2-inch cubes varied from 25,000 to 46,000 pounds. The chamber faces of the walls are of pointed-face ashlar and the other faces generally of rock-face ashlar except the back of the land wall. The corners, quoins, sills and coping are of bush-hammered dimension stone. The backing of all the walls is of sound, good-size, vertical-sided stones, shaped up and bedded top and bottom and the spaces between the stones filled solid with small stones and spalls. The concrete was mixed in batches made of 33 cubic feet of broken stone, 15 cubic feet of sand and two barrels of Rosendale cement, making about 36 cubic feet of concrete rammed in place. For drainage back of the land wall, loose stone was placed leading to a culvert in the lower wing. To guard against communication between the pools, puddle was placed about the upper wing wall. The miter sills are anchored to the bed rock with 1¼-inch wedge bolts. The lock gates are of white oak built without heel or miter posts, the main beams running through and the ends and center made solid by filling blocks, assembled with horizontal and vertical bolts and keys with the spaces planked. They are suspended at the heel on steel gudgeons and by top fastenings and anchorages, all below the level of the coping. Each leaf complete weighs about 37½ tons. The lock is filled and emptied by valves in the gates, each leaf having five cast iron valves hung horizontally in a wrought iron frame. The valves are manoeuvered by racks and pinions and the gates by spars and capstans. The lock is either filled or emptied at maximum lift in less than four minutes. Steam boats, without tows, are locked either way in from 6½ to 8 minutes.

The dam is of the Chanoine wicket type and is divided into the navigation pass, center pier, wier and abutment. The foundations of the navigation pass all rest on concrete, which extends to bed rock under the upper and lower walls and at the wicket and trestle anchorages and to hardpan elsewhere. The foundations are 50 feet long up and down stream between the neat lines of the walls. The surface of the pass is entirely of masonry except the wicket sill and the timbers for horse and trestle boxes. The pass is 248 feet wide and is closed by 62 wickets spaced four feet between centers. The wickets are of oak with pine panels and are 3 feet 8 inches wide by 14 feet ⅛ inch long. The axis of rotation is 6 feet 10 inches from the butt of the wicket and 5 feet 11 inches vertically above the top of the sill. The top of the wickets is 13 feet vertically above the sill, on which they lap 5 inches. They are inclined 20 degrees from the vertical. The service bridge is made by thirty wrought-iron trestles with attached aprons for walks and connecting rails; the trestles are placed 8 feet apart center to center and are connected by chains for use in raising; the aprons also form a part of this connection. The floor of the bridge is 16 feet 9¼ inches above the center of the bottom axis of the trestles and 2 feet 6 inches above the top of the wickets or normal pool level. The wickets and bridge are anchored by 1¾-inch rods and cast disks built into the foundations and spaced 4 feet apart.

THE CHANOINE WICKETS AT LOCK AND DAM NO. 9.

[The view shows three wickets of the weir in place and the service bridge erected, with a fourth wicket on the swing. The chains for the wickets and bridge trestles had not been placed. Vertical height of wickets above sill, 8½ feet; width between centers, 4 feet. Bridge trestles 12 feet high and 8 feet apart.]



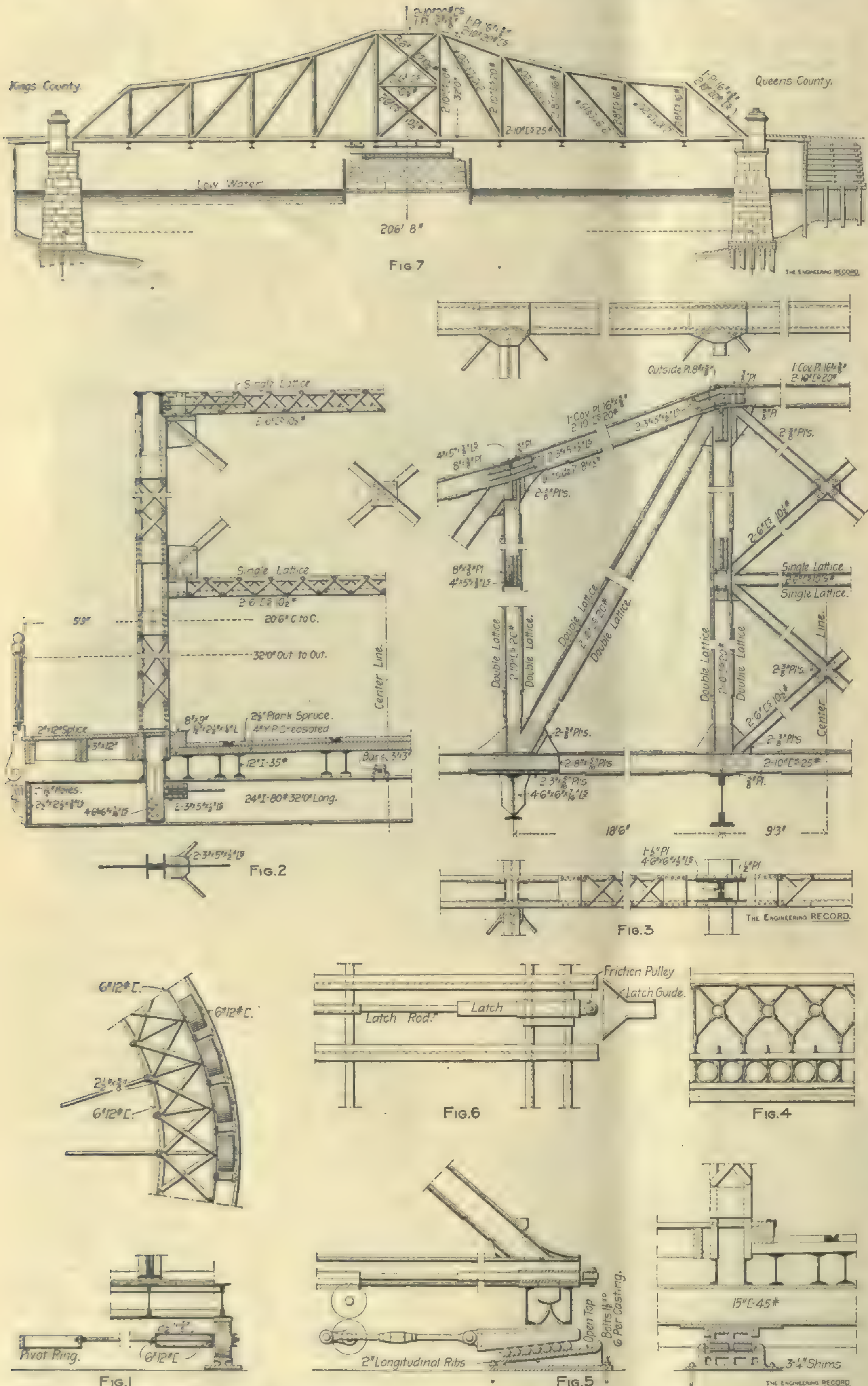
DETAILS OF NAVIGATION PASSES AT DAMS 7 AND 11.

The masonry of the downstream wall of the weir extends to bed rock and the remainder rests on the hardpan. The space between the upper and lower walls is filled with concrete and clay and gravel; the concrete being used about the anchorage and immediately under the masonry. The wier is 316 feet long, closed by 79 wickets each 3 feet 9 inches wide and 9 feet 2⅛ inches long and spaced 4 feet between centers. The axis of rotation and the top of the wickets are vertically 3 feet 4¾ inches and 8 feet 6 inches above the sill respectively. The wickets lap about 4 inches on the sill and make an angle of 20 degrees with the vertical. The weir service bridge is similar to that at the navigation pass. The foundations of the center pier all rest on bed rock and are of concrete except at the down stream end, where the stone masonry extends to the bed rock. The foundations of the abutment are of concrete and extend to the bed rock throughout. The stone work of the pier and abutment is principally rock-faced ashlar with dimension bush-hammered corners and coping. Loose stones leading to an opening in the lower wing were placed back of the abutment for drainage purposes, and to prevent communication between the pools puddle was placed around the upper wing-wall.

(To be Continued.)

THE GREENPOINT AVENUE BRIDGE.

The Greenpoint Avenue or Blissville bridge over Newtown Creek in the Borough of Brooklyn, New York city, is a low-level highway swing bridge about 200 feet in extreme length, with a 20.5-foot roadway and two 5.75-foot sidewalks cantilevered outside the trusses. It carries two electric car tracks and is designed for a heavy city traffic. The structure replaces an old swing bridge which had become inadequate, and rests on an old center pier which will be



GREENPOINT AVENUE BRIDGE DETAILS, NEW YORK CITY.

recoped and thoroughly grouted. The old bridge had a center bearing and its heavy pivot and suspended crossbeams will be retained for the new bridge and additional bearing will be introduced by inserting 40 chilled cast-steel coned wheels of 8-inch tread and 18-inch diameter under a light new drum 26 feet in diameter. The radial axles of these wheels all bear in the live rings and alternate ones are horizontally extended to the center, where they terminate in forked eyes bolted to an annular connection ring about 34 inches in diameter which is centered on the pivot. These twenty connections are all for which there is room on the pivot ring, and if holes were bored in it for additional ones the cross-section would be unduly weakened; therefore provision is made for the twenty remaining axle rods by centering and supporting them in bearings on a horizontal annular lattice girder of 20 feet inside diameter, which virtually forms an inner live ring and is secured by check nuts on each of the long radial rods which bear on the outsides of the inner and outer flanges. The axles of the intermediate wheels terminate at the inner flanges of the girder and center them on the tracks as shown in Figure 1.

The general design and arrangement of the trusses and details of the members are not of an unusual character and are indicated by Figure 2, which is a half cross-section at the center and corresponds very largely with sections at other panel points. The roadway floor is 6½ inches thick and is composed of crossed double planking on steel longitudinal joists which are each blocked up on planed wrought-iron shims to secure the 3.2-inch crown at the center. The level sidewalks are of 2-inch yellow pine on 3x12-inch joists 30 inches apart. Lateral and transverse struts and sway bracing and all the main truss connections are riveted and only the top and bottom lateral diagonal rods are pin connected. All main truss members are of rectangular cross-section, built of pairs of channels, latticed as shown in Figure 3. The verticals and diagonals have side angle clips to extend their connection surfaces on the gusset plates. The 24-inch steel rolled floor beams are riveted at each end to the bottom chord webs by four vertical 4x6-inch angles arranged in H shape and offset to partly clear the floorbeam top chord flanges. The handrail posts are of cast-iron and the rail consists of single light top and bottom horizontal angles and a thin intermediate flat piece to which simple wrought-iron cold-stamped bars are riveted to form a neat and inexpensive design, as shown in Figure 4.

The bridge is operated by hand and can be swung in one minute by four men working an ordinary rack and pinion mechanism. When the bridge is swung, the operating lever is first set on a key whose revolution releases the four end bearings and then unlocks and withdraws the latch. Then the lever is set on another adjacent key and operates the swinging pinion. In closing the bridge the lever is changed back to the first key and the adjustment locking and lifting of the ends are accomplished by one complete revolution, which must be made before the lever can be removed from the key. The latch at each end is a solid steel bar 6 inches square, operated by a 3-inch rod connected to an eccentric at the center of the span, as shown in Figure 6. It slides in a heavy socket and terminates in a horizontal friction roller which engages either side of a converging abutment socket 24 inches wide at the entrance. The latch is slightly extended to enter the socket before the bridge quite comes to rest. Then the lever is removed to the second key and forcibly extends the latch, which follows the inclined surface so as to force the bridge in either direction to exact alignment, after which it enters full length into the socket and is locked there.

Contact for the end bearings is made for each truss support by a wedge shown in Figure 5, which is commanded by a crank operated by a center shaft. It slides in locked guides supporting it from the lower side of the end floorbeam and engages a nest of chilled cast-steel rollers in the open top of the base casting on the abutment.

The work was designed and supervised by the Department of Bridges of New York City, Mr. S. R. Probasco, M. Am. Soc. C. E., chief engineer, and Mr. J. W. Ballet, assistant engineer. The Degnon-McLean Construction Company is the general contractor for the bridge, and the Elmira Bridge Company is the contractor for the steel work.

SOME DIFFICULTIES IN OBTAINING A WATER SUPPLY.

The readers of "The Engineering Record" need no introduction to the interesting system of water-works built at Birmingham, Ala., under the supervision of Major W. J. Milner. Nevertheless it is believed that a paper he presented at a meeting of the American Water-Works Association last week will be read with interest even by those who are already somewhat acquainted with these works. The paper was illustrated at the convention by a number of charts, of which one is reproduced.

In order to appreciate the difficulties, said Major Milner, encountered in providing an adequate supply of water for this city, it is necessary to understand the geographical situation and physical surroundings. Except small areas in the north end and in the southeast corner of the State, Alabama is drained by two river systems. The divide between the watersheds of these two basins is a ridge extending from about the center of the state to its northeast corner and rising from 400 or 500 feet above the adjacent plain. This is known locally as Red Mountain. Birmingham is situated on the northwestern slope of this mountain and its corporation limits extend nearly to its summit. Geologically, the valley, which is about 3 miles

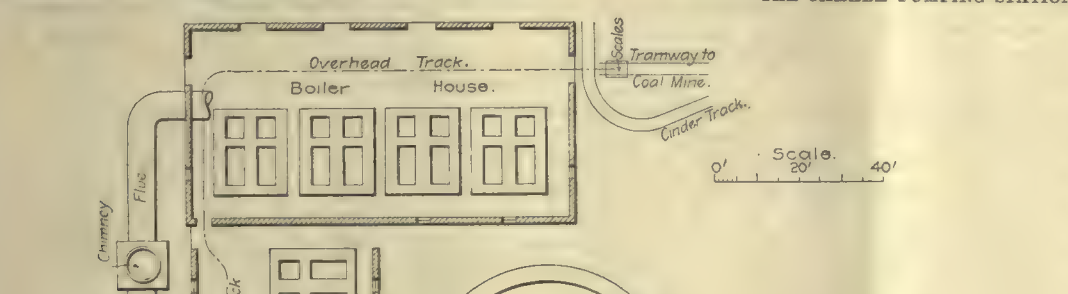
in width, is silurian limestone. Within the valley there are numerous limestone springs, but their available capacity is insufficient and all are liable to contamination. Geological conditions make a ground supply impracticable.

These conditions brought about a struggle to keep pace with the demand for water in the earlier days of the city. The first pumping station, erected more than twenty-five years ago, about 2 miles north of the center of the city, drew its supply from a little stream having its source adjacent to the limits of the village at that time. The population gradually extended over the watershed of this stream and rendered it unfit for use. To reach a different source a canal was extended in 1887 six miles northeastward from the pumping station to Five Mile Creek, a stream having a minimum flow of about 3,000,000 gallons daily. The canal is mainly an open ditch, and is in hard blue limestone for much of its length. Originally it was 4 feet wide on the bottom with slopes of 1 to 1 in earth and nearly vertical in rock, having a grade of 1 in 2,500. At its lower end the water is conducted through a cast-iron pipe under the valley of the stream formerly used, and delivered into a reservoir holding about 10,000,000 gallons, whence it is pumped direct into the distribution system. From 2,000,000 to 3,000,000 gallons daily is drawn from this source for the present supply.

Just as the work was completed and preparations were made to turn the water into the canal, the owner of a small water mill about 20 miles below made up his mind to file an injunction to restrain the diversion of the water. The situation was a desperate one, because one of the driest months of the year had been reached. The old supply, bad as it was, was much too small; street and lawn sprinkling had been stopped and hydraulic elevators and every other service not absolutely necessary had been discontinued. It became a race with the officers of the law to get the water turned into the canal before notice of the injunction was served. Victory rested with the company, but it was only temporary; to make it permanent, the old mill was purchased at the owner's price, several times its value. His success was the signal for similar proceedings by other parties, and it was necessary to take the matter into the courts to attain success.

This work was scarcely completed before it needed no gift of prophecy to see that time should not be lost in obtaining an additional supply. The only other available source was Cahaba River, 8 miles distant from the center of the city; but to reach it involved great engineering difficulties and the expenditure of a large sum of money. Two mountain ranges with many lesser ridges and several small streams intervened. One of the members of the Association, who examined the situation in order to bid on a pumping engine, remarked after his inspection: "I have been at the inauguration of many water-works enterprises, but never before have I seen such an exhibition of nerve." Cahaba River is a stream of wide fluctuations, its daily average flow in winter being from 150,000,000 to 200,000,000 gallons, while its dry weather flow is estimated at less than 15,000,000

THE CAHABA PUMPING STATION, BIRMINGHAM WATER-WORKS.



DETAILS OF CAHABA STATION AND TUNNEL.

gallons daily. The maximum difference between high and low water is probably about 40 feet.

A pump house was designed to meet these conditions. It is circular in plan, with an inside diameter of 54 feet. An excavation was made in earth and rock to about the level of the bed of the stream, and the entire surface covered with four feet of concrete. The wall, which is of brick laid in cement, is double and has a 5-inch core of concrete. It is 50 inches thick at the bottom and reduced by offsets to 40 inches at the door sill of the first opening, which is at the level of the boiler room floor, 32 feet above the bottom. The wall rises 15 feet above this level and is surmounted by a conical roof. Ample light and ventilation are afforded by windows above high water. It is provided with ventilating fans and an electric light plant. A masonry inlet 3½x4 feet in cross-section extends from the river to the pump well just outside the building.

The machinery consists of a horizontal Worthington high-duty pump of 5,000,000 gallons capacity; it has steam cylinders 28¾ and 57½ inches in diameter, 19-inch plungers and a stroke of 48 inches, and has an attached air pump. There is also a 6,000,000-gallon Knowles pump of the direct-acting duplex compound condensing type with outside packed plungers and an independent air pump. The steam cylinders are 30 and 60 inches in diameter, the plungers 24 inches, and the stroke 36 inches. There are twelve return tubular steel boilers, 60 inches in diameter and 16 feet long, each with a separate setting, so that any one may be cut out for repairs or cleaning. The results of a test of this plant are given at length in "The Engineering Record" of January 13, 1894.

Coal is supplied from the company's own mine less than half a mile distant. A little narrow gauge locomotive of about 5 tons weight hauls the coal cars from the mine to the boiler room door. After being weighed they are then caught up on an overhead track and dumped directly in front of the boiler doors. A separate swinging car returns the cinder by means of the same overhead track to a dumping car just outside the door.

From the pumping station a force main as-

cends abruptly, rising 380 feet in the first half mile. Two 20-inch mains, one for each engine, run to this point and connect there with a stand-pipe 55 feet high and 6 feet in diameter. From the stand-pipe the 30-inch cast iron main extends along rugged ground for a distance of 12,500 feet to a reservoir. Blow-offs are provided at the depressions and air cocks at the summits. Much of the excavation was in rock. There are two reservoirs at this place, called Shades Mountain, which is 220 feet above the city and nearly 5 miles distant. These reservoirs are natural basins formed by building three dams across the valley and removing the vegetable matter from the bottom. The dams were constructed of clay having a small natural admixture of sand and gravel. It was moistened and thoroughly rolled with a grooved roller in layers 5 to 6 inches thick, of uniform texture, and without any core wall whatever. The slopes are two to one on both sides and are protected by riprapping of sandstone. The dams are 18 feet wide on top and are 43, 32 and 18 feet in maximum height respectively. The first reservoir, the one nearest the pumping station, covers an area of 17 acres and holds over 110,000,000 gallons. The other covers 5 acres and holds 28,000,000 gallons; it is paved throughout with sandstone riprap. The delivery and outlet pipes of these basins are so arranged that water may be pumped into or drawn from either or both basins, or it may be pumped around them directly to the city. Usually it is delivered near the bottom of the first reservoir and drawn away near the top into the bottom of the second, from which it is drawn near the surface into the outlet main, thus securing the full benefit of circulation and sedimentation.

From the reservoir the pipe line runs at about right angles to the trend of the mountain. On the line there are two tunnels 150 and 2,100 feet long respectively and a large creek. The larger tunnel is through Red Mountain, and much difficulty was experienced during its construction. The northwest portal is in hard limestone, while the other is in stiff, waxy, blue clay. Chert, shale, sandstone and iron ore were encountered between the two. Slides of slushy material from the top were very troublesome and greatly enhanced the cost. The section in rock was 7x12 feet; in earth the excavation was sufficient to place an arch of 12-inch timber outside the masonry.

From the reservoir to the northwest portal of the tunnel, a distance of 16,300 feet, the main is 30 inches in diameter and laid on a hydraulic grade of 1.5 per 1,000, being calculated for a delivery of about 11,000,000 gallons daily. From this point 9,400 feet of 24-inch pipe extends to the center of the city, being connected to the lateral mains at all street crossings. The distribution system consists of about 66 miles of mains of all sizes.

The quality of the water is excellent, though at times it is sometimes roiled. The effect of this improved supply is apparent in the health statistics. Dr. W. P. Mason gives the death rate from typhoid fever prior to 1890 at 26.4 per 10,000. Last year the total deaths from typhoid originating in the city, out of a population of 40,000, were only eight, and in three of these cases hydrant water was not used.

THE SHONE SEWERAGE SYSTEM AT KARACHI.

There has recently been constructed in the city of Karachi, Sindh, India, a Shone sewerage system which presents a number of features of interest. It was described in a paper presented by Mr. James Strachan, C. I. E., to the Institution of Civil Engineers a short time ago and published in its "Proceedings," from which the following facts have been taken. The city is very flat and it seemed at first as if the proper place for the discharge of its sewage was the harbor. Various strong objections were raised against this procedure, however, and it was finally decided to deliver the sewage to a farm owned by the municipality. The advisability of this course was increased by the fact that the rainfall in the vicinity is very limited, and any crops which might be produced on the farm would not be subjected to serious competition from crops irrigated in the ordinary manner. The portion of the city to be drained is but a few feet above high-water mark; it has an area of about 175 acres and the population is estimated at 30,000. These conditions made it impracticable to use an ordinary gravity sewerage system. For the purpose of installing a Shone system the drainage area was divided into five blocks, subsequently increased to six. The sewers in each block gravitate to a main manhole near an ejector station containing two Shone ejectors of 240 gallons capacity each, arranged to discharge their contents automatically once a minute. The main manhole and the ejector station are connected by a cast-iron pipe.

Compressed air for the ejectors, which have been described a number of times in these columns, is furnished by two horizontal compound, non-condensing, single-stage compressors, each of about 25 nominal horse power. Each is stated to be capable of furnishing sufficient air to deliver 450 gallons of sewage per minute from the ejector stations against a dynamic head of 131 feet. The boilers furnish steam at 121 pounds pressure, and, as the engines are not working to their full power at the present, the grate area of each boiler has been reduced from 13.6 to 9 square feet by brickwork. Wrought iron retarders have, for the same reason, been fitted to the tubes, with very good results, the temperature of the gases passing through the smoke box to the chimney having been reduced thereby from 420 to 200 degrees Fahrenheit.

The air mains running to the different ejector stations are of ordinary cast-iron pipe 3 to 5 inches in diameter and laid with lead joints. From the ejector stations to the outfall, the sewage discharge mains consist of cast-iron pipes 7 to 12 inches in diameter with turned and bored joints. The gravity sewers in which the sewage flows to the ejectors consist of ordinary cast-iron or clay pipes, according to the character of the excavation. These pipes vary from 5 to 9 inches in diameter and are laid in grades varying from 1 in 80 for 5-inch sewers to 1 in 200 for 9-inch sewers.

On account of the slight elevation of the natural surface of the ground the construction of the ejector stations entailed excavating at each a well 16 feet square, within which a lining was placed to form the outer walls of the station. This lining is formed of cast-iron flanged plates ⅞ inch thick with 1¼-inch flanges. Access from the road to the ejectors is obtained by means of a manhole and a cast-iron circular shaft fitted with a ladder. The joints of the lining were all carefully planed and fitted together before being finally erected, and, to insure perfectly water-tight fitting, lengths of flattened lead pipe were placed in them; the plates were then screwed together and the joints were finally calked. The manhole near each ejector station was built of cut stones in two concentric rings with one inch of neat Portland cement between them. The joints were made to break bond both vertically and horizontally. The remaining manholes were constructed of rubble masonry or Portland cement concrete.

Each main gravity sewer is provided at its upper end with an automatic flush tank of a capacity varying with the length of the sewer and supplied with water by a pipe from the nearest water pipe. Disk flush-tanks are provided at the ends of the shorter lines of sewers. These are filled with water from carts kept for the purpose, and it is found sufficient to flush them every third day. The automatic flush-tanks are arranged to discharge their contents once in 48 hours. The gravity sewers are ventilated according to the Shone-Ault system, which calls for an inlet air shaft of cast-iron, 7 to 12 feet high, at the upper end of each sewer and connected by a pipe with the manhole at the end of the sewer line. An outlet ventilating shaft of cast-iron of a sufficient height to carry the discharged air above the neighboring houses is erected on a suitable site near the ejector. Between the ejector chamber and another chamber built at the foot of the outlet ventilating shaft is laid an exhaust pipe fitted to a nozzle in the latter chamber. When the compressed air has forced out the sewage, the exhaust pipe is automatically opened and the air passes rapidly along it, causing an intense current down the inlet shafts to the heads of the sewers. The main manhole into which all the gravity sewers discharge is connected with the nozzle chamber by a pipe, and thus all the foul air escapes by the outlet shaft. Mr. Strachan says that this system of ventilation has proved very efficient, no difficulty having ever been experienced by any of the men who attend to the manholes in entering them at any time, nor has any trace of foul air ever been noticed.

As before mentioned, a sixth ejector station was added soon after the works were put in operation. This was installed to take care of a large valume of waste water from the bathing ghats of the Hindoos, and is operated by compressed air from the air main leading to the same ejector station whose discharge pipe forms the outlet for the discharge of the new station. In connection with this ejector, a large night-soil depot has been established where the contents of carts loaded with this material can be flushed into the sewers. The water used for flushing is raised from a well on the premises by means of a small pump run by compressed air from the mains. The general details of each of the six stations are shown in the following table:

Station.	Tributary Sewers, ft.	Automatic Tanks.	Disk Tanks.	Population.	Discharge Gals. per minute.	Discharge main Diameter, in.	Discharge main Length, ft.	Lift of ejectors, ft.
1	12,963	10	34	5,010	35	7	831	55⅛
2	11,619	10	30	5,390	55	7 8	198 1,620	55
3	14,268	11	41	7,330	86	7 9	93 1,854	54⅖
4	14,475	12	29	7,560	115	7 10	489 1,449	52
5	7,074	6	28	5,390	82	7 12	1,977 10,389	53¼
6	4,977	2	6	1,500	39	6	975	59¼

There were not very many house connections at first, owing to the habits of the people and their objection to the outlay involved in making them, but it is anticipated that connections will soon become general in the area sewered. As a rule 4-inch earthenware pipes are carried to a syphon trap placed on the main drain close to the outer wall of the building. Between the trap and the wall of the house a 4-inch ventilating pipe is carried up a few feet above the roof of the house. Night soil depots have been provided along the lines of all the gravity sewers for the convenience of the scavengers.

The sewage is discharged at the farm at a level nearly 60 feet above the elevation of the discharge pipe of the lowest ejector, into a tank of 18,000 gallons capacity. This was originally provided with an automatic syphon which discharged the contents of the tank on the farm at intervals very rapidly. It was found, however, that the men in charge could not distribute the sewage properly in such bulk, and arrangements have been made whereby it is delivered on the farm at the velocity it has while flowing from the main.

The farm contains about 800 acres, but at present only 60 acres have been laid out. It is intersected by masonry carriers for a certain portion of its area and by earth carriers elsewhere. From April to October strong breezes blow from the sea which have a most damaging effect on plants. Efforts have therefore been made to shelter the crop by dividing the farm into 4-acre blocks with a cart road around each, along the sides of which trees have been thickly

planted. The soil of the farm varies from light sandy loam to hard, black, caking earth several feet thick; the subsoil is all gravel. Water is not found within 18 feet of the surface. Various plans for irrigating the fields were tried before a suitable one was discovered. The most satisfactory method, that now in use, not only disposes of the sewage quickly but is accompanied by no offensive odor. Each field measures one acre and is divided into 20-foot beds running the full length of the field, 198 feet. The sewage, which is brought to the upper end of the ground in earth channels, is run on a bed until it has reached about three-fourths of its length; it is then turned on another bed, and the same process is repeated until the whole field has been irrigated. The fields have a fall of 4½ inches in 100 feet; and the sewage which is cut off from the bed in the manner mentioned is sufficient to irrigate the whole bed before it ceases flowing. There is no effluent from any field. The whole of the liquid part of the sewage is either evaporated by the sun or is absorbed by the soil within a few hours after it is run on a field. Irrigating once in 8 or 9 days is sufficient for all the crops yet tried on the farm.

The crops already tried are guinea grass, lucerne, chubber, Italian rye grass and sugar cane among what may be roughly classed as perennials, and juar, bajri, makai or Indian corn, wheat spelt, barley and millet. The last did not do very well, as the stalks were too weak. Both Indian and European vegetables throve well. Sugar cane was not a marked success. The best results were obtained with guinea grass, lucerne, Indian corn, and wheat spelt.

Tests were made of the efficiency of the entire sewerage system with the following results: Cardiff steam coal of fair quality was used, which had been standing in an open-air stack for 10 months. It was carefully weighed and at the close of the trial the amount of clinker and incombustible ash was deducted from the total quantity used. The trial showed a consumption of 3.8 pounds of coal per indicated horse power per hour, the steam pressure being 110 pounds. Diagrams were taken from both the steam and the air cylinders. These showed that the air cylinders developed 29.23 indicated horse-power and the steam cylinders 35.69 horse-power, so that the engine efficiency was 0.819. On stopping the engines at noon all outlets from the air mains at the ejectors were closed, and it was found that the pressure of air indicated on the gauge in the engine room at that time was 30 pounds. At the end of the two hours shut-down, the gauge showed a pressure of 25 pounds. On starting the engines again it was found that 150 revolutions were required to raise the air pressure in the mains to the normal working pressure of 30 pounds. As during the engine trial it was ascertained that the engine made 80 revolutions per minute, and as the loss by leakage for two hours was equivalent to 150 revolutions of the engines, the total percentage of constant leakage at all times would be 75 divided by 4,800, or 0.0156 of the whole. This would give the efficiency of the air mains as 0.9844. The total quantity of sewage lifted during the trial was 637 gallons per minute and the dynamic head was 69.2 feet. Assuming that the sewage weighed 10 pounds per gallon, the ejectors therefore developed 11.135 horse-power. The efficiency of the ejector was found by dividing this horse-power by that developed in the steam cylinders, which gave 0.312. From these results the combined efficiency of the system was found to be as follows: Efficiency of engines, 0.819; efficiency of air mains, 0.984; efficiency of the compressed air as a working fluid, 0.458; theoretical efficiency of the machinery, the product of these three factors, 0.369. When there is sufficient power to work the engines at their full capacity it is expected that the system will be more efficient.

THE PRESENT STATUS OF WATER FILTRATION.

While the problem of water purification is not a new one by any means, nevertheless it is only within a comparatively few years that really scientific methods of studying it have been employed. At the present time about 25,000,000 gallons of water are being purified daily for the supply of American and foreign municipalities, and the experience gained at the plants where this work is done, together with the results of careful investigation, show that the subject is a much more difficult one than was generally believed until recently. American conditions have introduced complications in water purification which are not experienced in foreign filter plants, for in most such works the water contains considerable sewage contamination and relatively little silt and clay. In certain sections of the United States where filtration is urgently needed the conditions are reversed. Mr. George W. Fuller, Assoc. M. Am. Soc. C. E., reviewed the subject very clearly at the meeting of the American Water-Works Association last week, and his paper, which is reprinted practically in full herewith, points out these new conditions and their influence in a manner which will interest all water-works superintendents.

To define in a practical way those waters which are actually purified abroad, it may be stated in general terms that they represent a type of water, which can be filtered satisfactorily through sand layers from 3 to 5 feet thick at a rate of about 1½ to 3 million gallons per acre daily, either with or without preparatory treatment of the water by plain subsidence for one to five days. There is very little reason to doubt but that, for those waters for which it is applicable, it is the cheapest and most efficient method of purification except in a few isolated cases. Theoretically it is possible to purify any water by this system if sufficient advantage is taken of preliminary subsidence, thick sand layers, slow rates of filtration or a combination of these three helpful steps. Practically, however, the situation is not so simple in many cases because this procedure would be excessively expensive.

Turning from the relatively clear waters which are filtered abroad to very muddy and turbid rivers, of which the lower Ohio River is typical, it is found that European experience is not a safe and adequate guide for the construction and operation of purification works. This is because of the large quantities of clay particles, not more than 0.00001 inch in diameter, which are present in the water for weeks at a time during the period of heavy freshets. Experience has shown clearly that for such water the English system of purification is unsuited, when the period of subsidence, thickness of sand layers and the rate of filtration are carried to practical limits, on account of a number of reasons of which the chief are as follows: 1. During prolonged freshets the effluents become very turbid and have a brownish appearance. 2. Toward the end of periods of very turbid effluents the filters show a diminution in bacterial efficiency. 3. The penetration of fine clay particles into the sand layers leads to complications in cleaning the filters, and makes the cost of operation abnormally large as compared with that abroad. While it is true that with such waters as those of the lower Ohio River the English system of slow sand filtration will give perfectly satisfactory results except during heavy freshets, yet the process cannot properly be regarded as a success, and, in Mr. Fuller's opinion, it is unjustifiable in the light of present evidence to spend large sums of public money for works which cannot fill the requirements for which they are to be built at times when they are most needed.

In the course of some recent investigations conducted by the Water-Works Commissioners of Cincinnati, a modification of the English system was introduced, as described in these columns some weeks ago, with a view of assisting the process at times of heavy freshets. This modification consisted in the use of a coagulating chemical to assist subsidence when the river water was very turbid, so as to afford the water an adequate preparatory treatment, prior to filtration through English filters. By using such a coagulant and allowing the coagulated particles of clay to subside before the water was delivered to the filters, a very satisfactory effluent was obtained. But the process was somewhat difficult of management on account of the possible passage of coagulated masses of clay to the layer of sand in sufficient amounts to clog the surface quickly, and it was somewhat more expensive than other methods under consideration at the same time.

That the use of chemicals in connection with water purification is undesirable, there can be no doubt. There is, however, a misunderstanding in many quarters of their action. Coagulating chemicals as applied to the class of water in question are able to collect the very small bacteria and the still smaller clay particles into aggregates of such size that they can be handled to much greater advantage than in the original form. The effect of coagulation in water is similar to the familiar action of the white of an egg on turbid coffee. There are a number of cheap commercial chemicals which may be used for the purpose; just which is the best depends somewhat upon natural local conditions and market prices, and is not a matter which can be finally settled for all cases at the present time.

During the Cincinnati experiments already referred to, sulphate of alumina was used as the most suitable for the purpose, as judged from evidence then available, although it was not considered to be necessarily the cheapest. The clay-bearing water of the Ohio River contains considerable carbonate of lime, and it is mainly on this account that sulphate of alumina can be used safely and satisfactorily. This chemical does not produce the required coagulation directly. The practical benefit coming from its use depends on its decomposition by the carbonate of lime present in the water. As a result of the decomposition, there is formed aluminum hydrate, a white gelatinous solid which effects the coagulation of the bacteria and clay. For each grain of applied sulphate of alumina there is approximately half a grain of carbonate of lime converted into sulphate of lime, with the liberation of about 0.2 grain of carbonic acid. The aluminum hydrate in the form of flakes is removed by subsidence or filtration, while the lime in its modified form and the carbonic acid pass into the filtered water. When the sulphate of alumina is applied in large quantities the conversion of the lime into the form of sulphate and the liberation of carbonic acid become matters for serious consideration. This is because the sulphate of lime forms a more objectionable scale in steam boilers than does the carbonate of lime and the carbonic acid facilitates the corrosion of uncoated iron in pipes. When the sulphate of alumina is applied at the rate of 1 to 3 grains per gallon of water, as usual, the effect of the application is very slight indeed on the character of the water, and, at times, when the quantity applied would be greatest, the filtered water would not as a rule be less desirable for boiler use than the river water during low stages.

Concerning the effect upon the human system of the compound resulting from the decomposition of the stated quantities of the sulphate of alumina, the evidence shows that it is practically nil. With undecomposed chemical; that is, quantities in excess of those which can be broken up by the lime in the water, the situation is different, but, as already stated, the presence of undecomposed chemicals in the filtered water is absolutely inadmissable. One of the advantages of the use of a coagulating chemical is that it prepares the water so it can be filtered through a sand layer at a very rapid

rate. For this purpose so-called mechanical filters are used, and for such water as that of the Ohio River they form the last step in the process which has been called the American system of purification. For a number of months this system was investigated at Cincinnati. The process consisted in allowing the river water to subside for two or three days; applying sufficient chemical to coagulate the subsided water; allowing the chemically treated water to coagulate and subside for a supplementary period of 0.5 to 6 hours, according to its character; and then filtering the partially clarified and thoroughly coagulated water through a layer of sand at a rate of about 120,000,000 gallons per acre daily. Satisfactory results were obtained by this method, and the difficulty in management and the cost were found to be somewhat less than by the modified English system. The effluent was clear, contained little organic matter and few bacteria, was absolutely free from undecomposed sulphate of alumina, and was a satisfactory water for use in steam boilers.

Very recently there was investigated at Cincinnati a new process of purifying clay-bearing water after the general method of the American system. The plant was constructed and operated by the Ohio Sanitary Engineering Company at its own expense and was tested officially by the city of Cincinnati for 42 days. The process comprised three essential steps in its original form: 1. The treatment of the original river water with lime water. 2. The precipitation of the coarser particles in the water after the lime treatment. 3. The rapid filtration of the partially clarified and thoroughly coagulated effluent from the precipitation tank.

With regard to the action of the applied lime water on this particular river water, Mr. Fuller states that it produced coagulation and the bacteria and particles of clay were collected into relatively large masses, thus facilitating rapid precipitation and filtration. In this case it was found necessary to apply sufficient lime water to combine with the free and half-bound carbonic acid of the river water, and also to afford a sufficient excess of lime water to produce the coagulation. Whether or not it would be necessary to use such an excess of lime water in the treatment of all waters by this process was not brought out during these tests. The precipitation tank was operated on the continuous displacement plan, and the period of subsidence was 12 hours, which was found adequate when the river water was in its worst condition. With a suitable quantity of applied lime water, the effluent from the precipitation tank was well clarified in consequence of the thorough coagulation. By virtue of this coagulation the small percentage of bacteria and suspended matter which passed through the precipitation tank was well prepared for satisfactory removal by rapid filtration through a sand filter equipped with mechanical appliances for cleaning it. These devices, aided largely by the clearness of the applied water, made it necessary to use but a very low percentage of the effluent for washing the sand. Under efficient management, which is of course necessary for all systems of water purification, the effluent from the sand filter was perfectly clear in appearance and very low in its contents of organic matter and bacteria. The excess lime water passed through the system and appeared in the effluent from the filter in a practically undiminished quantity. The presence of any such quantity of lime water is inadmissable in a public supply for several reasons, and it is necessary to remove it in order to obtain a water of satisfactory character. It is said that on a large scale this would be accomplished by the application of carbonic acid obtained from the gases from lime kilns operated at the works, and the subsequent removal of the carbonate of lime formed thereby. During this test, however, the action of the gas was demonstrated by the use of carbonic acid obtained and applied in a liquid form.

A NEW COAGULANT FOR MECHANICAL FILTERS.

After a series of experiments continued night and day for five or six months a new coagulant has recently been introduced at the water-works of Quincy, Illinois, the use of which is said to be very satisfactory. The water used at Quincy is taken from the Mississippi River and at times is necessarily very muddy. About seven years ago the Jewell system of mechanical filtration was adopted and has been in use since that time. In July, 1898, the officials of the water company, in connection with Mr. O. H. Jewell, of the O. H. Jewell Filter Company, began a series of experiments, using iron as a coagulant instead of sulphate of alumina. The first question that arose was as to the best method of dissolving the iron and getting it into solution. At first this was done by using the gases from the chimney. The smoke was drawn from the chimney by means of a blower and was forced through a tank containing scrap iron and water. At times this was very satisfactory and at others it was not, depending on the amount of sulphur in the coal that was being burned.

After experimenting with this for a while it was decided to burn powdered sulphur. For this purpose there is an iron kettle about 14 inches wide, 2 feet deep and 6 feet long, provided with a loose cover. Near the top at one end is a 2-inch pipe running to a steam injector to which is connected a ¼-inch steam pipe. This acts as a blower and draws the sulphur fumes away from the kettle. All of the pipes and connections are made of cast iron, as the fumes attack wrought iron and destroy it, a nipple of the latter metal being entirely destroyed in a day in one case. A stream of filtered water is also passed into one end of this injector. From the latter the gases are conducted to a circular condensing tank, 2 feet in diameter and 8 feet high, containing scrap iron, into which cold water is turned at the top. After passing through this tank the gases are usually all absorbed and issue from it in the form of a sulphur solution. This is conducted through a wooden pipe to two circular wooden tanks, each 7 feet in diameter and 10 feet deep, containing scrap iron. The solution enters at the bottom of the first tank, passing up through it and down through the second one. It is in these tanks that the iron is taken into solution, and the greater part of this action takes place in the first one. The solution is then run to another wooden tank, 3 feet in diameter and 3 feet high, containing perforated steam pipes. As the solution issues from this tank it looks like ordinary filtered water except that it has a slight bluish color. Half a glass of lime water added to half a glass of this water throws down a green precipitate of ferrous hydrate about an inch deep on the bottom of the glass. The object of steaming the solution is said to be to start oxidation, changing the ferrous hydrate to an imperfect ferric hydrate. This oxidation changes the solution to a slight reddish color.

The solution is conducted to the suction pipe of the raw water pump, where it is added to the raw water with air and lime water, each being admitted through small independent pipes. Air is admitted in as large quantities as possible without causing the pumps to pound. The lime water is made in a circular wooden tank 5 feet in diameter and 10 feet deep. Filtered water is admitted through perforated pipes in the bottom of the tank and forced up through lime, issuing from the top of the tank as a comparatively clear solution. From the raw water pump the water passes to the settling basins, where it remains an hour and fifteen minutes and where the precipitate is thrown down, carrying with it the suspended matters in the water. The pump has a capacity of about 4,500,000 gallons in 24 hours and the suction pipe is 20 inches in diameter. The settling basin has a capacity of about 300,000 gallons and was described in "The Engineering Record" of June 4, 1898. About 4,000,000 gallons of water are treated each day.

The raw water from the Mississippi River shows no trace of iron whatever when tested with cyanide of potash. Under the same test a glass of water from the raw water pump, after the iron solution has been added, turns very blue, that from the settling basin turns about one-half as blue as that from the pump, and after passing through the filters, which have 4 feet of sand, the water, under this test, shows only a very slight trace of a bluish color. Samples of water are taken from the pump every fifteen minutes and the necessary amount of chemical needed is determined. The amount of the iron solution used is controlled by increasing or diminishing the supply of steam to the injector which draws the sulphur fumes from the kettle. The kettle can burn between 200 and 300 pounds of sulphur in twenty-four hours.

Among the advantages claimed for the use of iron instead of sulphate of alumina are independence of the amount of lime in the raw water and decreased cost. In using sulphate of alumina as a coagulant there must be a sufficient amount of lime in the raw water to combine chemically with the sulphate of alumina. When floods occur in the river the turbidity is very much increased and requires a larger amount of coagulant, while the relative amount of lime in the water may be much decreased. In using iron the chemical reaction depends on the oxygen in the water and not the lime. The cost of the sulphur and lime is about one dollar per million gallons of water treated when the raw water is clear and about $1.65 per million gallons when the raw water is much worse than usual. This is the first plant in which the iron process has been used and it has now entirely displaced the sulphate of alumina. Patents have been issued on this process.

The efficiency of filtration at Quincy is shown by the fact that with a population of about 40,000 there were but seven deaths from typhoid fever during 1898. Of these there was but one on premises supplied with water by the company and in this case there were other complications. Mr. Dow R. Gwinn is superintendent of the water-works company and "The Engineering Record" is indebted to him for this information.

VALUATION CLAUSES IN MUNICIPAL FRANCHISES.

Among the papers prepared for the American Water-Works Association's convention last week was one by Mr. John W. Hill, M. Am. Soc. C. E., on the method of construing certain clauses in municipal franchises. While it is probable that his views will not meet universal approval, yet because this subject is one on which engineers are often called to pass judgment, it is desirable to give the greatest publicity to the opinions of all who have had actual experience as valuers and appraisers, to the end that the practice may become more uniform even in the absence of decisions of the courts fixing the methods of procedure. Much of the trouble in the valuation of semi-public properties would be obviated if the franchises under which they are operated contained a clause similar to that in the Indianapolis street railway franchise, reviewed in these pages on May 13, which reads: "The City of Indianapolis may at any time within two years and not later than one year before the expiration of this contract, and the period for which this franchise is granted, purchase of the said company, its successors and assigns, its property of every description, but the value of the franchise hereby granted shall not be included or considered in estimating the value of said property, it being the intention of the parties hereto that the value of said property to be agreed upon shall be the actual value thereof, independent of all franchise rights hereunder—the said city to pay nothing for franchise rights." Such clauses are

not to be found in the contracts which come before appraisal boards, at the present time, however, and the forms considered in Mr. Hill's paper will continue to try the patience and judicial spirit of arbitrators for many years.

In a franchise granted to a certain water-works company there occurs, according to Mr. Hill, the following statement with reference to purchase of the works by the municipal corporation:

"The city shall have the right to purchase from the company all the buildings, machinery, and pipe of said water-works and all its corporate rights and privileges, (but not including any franchise herein granted or that may hereafter be granted to the company, nor including any estimated value of this charter), at such price as may be agreed upon by the common council and the board of directors of the company."

The language of this clause seems distinct, and the prevailing opinion of lawyers and commercial bodies of the city in question, was that the business established by the company or its future prospects should not be considered in valuing the property. The company took a different view, and put a value on its property which was far in excess of the value of the tangible property, and one which could be attained only upon the supposition that the city was required by the contract to pay for an established business, or value the property upon its capacity to produce a net revenue, which, when capitalized at the present value of money, represented a present worth 75 per cent. greater than the value of the tangible property.

A franchise for water-works in another city contains the following provision with reference to purchase of the works by the municipal corporation:

"At the expiration of ten years from the completion of said works, the city shall have the right to purchase said works from said grantees, at such price and upon such terms as may be mutually agreed upon; but in case no mutual agreement can be made, the said city may give notice, not less than six months in advance, of its intention to purchase said works by arbitration, and thereupon said city shall select one non-resident, disinterested person, said grantees shall select one non-resident, disinterested person, and the two thus selected shall select a third non-resident, disinterested person, and they shall constitute a commission, who shall examine and take testimony of experts, and otherwise determine the value of said water-works and property, not valuing the unexpired term of franchise."

In this instance, the municipal corporation by its law officer held that a limited consideration should be given to the net earning power of the works; not that the city was bound under the ordinance to recognize it, but as a means of reaching an agreement with the company to sell the property. On the other hand, the company ignored or otherwise construed the limiting clause "not valuing the unexpired term of franchise," and insisted that the city should pay a price which was unattainable by any mode of calculation known to Mr. Hill.

The ordinance under which gas is furnished to one of the largest cities of the United States, contains the following clause touching the purchase of the works by the municipal corporation:

"That at any time after the expiration of the said twenty-five years the said city council shall have the right and privilege of purchasing from said C., his associates, their heirs, assigns, or successors, their pipes, buildings, fixtures, and other apparatus owned and used by them in and about providing the city and citizens with gas, at a fair price and compensation. And the said price and compensation shall be ascertained and determined by five disinterested persons, two of whom shall be selected by the city council, and two by the said C., his associates, their heirs, assigns, or successors, and the fifth by the four thus selected or chosen."

The value of the real property in this example cannot exceed $6,000,000, while the business is stocked at $8,500,000, upon which a 10 per cent. annual dividend is paid in quarterly installments, and the stock within 30 days has sold at $2.10 upon each dollar of its par value. No controversy has arisen upon the method of arriving at the value of this property, but undoubtedly it will arise when the city undertakes to purchase it.

Referring particularly to the first two of the three clauses affecting the purchase of a public utility by the municipal corporation, the question that arises is how far, if at all, the established business, or the business which investigation may show can be established in pursuit of such public utility, should enter into the estimate of the value of the property to be transferred by purchase, from a private to a municipal corporation.

The definition of the term "franchise" implies the power to construct and operate certain works for the comfort or convenience of society, either directly by society itself, through its legally deputized officers, or by giving to private individuals the authority to do the same, under such limitations and restrictions as may be imposed by the social corporation and accepted by the private company. A water-works company without a franchise to supply water to an organized community, would have no use for pumping engines and reservoirs which it might happen to own; and after all it is in the judicious and prudent exercise of the State authority conveyed by a franchise, that the company operating under it is enabled to render of real value the various details of its works which constitute the tangible property. Separated from the franchise, the appurtenances to a water-works or other utility have only such value as an intelligent and experienced estimator would attach to them; and this value would be the same whether the private corporation to which they belonged was either making or losing money in the performance of its franchise duty. In ordinances of municipal corporations conferring franchise privileges upon quasi public corporations, in which the stipulation is distinctly made that when the property is valued for purchase by the city, no value shall be given to the franchise or to the charter; or where the term is employed in arriving at the value of the property of a company, that such value shall be arrived at without valuing the unexpired term of franchise, the question arises whether such terms of the ordinance do not clearly and unequivocally mean that, when the property or public utility is valued for purchase by the municipality, no consideration whatever shall be given to the established or assumed earning power of the real and other property necessary to operate and maintain the service contemplated by the franchise.

Having served on several important commissions for the appraisement of value of water-works and other properties of like character, and being familiar with the terms of the contracts under which many of them are now worked, it has seemed to Mr. Hill that in the inception of some of these enterprises, the intent of such language as is quoted in this paper is to inhibit the use of the revenue-producing power of the property as a factor in determining its present worth. In making this statement, he assumes that it will be accepted as applying only to those contracts which are so written, or seem to be so written, as to eliminate from consideration in valuing the property, the franchise or charter; and should not be accepted as applying to contracts so written as to leave in doubt the matter of imparting a value to the established business; or where it is distinctly provided that such business shall enter into consideration in arriving at the present worth of the public utility.

Referring to the first quotation from the ordinance granting a public franchise, the term is used "but not including any franchise herein granted, or that may hereafter be granted to the company, nor including any estimated value of this charter." The terms "franchise" and "charter" in this instance should be construed as meaning the good will of the business, or its net revenue-producing capacity, and the franchise as such is worth at any time only what the operations of the business has shown it to be worth. In short, the franchise can have no value beyond that obtained from proper consideration of its capacity to produce net revenue, and the net revenue directly measures the present worth of the property, from which should be deducted the value of the tangible property to arrive at the value of the franchise per se. In fixing the value of such works when the language of the ordinance granting the franchise clearly states that no value shall be given to the franchise granted, and the value shall be arrived at without valuing the unexpired term of franchise, no value should be given to what in business operations is termed good will or value of established business and prospect of gain in volume of business.

Referring to the third quotation from a municipal ordinance granting the right to construct and operate gas works, the language is less clear because in this it will be noticed, after citing the "pipes, buildings, fixtures, and other apparatus" owned and used by it, that there is no provision for valuing the business established by the company, or providing for a valuation of the franchise "at a fair price and compensation, and the said price and compensation shall be ascertained and determined," etc.

There is room for doubt as to how such a clause with reference to purchase of the works should be construed. Eminent lawyers upon the one hand have assumed that in the absence of a provision in the ordinance to value the business of the company, that the clause, "a fair price and compensation," shall be based entirely upon the real and other property of the company, not including the franchise obtained from the city council, and upon the other hand, that in the absence of a provision to the contrary, this clause shall be construed as allowing the appraisement commission to include the value of the established business in fixing the price to be paid. It is possible that these matters are purely within the domain of the law, and do not involve engineering questions, but before they have been ruled upon sufficiently by the courts, and hard and fast dictums have been established, engineers will frequently be called upon to construe contracts or ordinances containing provisions resembling more or less the three quotations upon which this paper is based, and will be required to discuss their merits from at least a semi-judicial standpoint.

It is obvious that a city council and a company operating a public utility cannot agree upon a mode of valuation which traverses the original grant or varies its terms; and to avoid conflict between the respective parties to the valuation and purchase of such public utility, it is eminently desirable that a rule be established by which a commission chosen to appraise a public utility shall be governed in fixing its present worth. Mr. Hill is of the opinion that in contracts for performing a continued public service, or operating a public utility, in which language is found like that in either the first or second references quoted, that the contracts contemplate only the valuation of the tangible property, and do not contemplate attaching a value to the "good will" of the established business, as at the date of appraisement and sale.

Referring to the first two contract purchase clauses quoted, whatever value has attached to the expired term of franchise has been enjoyed

by the company, and whatever value attaches to the unexpired term of franchise, after appraisement and sale, is to be enjoyed by the municipal corporation. If this were not so, then the authority or privilege which was conveyed as a gratuity by the municipal corporation to the company could be recovered only by paying for it, in which event the municipal corporation would be put in the attitude of a bidder for its own prerogatives, and would be compelled to pay as much as an alien bidder or financial speculator might be willing to offer.

The adjustment of value of a public utility may not be favorable to one of the parties to the purchase and sale, but that is a fault of the contract under which the use of public privileges was originally conferred, and would have to be accepted because it was a contract condition. When the terms of a contract can be waived and the appraisement of valuation based upon equity, then undoubtedly the municipal corporation should recognize the expenditure of time, money and effort required to overcome the difficulties and financial dangers surrounding the starting and successful establishment of so-called public utilities, and the value of such should not be measured by the simple estimate of real and other tangible property, but be based upon the proved capacity of such works to earn a net revenue. Provided, however, that upon this mode of estimate the value of the property shall not be less than the cost of reproducing it, or of building a works equal in capacity and efficiency, for it would be hard to assume that any company should be required to part with its property at a price less than the cost of duplicating that property. But it will so fall out that by any general method of valuation, in some examples, the property will be valued at less than its real worth, while in others the value will be more than the municipal corporation should be required to pay. Mr. Hill mentioned two of the larger cities of the country, the water-works of which are owned and operated by private companies. In one of these, if the valuation is based upon the net earnings of the company, its present worth will be much less than the cost of construction of equivalent works; while in the other case, if the property is valued at the cost of reproduction, the value will be much under the price which it would bring as a revenue-producing enterprise.

THE CONVENTION OF THE AMERICAN WATER-WORKS ASSOCIATION.

The nineteenth annual convention of the American Water-Works Association was held at Columbus, Ohio, on May 16 to 19 inclusive, the headquarters being at the Great Southern Hotel. The first session, Tuesday morning, was opened by addresses of welcome by Mr. Jerry O'Shaughnessy, chairman of the local committee, and by Mayor Swartz. In the absence of President Joseph A. Bond, Mr. W. R. Hill, first vice-president, replied to these addresses.

The first paper of the morning was by Mr. William R. Hill; it was entitled "How the Water Supply of the City of Syracuse is Kept Free from an Unpleasant Taste," and was reviewed last week. The discussion brought out the fact that the trouble with vegetable organisms has been entirely in the new reservoir having a cement bottom and not in the old reservoirs with clay or earth bottoms.

The second paper was by Major W. J. Milner, of Birmingham, Ala., and described some of the difficulties encountered in obtaining a water supply for that city. His paper is published practically in full in another column of this issue. In addition to the paper Major Milner stated that during 1898 there had been some agitation in Birmingham for reduced water rates and the company tried to get a statement as to the number of gallons of water to be supplied dwellings for the given rate. A committee of the Board of Aldermen met a committee of the water company, but could reach no understanding. As a result, the city annulled the contract with the company, repealed ordinances favorable to it and passed ordinances fixing the rates which were to be charged. These rates were to go into effect July 1, 1898, but the water company secured an injunction restraining the city from enforcing the ordinances and a decision of the Chancery Court of Alabama was rendered in January, 1899, in favor of the company. In reply to questions Major Milner stated that Birmingham now has about 4,400 services, about 600 of which are metered. The rate varies from a maximum of 30 cents per 1,000 gallons to as low as 8 cents, and there are special contracts at even lower rates. The company owns, sets and repairs all meters, making a monthly rental charge of 25 cents in addition to the charge for water.

At the afternoon session Mr. Julian Griggs, chief engineer of the department of public improvements of Columbus, read a paper giving a brief account of the Columbus water-works. In the discussion which followed it was said that the Court of Common Pleas has decided the City of Columbus cannot charge different water rates for different quantities of water consumed and can make no minimum charge, the consumer paying for the actual quantity of water used and no more. Mr. O'Shaughnessy stated that this uniform rate was brought about as follows: The Pennsylvania Railroad Company is a consumer of water to the extent of about $1,000 per month at a rate of 6 cents per 1,000 gallons. Some of the consumers in the city thought they should pay no greater rate and took the question into the courts. It was there decided that only one rate could be charged and the city made a flat rate of 6 cents rather than charge the large consumers more. This results in six months' water bills for some consumers amounting to but a few cents. The city never appealed the case. Other cities in Ohio are still charging minimum rates. The city of Newport, Ky., is revising its rate and counsel has advised that minimum or sliding rates cannot be charged. The courts of North Carolina ruled in a similar way in a case at Goldsboro. Mr. H. C. Hodgkins, of Syracuse, N. Y., without naming the state or city, mentioned a case where the courts, after much litigation, decided that a private company could not charge a minimum rate or make any charge for a meter, but could charge by a sliding scale such as 30 cents per 1,000 gallons for a certain quantity and 10 cents per 1,000 gallons for a larger quantity.

This discussion was followed by a paper by Mr. John B. Heim, of Madison, Wis., on "Thawing Frozen Water Pipes by Electricity," which was printed in these columns last week.

At the evening session Mr. Allen Hazen, of New York, gave an interesting talk on the construction of filter plants. This was illustrated by a large number of lantern slides, showing filter beds in Europe and those at Albany, N. Y., and Harrisburg, Pa., which were constructed from designs of Mr. Hazen.

At the Wednesday morning session officers were elected as printed in the personal column of "The Engineering Record" last week. Professor William T. Magruder, of the Ohio State University, then read an interesting paper on "Flow of Water Through Valves," in which he mentioned the various sources of loss of head in both globe and gate valves. The data he offered were obtained by many experiments and will prove of permanent value.

At the afternoon session Mr. George W. Fuller read an interesting paper entitled "An Outline of the Present Status of Water Purification," printed elsewhere in this issue. This was followed by an excursion to the Columbus foundry of the United States Cast Iron Pipe Company and to the west side pumping station of the Columbus water-works.

Thursday was spent at Minerva Park, a picnic resort about nine miles out from Columbus, and reached by one of the trolley lines. Two papers were read in the morning. The first was by Dr. C. O. Probst, secretary of the State Board of Health of Ohio, on "The Duty of the State in Protecting Sources of Public Water Supply." He stated that the function of the state should be to teach communities how to live, to point out their mistakes and how to correct them, but not to do for them what they can do for themselves. A city's water supply is very often taken from a stream into which sewage is discharged at some point above the intake. Even if the water supply is filtered there are sometimes causes which may interrupt the action of filter beds and the water should be fairly clean in the first place, and the streams and lakes from which it is taken should be kept clean. Even if sewage is purified before being discharged into a stream, water from such stream should be purified if used as a public supply owing to other dangerous matters which it may contain. Consequently there seems to be no manner for the city to avoid purifying its water supply. But when the stream comes from beyond the corporate limits, the state should protect the stream from pollution. When the stream comes from beyond the state line the question becomes a national one. The public must also be educated along these lines.

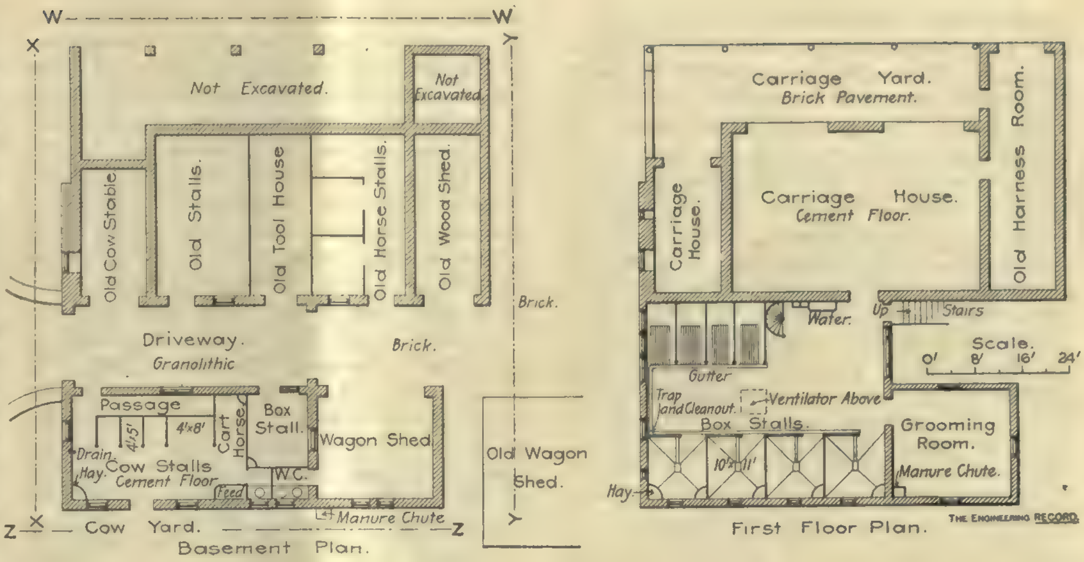
In 1893 the Legislature of Ohio passed a law requiring that all plans of municipalities for water supply or sewerage must be approved by the State Board of Health before the work of construction can be begun. Since that time plans of 142 municipalities or public institutions have been submitted to the board and thirteen sewage disposal plants have been or are being built. In 1897 an examination of the streams in Ohio was begun; this examination includes a description of the watershed and the location of all sources of pollution, towns, sewers, etc. The flow of the streams is measured and stations are established for taking samples both above and below any source of pollution. A special preliminary report was made to the Legislature last year. The next step should be to create a lively public interest in these questions and to bring a report before the Legislature showing the actual condition of affairs.

The discussion of this paper showed there is no penalty attached to the law requiring the approval by the State Board of Health of all plans for water-works and sewers, but the board has the rights of injunction and can use them to prevent the construction of any work without its approval. The discussion also showed that considerable interest is taken by the members in this subject. Mr. R. S. Weston, of Boston, Mass., stated that many rivers which are sources of water supply are now very badly polluted with sewage and the Association should take up the furtherance of state control over such streams. Mr. L. E. Chapin, of Canton, O., stated that he has found difficulty in getting action between state boards of health and municipalities and that there should be a closer union between them. No action can now be obtained from the State Board of Health until the plans of a proposed work are completed. He recommended a statute providing that the approval of the board should be necessary for the legality of bonds issued for the construction of any work. Mr. Hodgkins approved the recommendation of Mr. Chapin, and stated that in many cases the approval of the board was secured more for the purpose of selling the bonds than to provide a good source of water supply. He recommended an expression of the Association favoring a statute providing means to better carry on the work of state boards of health in this matter.

Mr. Snow, of Boston, Mass., stated that there was no more important question to be taken up by the Association than the protection of water supply. It is a nuisance for riparian owners of streams to use them as they see fit. In many cases the policy of the local authorities is very vacillating and the indifference of the people remarkable. He knew of a city draw-

ing water from a stream in which, within sixteen miles of the intake, there are outlets of three systems of sewers, and yet the people using the water are perfectly satisfied. Mr. H. C. Stillwell, of Marion, O., stated that above Columbus, O., there is turned into the Scioto River about 250,000 gallons of sewage per day.

The second paper was by Mr. Charles E. Bolling, superintendent of the water-works of Richmond, Va., entitled "An Object Lesson," in which he showed the increased pressure resulting from the introduction of water meters in that city. The afternoon was spent in enjoying the attractions of the park. At the evening session held at the hotel Mr. C. Monjeau, of Middletown, O., read a portion of the report of the committee on "Memorial to Congress praying for a national law to restrict pollution of streams from which water supplies are drawn, charged with memorializing the President and Congress for laws protecting the sources of water supply for the people."



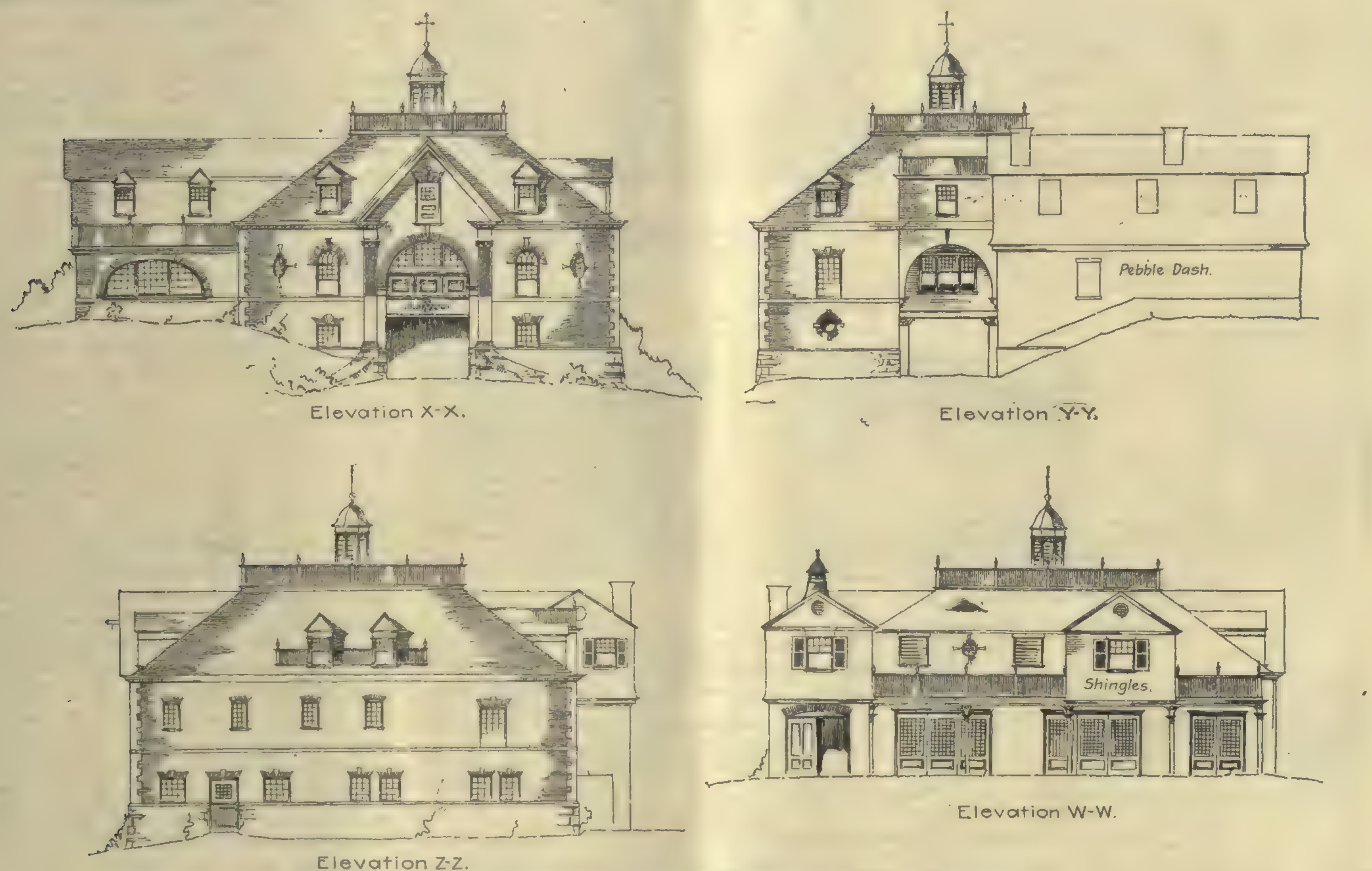


FIGURE 1.—THE STRAWBRIDGE STABLES, HAZLEHURST & HUCKEL, ARCHITECTS.

At Friday's session Mr. Hodgkins read an interesting paper entitled "Economic Arrangement and Construction of Substructures in Streets," in which he recommended the construction of subways under sidewalks for this purpose. Mr. H. E. Keeler, of Chicago, Ill., read a paper discussing the decisions of the Illinois Supreme Court in the Danville and Rogers Park water-works cases. These decisions were reviewed in "The Engineering Record" of April 8, 1899. Dr. Bleile, of the Ohio State University, then read a paper on "The Practical Value of Bacteriological Examinations." In the course of his paper he said that not much over ten years ago chemical examinations were the only ones made and inferences only could be drawn from these examinations. The germs of typhoid fever, cholera and other diseases may be carried in impure water and chemical examinations would not show it. In many bacterial examinations only the number of bacteria were determined and from this an approximative idea of general contamination could be formed. It was later decided to find the number of species of bacteria; this is valuable, but the exact nature of each kind ought to be determined. Faecal bacteria are usually determined and the colon bacillus is the one usually singled out. The presence of this indicates that human excrement may be present in the water, in which case typhoid fever bacilli may also be present. Milk contains as many or more bacteria than water, but they are usually harmless, and the large number is explained by the fact that milk furnishes good conditions for their development. A large number of bacteria in water indicates pollution. As to the number water may safely contain there is no concensus of opinion, the number varying between 50 and 1,000 per cubic centimeter, but Dr. Bleile thinks the latter number too high. Bacteriological examinations must be made immediately after the samples are taken. Shipping in ice is not allowable for numerical examinations and should not be for specific. Bacteriological examinations show contamination much earlier than do chemical examinations. Percentage of removal of bacteria may have very different meanings; thus the removal of 98 per cent. of bacteria when 1,000,000 are present is different from 98 per cent. removal when 1,000 are present, the former leaving 20,000 and the latter only 20.

After this paper the usual resolutions of thanks for courtesies were passed and it was voted to hold the next convention at Richmond, Va., after which the convention adjourned. In the afternoon a number of the members took a trolley ride to the Ohio State University, where, under the guidance of Professor W. T. Magruder, they visited the hydraulic and mechanical laboratories and also the laboratory in which the tests of paving material have been made.

The exhibits were particularly interesting and a review of them will be found under the head of "Business Notes" in another portion of this issue.

THE STRAWBRIDGE STABLE, GERMANTOWN, PHILADELPHIA, PA.

Mr. J. C. Strawbridge's residence in Germantown is a large colonial mansion situated in extensive well-shaded grounds, which give it the aspect of a country estate, although it is really within the city limits of Philadelphia. The ample space provides lawns, walks and driveway in front of the house and furnishes generous room some distance in the rear for the horse and cow stables, barn and carriage house, coachman's house, etc., which are in a stone and brick building about 64 x 76 feet. This is located on a gently-sloping hill, affording a side entrance at grade to the basement, cow stables, wagon house, store rooms, etc., and

main entrance from the driveway level to the first story stables and carriage room. This arrangement utilizes the lower part of the building, which would not be desirable for the carriage horses, and provides an accessible and inconspicuous stable for cows and work horses, which is warm and sheltered, sufficiently lighted by windows on two sides, and dry and well aired. The building provides for eight carriage horses and a dozen vehicles on the main floor, for grain and hay storage and groom's bath room and sleeping rooms on the second floor, and for four cows and two cart horses and carts in the basement, where there are also available several stalls and storage rooms in the old part of the building, which was in service before the present structure was remodeled in 1897.

The main floor plans and elevations are shown in Figure 1, where the sections of the walls are unshaded in the old part, which was two stories high and about 44 x 72 feet in plan. The old walls had masonry footings rising a short distance above the surface of the ground on the lower side, and continued up to the top of the basement with rubble work surmounted by a frame structure with ornate shingled walls and roof. On the side of the old building where the central entrance is, the front wall of the new portion was extended in front of the old part to make a uniform symmetrical face for the gable end and distinguish between it and the remainder of the old portion, which appears like a wing.

The new part has a base of Germantown local stone in parallel courses and outer walls of Roman buff brick up to the cornice of the second story; these are trimmed with gray stone and Roman brick of darker tone and carry the band courses and cornice lines around the building in conformity with the original scheme. In the new part the first story floor is of buff brick arches laid in buff color mortar on steel beams, thus forming the ceiling of the basement, which has a floor of concrete with a cement finish. Elsewhere the floors have wooden beams and double surfaces of 1¼-inch tongued and grooved boards, crossed. In front the second story projects about 10 feet beyond the first and covers a yard or porch which is paved and drained so as to serve for carriage washing. The overhanging second story is supported on a row of ornate cast-iron columns, which, in winter, receive large glass doors, enclosing the whole porch. Two 14-foot sliding glazed doors open from the porch into the 27 x 42-foot carriage room having its walls and ceiling finished in matched natural wood. A special carriage room about 12 feet wide occupies the space off one end of this room, and is entered through an 8-foot double-leaved hinged door. This room is lighted by small windows and serves for the storage of vehicles not in frequent use. The corresponding room on the other side of the large carriage room is used for harness and storage and cleaning, and is fitted with wall hooks and with handsome plate glass enclosed cabinets or harness closets in which all harness, bits, chains and other steel trimmings are displayed. Hot and cold water and telephone are provided in this room.

In order to preserve the carriage room unobstructed by columns the floor of the hay loft above is suspended from three queen-post trusses of 27-foot span. The floor above the 40 x 31-foot stable is similarly supported and the sides of its joists are also ceiled with narrow beaded oak boards with natural finish. The ceiling is laid out in panels formed by beams. The height of the ceiling is about 12 feet, and nearly in the center is an open ventilating shaft about 4 feet square, which extends through the roof and terminates above it in the frustrum of a pyramid with a horizontal-pivoted glazed cover, opened and closed from the stable by means of cords. This opening is protected by a cupola 5 feet in diameter and 10 feet high, whose domed roof is supported on eight turned columns with open spaces between them. The wooden floor in the carriage room is covered with oak flooring 3 inches wide. The tops of the brick arches under the stables are levelled up with concrete and grouting 4½ inches deep above the crowns and finished with bevelled-edge Ohio River buff brick laid on edge, thus forming a floor that prevents slipping. This floor forms the wearing surface except in the stalls, where it is covered with planking.

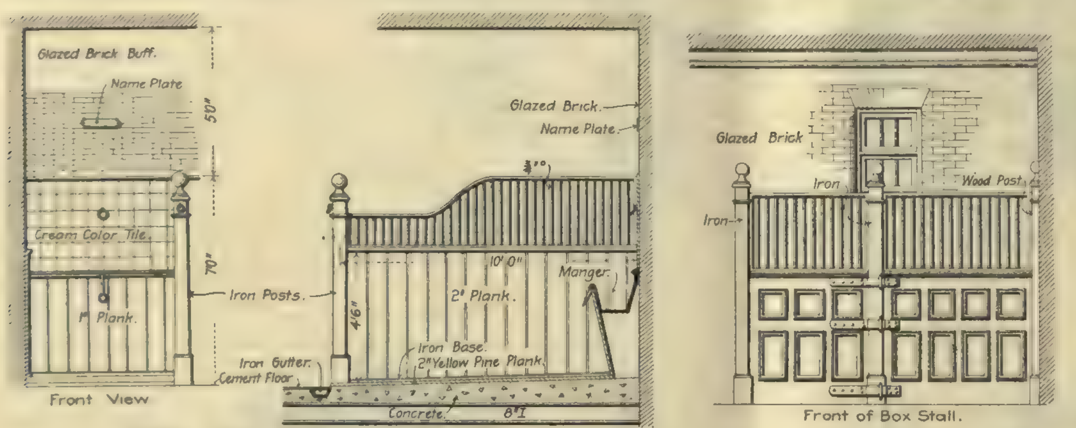
The open stalls are 5 feet 3 inches wide by 10 feet long, and have tight wooden floor platforms of 2-inch yellow pine pitched 1½ inches to a cast-iron gutter, 8 inches wide and 4 inches deep, with a perforated sectional cover. The gutter is set flush with the concrete and receives the stall drainage from movable oak gratings 4 feet wide and 7 feet long, made of strips 2 inches square, bolted together with ½ inch spaces and set in the middle of the stall floor, as shown in the general plan, Figure 1.

Under these gratings are iron pans receiving the liquid and conducting it to the gutters, which are pitched to a trap at one end of the room, which discharges into the stable drain. The box stalls are each 10 feet by 11 feet with watertight yellow pine flooring 2 inches thick, pitched from all sides to the middle, where a special grating delivers into a closed gutter, bedded in the concrete and emptying into the main gutter across the front of the stalls. The floors of the box stalls are made as shown in Figure 2, each in four triangular sections with the 6-inch plank, jointed with 1¾ x ½-inch splines set in white lead. They are also bound and cleated with ½-inch iron straps, screwed on, and the upper edges of the plank are chamfered to make V-shaped grooves ⅜ inch deep, parallel to the sides of the stall.

The stall partitions are all made of 2-inch oak plank 4½ feet long with chamfered edges, set vertically in a grooved cast-iron bottom cleat, which is fastened in the concrete by wedge bolts. The tops of the partitions are capped and surmounted by a guard of ¾-inch vertical rods about 4 inches apart, as shown in Figure 3. Cast-iron mangers with bevelled sides extend entirely across the end of each open stall. The front edge is 3 feet high, and each one is divided into two equal receptacles about 16 inches wide and 12 inches deep. The fronts of these mangers are enclosed by 2-inch pine sheathing extended to the floor. Above the manger the wall is faced with cream-colored glazed brick to the top of the iron guard on the stall partition, from which height to the ceiling it is faced with buff tile. The stall posts are of cast-iron 6 inches in diameter, and nearly 8 feet high. They have wide base flanges, not shown in Figure 3, which are bolted and leaded to the concrete. The box stalls have cast-iron corner mangers and partitions and tiling corresponding to the open stalls. The box stalls have panelled fronts 4½ feet high with iron guards on top like the partitions. All posts are capped with brass balls and mold finishes. Two of the posts of each box stall are set 4 feet apart, and the front between them is hung as a door with three wide iron strap hinges bent around the semi-circular front of the post. Each box stall has a 27 x 30-inch window with its sill 7 feet above the floor. The sides of the window openings are built with rounded brick, and the lower sash is stationary, the upper one being hinged on the lower edge to open inwards at the top, and prevent a direct entrance of cold air on the horses' heads. The hitching rings, name plates and other small trimmings are of polished brass, and handsome hardwood racks are provided for brass forks, shovels, etc. Around each stall post a very thick ornamental mat of cocoa-nut fiber is wrapped vertically and hung from the top of the woodwork on each side of the partition so as to serve as a cushion and kicking piece and protect the outer 4 feet of the partitions.

An open spiral iron stairway leads from the stable to the hay loft and to the man's room above. Near the foot of the stairs is a hay and grain chute and a large enameled iron watering trough, supplied by city pressure. Communicating with the stable is an 18 x 20-foot room originally intended for an exercising room, but chiefly used for a grooming room. In this room is an iron trap door to an inclined manure chute through the outer wall, which discharges into an outside manure pit.

The basement entrance is through a 14-foot archway with curved wing walls, from which a full-width passage with brick and granolithic pavement forms a driveway open at both ends through the building, to the barn yard beyond. On one side the old stables and store rooms are excavated in the hillside and lighted by windows in the passageway; on the other side the new stables and wagon room are above grade with windows on two sides and the passageway. The wagon room is 18 x 20 feet, with a 16-foot open entrance. The cow stable is 18 x 40 feet with hinged doors. The floor is of concrete with cement finish, and the walls are faced inside with buff Roman brick. Hay is thrown down from above through a chute and carried around through a wide passage and delivered in front of the cow stalls. Ground feed is kept in a bin lined with galvanized



Single Horse Stalls. Side View.

FIG.3

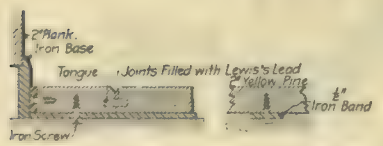
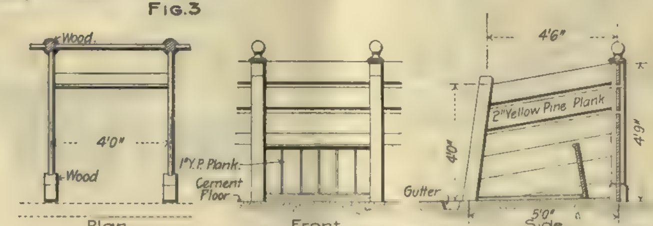


FIG.2 Section through Floor of Box Stalls.



Plan Front. Side.

FIG.4 Cow Stalls.

DETAILS OF STABLE FITTINGS, STRAWBRIDGE ESTATE.

iron, and is fed in pails. An open gutter, not shown in the plan, is molded in the top of the concrete floor, across the ends of the stalls, and discharges through a strainer plate and bell trap into a branch of the soil pipe from above. There are three 4 x 5-foot open cow stalls and one measuring 4 x 8 feet which is normally open, but may be closed by bars and used for sick cows or cows and calves. There is an open 5 x 13-foot stall for a cart horse and another 10 x 13-foot box stall, both having board gratings in the floor over the concrete surface and enclosed by plain solid board partitions 4½ feet high. All stall floors pitch about 1 in 40 towards the gutter. The partitions of the cow stalls are made of 2-inch yellow-pine plank 8 inches wide, laid at a slight angle with the horizontal and close together for the first three courses. Above that two more courses are laid with 1-inch cracks and all secured at each end in rebates in the 6-inch wooden posts. The mangers are 3 feet high and 18 inches wide at the top and 12 inches at the bottom, as shown in Figure 4.

The general style of architecture adopted is that known as Colonial, all detail, such as window and door design, cornice work, balustrading, etc., being in conformity with that style as well as the general color effect of buff, pebble, dark-buff brick and the cream color of all exposed woodwork. The building throughout is thoroughly lighted, and positively ventilated, and is free from disagreeable odors. The artificial lighting is by incandescent electric lamps, so placed that the entire building or any part of it can be illuminated. The wiring is divided into several sections, all of which are centrally controlled from a single switchboard. This stable was designed by Hazlehurst & Huckel, Philadelphia, to whom acknowledgment is made for data.

VENTILATION AND HEATING OF A NEW YORK SCHOOL.

The following article is a description of an interesting ventilating and heating plant in one of the public schools of New York City. It is intended, however, to be more extended in scope, in order to indicate the general scheme which is followed in the design of this work in the schools built in recent years throughout the city. All the school buildings, it may be recalled, are planned by the building bureau of the Board of Education under the supervision of the superintendent of buildings, Mr. Charles B. J. Snyder. The various classes of work which enter into the construction of the buildings are therefore designed by the same individual departments, and it has been assumed that the description of the ventilating and heating work in one school may serve to illustrate the chief points of the present practice for the whole city. Considerable attention is paid to providing for a supply of fresh air, and without doubt, a survey of the work done will prove of added interest when it is remembered that there is a lack of compulsory laws in New York State affecting provisions for ventilating such buildings. This part of the work of the building bureau is in the hands of a heating and ventilating department, of which Mr. William McMannis is the directing engineer.

Public School No. 159 extends from One Hundred and Nineteenth Street to One Hundred and Twentieth Street, on the block between Second and Third Avenues. Unlike the average school in the United States, where the relation of ground to building is such that it is usually possible to count on window light on all sides, the school in New York must occupy as much of the land as possible; the needs of the populous district in which it is erected demand the largest possible building. It has a frontage on the two streets mentioned, but both of its sides are party walls, which are or may be obstructed at any time. The building is therefore indented with a large court from each street, giving the building in plan the form of the letter H. Figure 1 is a plan of the cellar, and Figure 2 shows the second floor. The building is five stories high. The cellar, as indicated in the figure, is only partially excavated and is devoted entirely to the ventilating and heating apparatus. The first floor is about on the level of the ground and is taken up largely with playrooms. It is divided into two parts by a partition extending from side to side and separating the boys from the girls. The entrances to the building are made directly from the streets through the wings, and the boys therefore enter the school at one street, and the girls at the opposite end of the building at the other street. The next three floors, the second, third and fourth, are divided into classrooms with wardrobes and other smaller rooms, as shown in Figure 2. The central portion of the second and fourth floors are divided by sliding partitions by which that part of each of the two floors may be converted into an assembly room at any time. This is a practice long in vogue and may be taken to show that space is regarded as too valuable to warrant providing for a special large open room. The fifth floor is planned with rooms for drafting and modeling, for cooking and sewing, and includes a good-sized library and separate reading room.

The building is heated by direct radiation. Steam is generated at low pressure in a battery of boilers in the cellar and is carried by two horizontal mains which supply short horizontal connections leading to the foot of rising lines of supply pipes for the radiators on the floors above. The steam mains extend across the cellar, as shown in Figure 1, and are supported by hangers from the ceiling every ten feet. The condensation occurring in the supply piping is disposed of by drips, the water from the steam mains passing into a drip pipe at every change in the size of the main, and the condensed steam in the supply risers passing directly into a drip at their bases. A radiator connection is taken from each riser for every floor and the steam supply is controlled by a diaphragm valve working under the Johnson system of temperature regulation. Each radiator has a separate ¾-inch return pipe which drops to the cellar, where the return pipes corresponding to each steam riser are joined to a branch tee header. Each header is placed below the water line of the system and is connected with the return mains, which run at the cellar floor, beneath the steam mains. The drips of the steam mains and risers, already mentioned, drain separately to the return mains, and thus keep the different parts of the return system at the same pressure at that of the supply mains. The connection from the header to the return mains is provided with a check valve to prevent water from backing up in case any radiator is left open to the return when the steam valve is closed. The return mains are held by iron stands and pitch toward the boiler ⅛ of an inch every 12 feet. The main is about 4 inches above the floor at the boilers, which is the minimum height above floor level allowed, permitting of working around the pipe at any time with greater ease than if the returns were dropped closer to the cellar floor. The returns in the cellar are boxed in for protection with 1¼-inch planking.

The unexcavated portion of the cellar, which is under the wings, as has already been pointed out, required the institution of a separate water line in each case to seal the returns of the radiators in this portion of the building. The supply risers are taken from a main which branches from the cellar main and passes into the first story. The branch return main has also to be at this higher level, and is kept full of water by the usual inverted U-connection, joined at the top by a pipe to the steam main, to overcome any tendency for syphoning. The inverted U-connection is made with a by-pass across the bottom closed by a valve and used to blow out the returns when refuse or any deposits accumulate, a condition which is apt to occur, particularly when the apparatus is first put into operation.

The boiler plant consists of four boilers, two for the heating system generating steam at 10 pounds pressure, and the other pair for the engines, with steam at 50 pounds pressure. One of the power boilers may also be connected to the heating system directly, at low pressure, or may serve the heating system through a pressure-reducing valve, when it is necessary to raise the pressure in this boiler to supply steam for the engines in times of increased demand. The boilers are of the horizontal tubular type, 14 feet long and 5 feet in diameter. Each boiler contains 87 tubes 3 inches in diameter and of the full length of the boiler. Coal is delivered to the building in one of the courts, as shown in Figure 1. An overhead conveyor has been erected consisting of a rail suspended from the ceiling of the cellar, and a carriage holding a differential pulley gear, by which coal is hoisted from the ground in a bucket. The coal is carried in this manner to a brick-floored firing pit between the two pairs of boilers. A similar railway, as shown in the figure, is used to convey the ashes from the pit to an adjacent ash hoist.

The air supply to the building is intended for ventilation only. The air enters the building at three points, each at an inner corner of the courts, is heated, passes to a blower, thence through ducts and flues and into the rooms. The inlets are about 20 feet above the court yard and open each into a room set apart for a heating chamber. Each room contains a heating stack, consisting of two sets of coils, designed to temper the admitted air from 68 to 70 degrees Fahrenheit. The amount of surface in each stack of two of the chambers is 1,716 square feet, and the third chamber has a heating surface of 1,980 square feet. A section through the latter chamber is shown in Figure 3, and includes the blower and a portion of the fresh-air ducts. The upper set of coils is supported on I-beams and is arranged for utilizing the exhaust steam from the blower engine; the lower collection is suspended from the beams by rods and is connected to the heating system, but may also receive the exhaust steam. The supply of steam to each set is controlled by pneumatic valves and thermostats. The rest of the exhaust steam passes through a feed-water heater for the power boiler, and may pass to the atmosphere through two risers extending up through the building and fitted with back-pressure valves to work in connection with the use of the exhaust steam in the tempering chambers. The exhaust risers are capped with exhaust heads, arranged to send the drip to a leader.

The air is led from the chambers through large circular ducts to corresponding blowers. There are three blowers, two 7 feet in diameter, and one 7½ feet, made by the American Blower Company of Detroit, Mich. They are belt driven by Buffalo Forge Company horizontal engines at a speed of 240 and 210 revolutions per minute, respectively, and are designed to deliver into every class room 90,000 cubic feet of air per hour, which is at the rate of 30 cubic feet per minute per capita, on the basis of 50 occupants per room. The adoption of three blowers was made because of the lack of head room, and removed the necessity of running long lines of ducts to portions of the cellar distant relatively to the blower, decreasing thereby the travel of the air, as well as the size of the blower. The air is discharged from the blowers at two points, passing into ducts which extend in opposite directions along the ceiling, and is driven through branches to nests of flues, which rise to the second, third or fourth floor as the case may be. Dampers are fitted in the ducts in the cellar and are set to equalize the amount of air given to each room. A special air provision is therefore made only for the class rooms, excepting an arrangement by which

air may be diverted into the playrooms on the first floor. This is accomplished by a door in the side wall, near the ceiling, hinged at the top and made to swing into the current of rising air for the room above. When no air is desired in the play rooms, the door fits tightly the opening for the air inlet. The air enters each classroom at a velocity of about 5 feet per second through an inlet 12 feet above the floor provided with a deflector or diffuser. The temperature of the rooms is maintained by the Johnson system of temperature regulation, diaphragm pneumatic valves being inserted in the supply pipes of the radiators. The radiators are all provided with screens of galvanized iron and when the seats are no more than 18 inches from the radiators the screens are double, with an inch air-space between the two sheets of iron. The class rooms are about 14 feet high and an outflow of vitiated air is obtained through two vent registers in each room, one at the top and the other at the bottom. The floor register is always open, but the top opening is connected with the temperature-regulating apparatus in such a way that as the diaphragm valve is closed the top register is open. The rooms of the central portion of the building are vented through openings in the floor, from which ducts run below the floor to convenient vent flues. The ceiling below each duct is dropped to accommodate it. The vent flues rise in the shafts for the fresh-air flues and carry the air to ventilating hoods above the roof. The plant which has been described was installed by Messrs. Blake & Williams of New York.

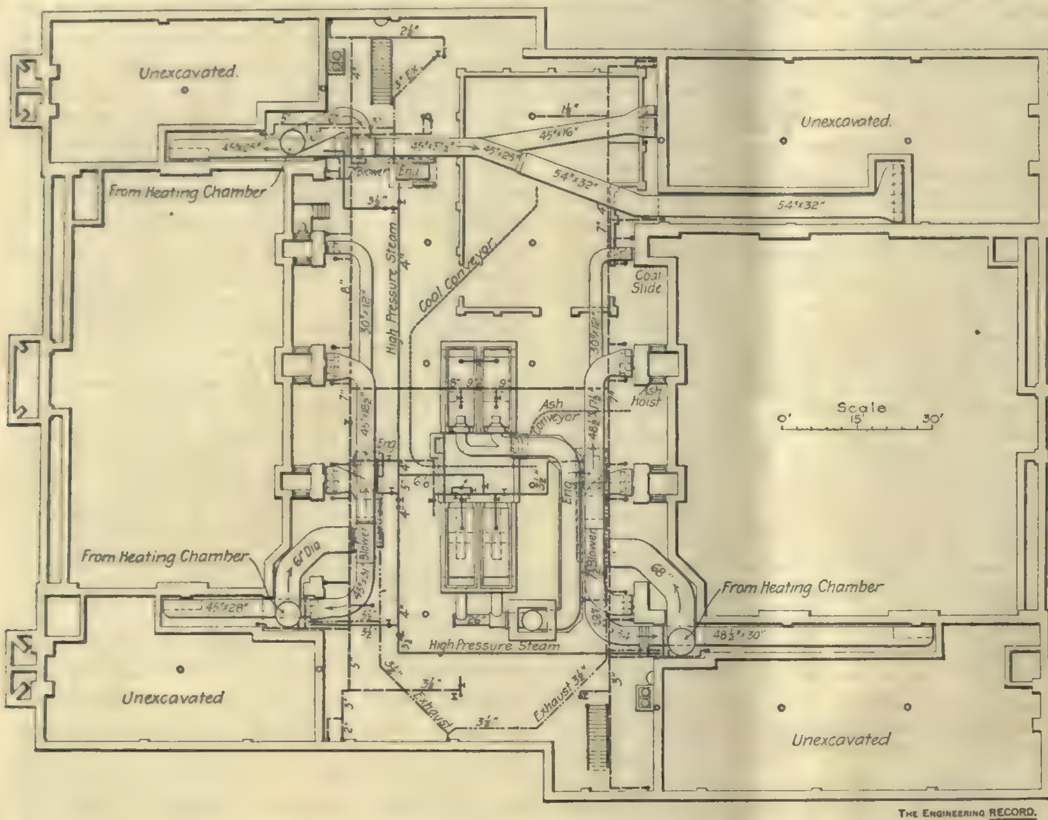


FIGURE 1.—BASEMENT PLAN.

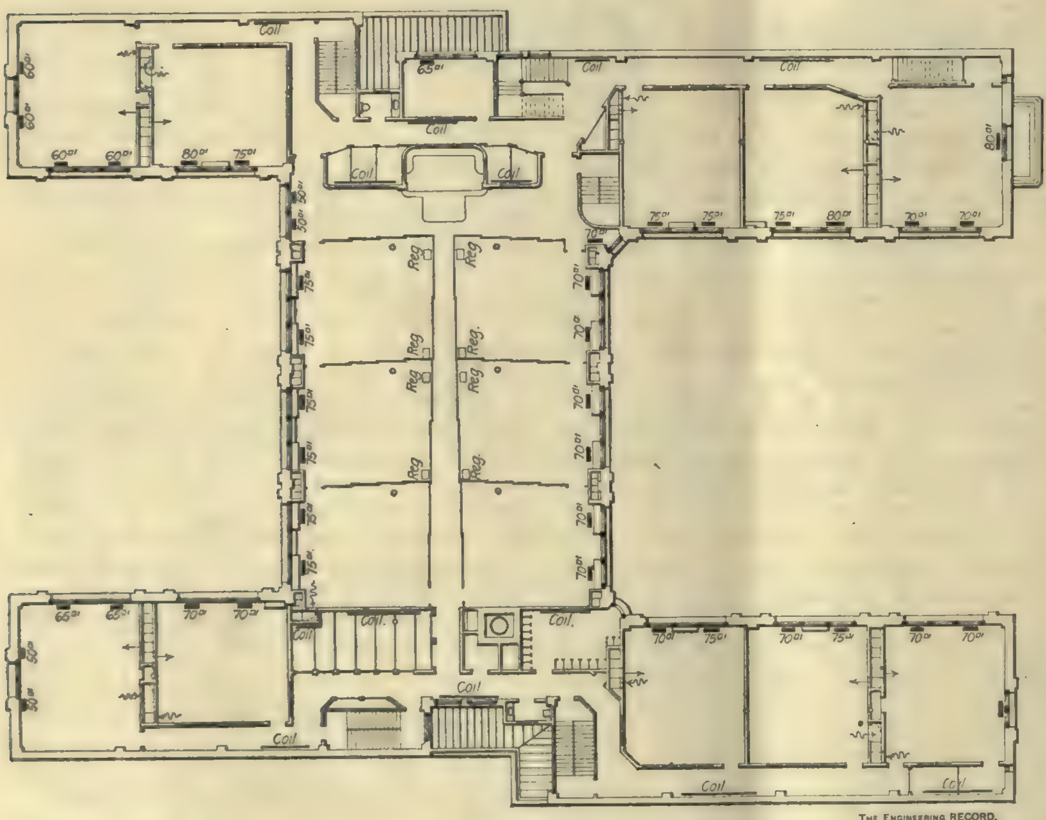


FIGURE 2.—SECOND FLOOR PLAN.

TRADE PUBLICATIONS.

The Consolidated Cement & Supply Company, 1133 Broadway, New York, has prepared a little pamphlet containing a number of tests of the Star brand of cement, and letters from engineers who have been using it for the last thirty years.

The Fischer Equipment Company, Chicago, has issued an attractively illustrated catalogue of the electric automobile vehicles of various types which it is now manufacturing. Many of these are of patterns which are decidedly novel in self-propelled vehicles.

The Standard Steam Specialty Company, 111 Fifth Avenue, New York, has printed a pamphlet describing its line of separators, governors, boiler feeders, valves and other specialties. The descriptions are unusually complete and fully explain the mechanism of all apparatus illustrated.

The annual manual of the Barber Asphalt Paving Company, 11 Broadway, New York City, appears in a new dress this year and contains a large amount of interesting information concerning the materials used by the company and the pavements it has laid. It is hardly necessary to say that the pamphlet is one which will be of value to all engineers engaged in street work.

The Magee Furnace Co., 32-38 Union Street, Boston, has prepared a manual of information relating to hot water and steam heating, which it publishes as a morocco-covered book of a size readily carried in the pocket. It naturally contains detailed information concerning the large line of heaters and boilers made by the company, but along with this trade literature there are many handy tables and useful rules.

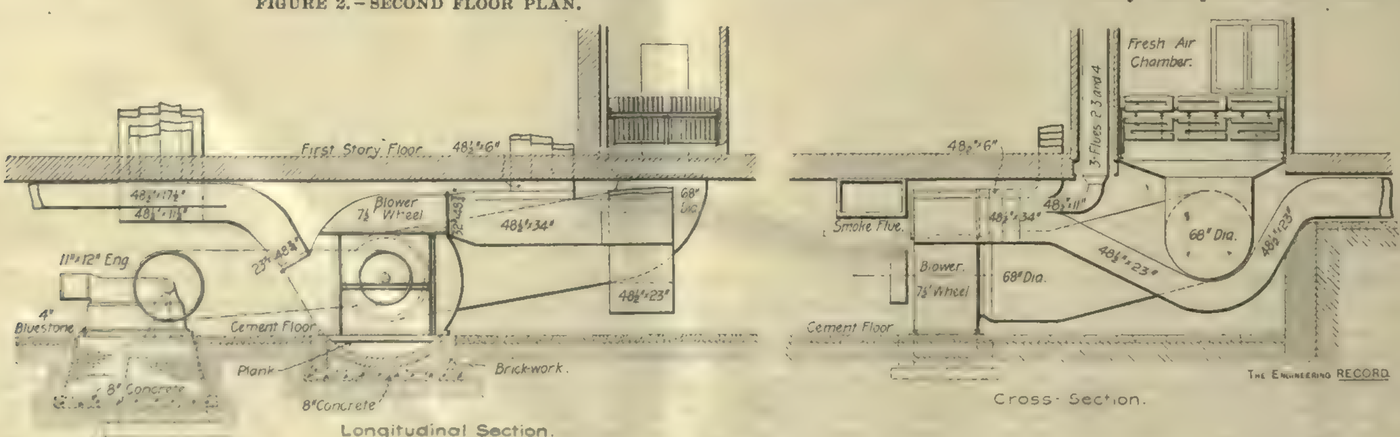


FIGURE 3.—ARRANGEMENT OF TEMPERING CHAMBER AND BLOWER.

VENTILATING AND HEATING PLANT OF A NEW YORK SCHOOL.

MR. CHARLES B. J. SNYDER, ARCHITECT; MESSRS. BLAKE & WILLIAMS, CONTRACTORS.

CONTRACTING NEWS

OF SPECIAL INTEREST TO
CONTRACTORS, BUILDERS, ENGINEERS, AND MANUFACTURERS
OF ENGINEERING AND BUILDING SUPPLIES.

For Proposals see pages xi, xii and 608.

WATER.

Montreal, Que.—The Water Committee has asked the Council for $55,250 for a pump.

Arlington, Ia.—O. S. Osburn, Mayor, writes that bids will be received in June for water works, to cost about $5,000. Jackson & Moss, Engrs., Des Moines.

Steelton, Pa.—The Home Water Co., it is said, has decided to issue bonds to the amount of $30,000, part of which will go to improve the reservoir.

La Crosse, Wis.—It is proposed to expend $15,000 in extending the water works and $12,000 on new sewers. Frank Powell, City Engr.

Lakefield, Minn.—It is stated that the citizens will vote May 29 on constructing water-works and an electric light plant, to cost $15,000.

Milton, N. H.—A water system is reported designed for the village; estimated cost, $20,000.

Morton, Minn.—The City Recorder writes that it was voted May 16 to issue $8,000 bonds for water-works.

Martinton, Ill.—The village contemplates building water-works.

Plymouth, N. H.—Surveys are in progress to extend the water-works recently purchased by the village. A. W. Dudley, Engr., Exeter.

Manistee, Mich.—A bill has passed the Legislature authorizing the issue of bonds in amount $200,000 to purchase the plant of the Manistee Water Co. and make additions and improvements.

Pendleton, Ore.—Bids are wanted June 14 for $15,000 bonds to be used to construct or repair and maintain the present system of water-works. J. E. Beam, City Recorder.

Baring Cross, Ark.—Reports state the incorporation of the Baring Cross Water Co. to build water-works. Incorporators, F. C. Amsbary, H. F. Barnard and John McIntyre; capital $10,000.

Brownstown, Ind.—The Brownstown Water & Light Co. has been incorporated, with a capital of $8,000. Directors: John B. Burrell, Chas. A. Bollis, of Brownstown, and Geo. W. Sturtevant, Jr., of Chicago.

Butte, Mont.—The water-works proposition, it is said, is again being considered.

Bardwell, Ky.—C. V. Heaslet, City Clk., writes that it is proposed to construct water-works, to cost about $5,000.

Blooming Prairie, Minn.—According to press reports, bids are wanted for water-works.

Los Angeles, Cal.—The Park Board is reported in favor of a water-works system for Elysian Park.

Pasadena, Cal.—The Pasadena Land & Water Co. is said to have authorized the purchase of additional meters. H. G. Bennett, Secy.

Sheridan, Mont.—The Sheridan Water-works Co. has been incorporated to build and maintain water-works; capital, $5,000. Saml. Ogden, Engr.

Galesville, Wis.—The Western Engineering & Construction Co. is said to have received the contract for the water works, at $13,500.

Iowa Falls, Ia.—Press reports state that the City Council wants bids for an 8-in. well.

West Point, Neb.—The construction of a reservoir is said to be under consideration, from plans of Andrew Rosewater, Omaha.

Tucson, Ariz.—Chas. T. Connell, Recorder, writes that $100,000 water bonds will be sold in about 60 days.

Davenport, Ia.—The Davenport Water Co. is said to be considering extensions of its lines.

Middleport, Pa.—It is stated that the Village Council has granted a franchise to the Pomeroy & Middleport Water Co. to lay water mains.

Yoe, Pa.—A company is said to have been formed to build a reservoir. Stockholders: Moses Snyder, G. A. Kohler and others.

Marinette, Wis.—See Menominee, Mich.

Duke Center, Pa.—A water-works system is being considered.

Menominee, Mich.—The Council is reported considering a joint purchase with Marinette, Wis., of a filtering plant for the two cities; estimated cost, $30,000.

Garwin, Ia.—It is reported that the village is to vote on water-works.

Baton Rouge, La.—The citizens on May 16 voted to issue $200,000 bonds to purchase the water-works and erect a school and city hall.

Arvilla, N. D.—Bids are wanted June 6 for boring an artesian well on the poor farm. J. W. Scott, Co. Aud.

Lancaster, Pa.—See "Paving and Road Making."

Worcester, Mass.—The Senate has passed a bill authorizing a $700,000 water loan.

Holly Springs, Miss.—The issue of $18,000 water bonds is reported voted.

Rossland, B. C.—The City Council is said to have voted to issue $15,000 bonds for water-works.

New Cumberland, W. Va.—The New Cumberland Water & Gas Co. has been chartered to deal in natural gas in W. Va., Ohio and Ky. and operate water-works in this place. Incorporators: Wm. W. Splane of Oil City, Pa.; Joshua G. Splane and Wm. S. Semple of Pittsburg, Pa.; Geo. B. Walmer of New Cumberland, and others. Capital, $50,000.

Kenton, O.—The City Council, it is stated, consider that more water is needed at once.

Chicago, Ill.—Bids are wanted May 29 for 26,500 pieces of 4 to 24-in. cast-iron water pipe. L. E. M'Gann, Commr. Pub. Wks.

Duluth, Minn.—According to an agreement which has been entered into by the Superior Water, Light & Power Co. and the City Council, a filtration plant will be built at a cost of $75,000, additional pumping machinery will be put in, and a 12-in. main will be laid.

Danville, Ill.—A committee of Aldermen has been appointed to investigate the feasibility of a city water plant, and $43,000 has been set aside for that purpose.

Three Oaks, Mich.—Gov. Pingree has signed a bill allowing the village to extend its water works and electric light plants.

Montgomery, Ala.—Bids are wanted June 5 for the enlargement and extension of the air lift pumping plant. R. H. Somerville, City Treas.

Princeton, Minn.—It is stated that bids are being received for water-works and an electric light plant. C. F. Loweth of St. Paul, Engr. J. Hartman Village Recorder.

Philadelphia, Pa.—The Common Council has passed the temporary loan bill providing $500,000 for improvements to the pumping stations, and adding $200,000 for underground work in streets to be repaved out of the $2,000,000 item of the $11,200,000 loan.

Winnipeg, Man.—Bids are wanted July 3 (change of date) by the Chairman of the Fire, Water and Lighting Committee, for a softening plant, as advertised in "The Engineering Record" May 6, 13 and 20. C. J. Brown, City Clk.

Rochester, N. Y.—The Common Council has voted to expend about $70,000 for water main extension.

Redwood City, Cal.—Daniel R. Stafford, City Clk., writes that it was voted May 20 to issue $8,000 bonds for water mains and $4,185 for an electric light plant.

Oskaloosa, Ia.—The franchise of the Oskaloosa Water Co. expires Aug. 15, and the Council is said to be considering the matter of constructing a municipal plant.

Denver, Colo.—Press reports state that the Denver Union Water Co. will build a large reservoir 23 miles up the south fork of the Platte River from Symes.

Mankato, Kan.—W. W. Cook, it is stated, has received the contract for water-works. For list of bids see issue of April 22.

Albany, N. Y.—Bids are wanted June 6 for 380 gross tons of cast iron coated water pipe and 18,000 lbs. special castings. Geo. I. Bailey, Supt. Bd. Water Commrs.

Hillsboro, Ill.—It is reported that the City Council is to build a new brick and steel water tower, with 100,000 gal. tank.

Nappanee, Ind.—Bids are wanted June 15 for a steel tank having 75,000 gals. capacity; also for a steel water tower. M. S. Hoover, Town Clk.

Clinton, Mass.—The following bids for excavation and other work for a part of North Dike, Nashua Reservoir, were opened May 17 by the Metropolitan Water Board, Boston: Cenedella Bros., Milford, Mass., $81,476; Moulton & O'Mahoney, Boston, $83,812; Newell & Snowling Construction Co., Uxbridge, Mass., $87,743; Long & Little, Leominster, Mass., $90,889; Murphy Bros., Clinton, $101,427; Busch Bros., Buffalo, N. Y., $107,966; Baker & Judson, Gloversville, N. Y., $109,602; H. P. Nawn and N. S. Brock, Boston, $117,251; Rowe & Hall, Boston, $120,306; Neill Devine, Clinton, and Neill McBride, Brighton, $121,435. The principal items were 220,000 cu. yds. soil excavation and 155,000 cu. yds. earth excavation, on which the lowest bidders tendered at the rate of 18 and 20 cts. respectively.

Seattle, Wash.—The itemized bid on which the Pacific Bridge Company, Portland, Ore., was awarded the contract for Subdivision No. 1 of the new water-works system, of which the total bids were printed two weeks ago, was as follows:

Headworks. Diverting Weir. Clearing, 5 acres at $81; 2 acres clearing and grubbing, $175; 2,300 yds. earth excavation in river, 62 cts.; 500 yds. rock excavation, $1.25; 2,200 yds. embankment, 18 cts.; 2,000 yds. rock in weir and crib, 62 cts.; 600 yds. gravel filling, 37 cts.; 500 ft. 12-inch hewn timbers, 12 cts.; 270 M ft. timber in weir, abutment and wings, $17.50; 10,800 lbs. drift bolts in place, 3 cts.; 3 head gates, $162 each; wooden rack, $62.50; coffer-dam, $1,870.

Intake Canal. Earth excavation, 3,400 yds., 31 cts.; 400 yds. rock excavation, 93 cts.; 155 yds. concrete lining with cement coating, $9.37; 290 yds. rubble masonry in cement mortar, $11.25; 75 yds. dry rubble, $8.75.

Settling Basin. Earth excavation, 850 yds., 31 cts.; 150 yds. rock excavation, 93 cts.; 375 yds. Ransome concrete, $9.37; 11,500 lbs. twisted steel rods in concrete, 5 cts.; 3,000 lbs. iron guides for screen, in place, 6 cts.; 3,500 lbs. rack iron in place, 5 cts.; 20,000 lbs. special castings, 5 cts.; 22,000 lbs. cast-iron pipe in place, 2½ cts.; 4 wood gates, $156.25 each; 4 24-inch sluice gates, $187.50 each; 48-inch sluice gate in place, $593.75 each; 16 copper wire screens, $120 each; 22 x 42-ft. gate house, $500; 3½ M. ft. timber floor in place, $17.50; 300 lbs. anchor bolts in place, 5½ cts.; 24 x 42-ft. house, $2,500; 20 x 30-ft. stable, $375.

Pressure Pipe. Clearing, 115 acres, $81; 60 acres clearing and grubbing, $175; 73,000 yds. earth excavation in wagon road, 23 cts.; 28-mile telephone line complete, $140 per mile; 6 telephones in place, $18.75 each; 325,000 yds. earth excavation, trenching, and backfilling, 31 cts.; 8,000 yds. sandrock excavation, 75 cts.; 3,000 yds. rock excavation, $1.25; 145 M. ft. timber in culverts and bridges, $17.50; 3,100 lbs. wrought-iron bolts and rods, 5½ cts.; 320 ft. 12-inch sewer pipe in place, $1; 40 ft. 16-inch sewer pipe in place, $1.50; 50 ft. 18-inch sewer pipe in place, $1.80.

Tunnels. Earth excavation, 2,800 yds., $1.87; 20 yds. rock excavation, $15.50; 108 M. ft. timber in place, $18.75.

42-inch Stave Pipe. Lumber in staves, 3,700 M. ft., $31.25; 3,800,000 lbs., steel bands, 4½ cts.; 40 14 x 16-inch manholes, in place, $62.50 each; 35 4-inch air valves in place, $31.25 each; 32 blow-offs in place, $38.75 each; 1,450 ft. 6-inch wrought-iron waste pipe in place, 63 cts.; 2 weir shafts, $125 each; four 36-inch stop valves in place, $625 each.

42-inch Steel Pipe. The price bid per lineal foot varied with the thickness of the plates as follows: 16,950 ft. of ¼-in., $8.09; 8,450 ft. of 5/16-in., $8.97; 2,150 ft. of ⅜-in., $10.19; 6,410 ft. of 7/16-in., $11.50. Curves of 30-ft. radius, 90 ft. length, 3/16-in. plate, $7.75 per ft. in place; 12 flanged ring connections between steel and stave pipes, $112.50 each; 66 14 x 16-in. manholes in place, $62.50 each; 4 air valves in place, $32 each; 6 blow-offs in place, $38 each; 300 ft. 6-in. wrought-iron waste pipe in place, 62 cts.

Black River Crossing. Submerged 42-in. steel pipe, 140 ft. long, 7/16-in. plate, $15 per ft. in place, inclusive of dredging and refilling trench in river.

Pipe between Reservoirs. Earth excavation, trenching and backfilling, 2,000 yds., 31 cts.; 115.7 M. ft. staves for 36-in. pipe, $31.25; 106,000 lbs. steel bands, 4½ cts.; 247 ft. 36-in. straight and curved steel pipe, 3/16-in. plate, $6.50 per ft. in place; 2 flanged ring connections between 36-in. wood and steel pipes, $97.50 each; one for 32-in. pipe, $87.50.

Waste Pipe to Lake Union. Earth excavation, trenching and backfilling, 5,000 yds., 31 cts.; 66 M. ft. stave lumber for 24 and 30-in. pipe, $31.25; 26,000 lbs. steel bands, 4½ cts.

Change of River Channel. Clearing, 3 acres,

$81; 4 acres clearing and grubbing, $175; 65,000 yds. earth excavation, 31 cts.

Improvements at Swan Lake. Clearing, 15 acres, $81; 2,000 yds. earth dam, 25 cts.; 5,200 yds. earth excavation, trenching and backfilling, 31 cts.; 3,000 yds. earth excavation in tunnel, $1.88; 322 M. ft. timber in tunnel, $18.75; 14 M. ft. timber in cribs and gate chamber, $17.50; 620 lbs. wrought-iron bolts and rods in place, 5½ cts.; 1,500 ft. piling in place, 37 cts. per ft.; 115 M. ft. stave lumber, $31.25 per M.; 41,400 lbs. steel bands, 4½ cts.; wood gate, $90; 4 copper screens, $25 each; 11 x 14 ft. frame gate house, $81.

The remainder of the work was awarded to Smyth, Wakefield & David, of Portland, Ore., at the following rates:

High-Service Reservoir. Clearing and grubbing, 10 acres, $50; earth excavation, deposited in embankment and rolled, 66,000 yds., 22 cts.; puddle in place, 15,000 yds., $1.50; slopes covered with loam and seeded, 4,400 sq. yds., 20 cts.; broken rock lining in place, 1,500 yds., $2.25; concrete lining in place, 2,450 yds., $7.50; cement plastering, 14,600 sq. yds., 20 cts.; two-coat asphalt covering, 14,600 sq. yds., 25 cts.; Ransome concrete, 300 yds., $9; twisted steel rods in concrete, 7,000 lbs., 3¾ cts.; cement plastering, 1,100 sq. yds., 45 cts.; concrete in roadway, 210 yds., $7.50; asphalt wearing surface on roadway, 950 sq. yds., $1; wrought-iron fencing, 1,350 lin. ft., $3; double gates, 1 pair, $40; 16-in. cast-iron pipe, 12,500 lbs., 3 cts.

Gate House. Ransome concrete in chamber, 920 yds., $10; rubble in cement mortar, 55 yds., $6; Ransome concrete in walls, 128 yds., floor and roof, 50 yds., $15; twisted steel rods in concrete, 22,000 lbs., 3¾ cts.; concrete water table, 124 lin. ft., 15 cts.; concrete belt, 250 lin. ft., coping course, 124 lin. ft., and cornice, 130 lin. ft., 25 cts.; 10 arches over windows, $5; 1 arch over doors, $5; concrete door steps, 46 lin. ft., 50 cts.; cement plastering, 440 sq. yds., and asphalt roofing, 106 sq. yds., 40 cts.; cement plastering on exterior, 75 sq. yds., and interior walls, 280 sq. yds., 50 cts.; picked wall surface, 160 sq. yds., 50 cts.; vault lights in floor, 90 sq. ft., $1; double doors, 1 pair, $25; 10 windows complete in place, $6; wainscoting in place, 55 sq. yds., 40 cts.; steel plates and shaped iron in distributing tank, etc., 14,500 lbs., 5½ cts.; cast-iron flanged pipe, 11,000 lbs., in place, 3 cts.; special castings in place, 35,000 lbs., 4 cts.; 12 double screens with hoists, $200; one weir gauge in place, $10; one 8-in. stop valve in place, $20; one 18-in. stop valve in place, $100; two 26-in. stop valves in place, $275; one 36-in. flap valve in place, $350.

Low Service Reservoir. Clearing and grubbing, 10 acres, $40; earth excavation, 80,000 yds., 25 cts.; earth excavation deposited in embankment and roads, 15,000 yds., 25 cts.; loam covered slopes, 2,200 sq. yds., 5 cts.; concrete bottom and slope lining, 3,290 yds., $7.50; cement plastering, 19,500 sq. yds., 25 cts.; asphalt coating laid in two coats, 19,500 sq. yds., 25 cts.; Ransome concrete, 365 yds., $9; twisted rods, 8,500 lbs., 4 cts.; cement plastering, 1,270 sq. yds., 45 cts.; concrete in roadway, 250 yds., $8.50; asphalt wearing surface, 1,110 sq. yds., $1; fencing, 1,635 lin. ft., same as in high service reservoir; 16-in. cast-iron pipe in place, 38,000 lbs., 2½ cts.; special castings in place, 4,500 lbs., 5 cts.; Ransome concrete, in fountain, 25 yds., $12; same in chamber, 1,100 yds., $10; same in main walls, 200 yds., floor and roof, 100 yds., $15; twisted steel rods in concrete, 42,000 lbs., 4 cts; concrete water table, 200 lin. ft., 15 cts.; concrete belt courses, 400 lin. ft., coping course, 200 lin. ft., and cornice work, 210 lin. ft., 15 cts.; 13 arches over windows, $5; 1 arch over doors, $10.50; concrete door steps, 90 lin. ft., 50 cts.; cement plastering on floors, 840 sq. yds., 50 cts.; 2-coat asphalt roof, 215 sq. yds., 25 cts.; cement plastering, 50 cts., on outside, 150 sq. yds., and 40 cts on inside walls, 550 sq. yds., picked wall surface, 270 sq. yds., $1; doors, 1 pair, 13 windows and wainscoting, 90 sq. yds., as in high-service reservoir; steel plates and shaped iron in distributing tank, etc., 14,500 lbs., 5 cts; special castings in place, 78,000 lbs., 5 cts.; cast-iron flanged pipe in place, 17,500 lbs., 2½ cts.; 1 weir and screens, 1 set, as before; one 8-in. stop valve, $20 in place; one 16-in. stop valve in place, $80; four 24-in. stop valves in place, $225; one 30-in. flap valve in place, $350; complete power plant comprising 2 pumps and water wheels in place, with all machinery and fittings, $10,000.

Stand Pipe. Steel plates and angles in place, 136,000 lbs. 6 cts.; 3,500 lbs., special castings, 5 cts. in place; 1,600 sq. yds. coating on metal, 60 cts.; 36 ft. 4-in. lap-welded pipe, No. 12 B. W. G. in place, 20 cts.; 100 ft. 8-in. lap-welded pipe, No. 10 B. W. G., in place, 90 cts.; 30 ft. 12-in. lap-welded pipe, No. 8 B. W. G., $1.25; 4-in. stop valve in place, $10; 2 12-in. stop valves in place, $30; 12-in. swing valve in place, $50; 11 x 18-in. manhole, in place, $50; 300 yds. earth excavation, 30 cts.; 225 yds. concrete in foundation, $9; 265 yds. concrete in walls, $13; 25 yds. concrete in deck, $20; 390 ft. concrete belt courses, $1; 320 ft. concrete arches, $2; 116 ft. concrete cornice work, $5; 20 ft. concrete door steps, $1 per ft.; 500 sq. yds. picked wall surface and 315 sq. yds. cement plastering on walls, 50 cts.; 110 sq. yds. asphalt on deck, 30 cts.; 18 sq. ft. vault lights, $2; double doors, $30 per pair; 24 x 36-in. trap door, $25; 12 windows, $6 each in place; 8 ventilating grates, $10 each in place; down spout, $6; concrete gate chamber, $12; 16,500 lbs. twisted steel rods, 4 cts.; painting, $35.

Force Main. Kalamein 12-in. pipe, laid, 13,200 ft., $1.75; 2,600 ft. 16-in. ditto, $2.75; 7,400 lbs. specials in place, 5 cts.; 6-in. stop valve in place, $20; 2 8-in. ditto, $25 each; 3 12-in. ditto, $35 each.

Subdivision No. 4. Earth excavation, trenching and back filling, 8,600 yds., 25 cts.; 250 ft. 24-in. steel pipe, 3/16-in. plate, in place, $3.25; 30-in. steel pipe in place, $4.20 for 3,560 ft. with 3/16-in. plate, and $6 for 1,240 ft. with ¾-in. plate; 2 30-in. stop valves with brick chambers and cast-iron covers in place, $400 each.

SEWERAGE AND SEWAGE DISPOSAL

East Cleveland, O.—Bids are wanted June 3 for brick sewers in 2 streets, and on June 17 for sewers in numerous streets. H. B. Chapman, Village Clk.

Sioux City, Ia.—An ordinance has been passed by the Council providing for construction and repair of sewers and catch basins.

Jersey City, N. J.—The Street and Water Board has reported favorably on the improvement of several streets and sewers in Lienan Place, in Garrison Ave., and trunk sewer in Marcy Ave.

Lynn, Mass.—Sewers were ordered built in 2 streets, and several others are contemplated.

Valdosta, Ga.—Maxey Ashley, City Clk., writes that it was voted May 20 to issue $35,000 sewer bonds.

Waycross, Ga.—R. P. Bird, Clk. of Council, writes that W. H. Chapman, 874 Bway, New York City, is preparing plans for a sewerage system, to cost about $20,000. Bids will probably be asked next winter.

Southbridge, Mass.—John A. Whitaker, City Engr., writes that $30,000 has been appropriated for sewer extension and construction of filter beds.

Lead, S. D.—It is stated that a sewer system will probably be put in during the summer.

Fall River, Mass.—The Common Council has passed an ordinance to construct a number of sewers.

Pottsville, Pa.—The Sewer Department has recommended the construction of a number of sewers.

Newmarket, N. H.—A correspondent writes that plans are being prepared for a sewerage system.

Houston, Tex.—An election will soon be held to vote on issuing $300,000 bonds to change the sewerage system. Alex. Potter, Consulting Engr., 137 Bway, N. Y. City.

Hibbing, Minn.—The Village Council is reported in favor of building a sewerage system.

La Crosse, Wis.—See "Water."

Rochester, N. H.—It is proposed to extend the sewerage system.

La Junta, Colo.—City Engineer Lewis has been instructed to ask for bids for sewers.

St. Louis, Mo.—It is stated that bids are wanted June 6 for repairing and reconstructing certain sewers. R. E. McMath, Pres. Bd. Pub. Improvements.

Glencoe, Ill.—Bids are wanted June 6 for grading, draining and lowering water mains for a subway under the Chicago & Northwestern Ry. Frank A. Windes, Engr., Winnetka.

Jersey City, N. J.—Bids are wanted May 31 for 4,923 lin. ft. of 18 to 54-in. brick and pipe sewers in 3 aves. Geo. T. Bouton, Clk. Bd. St. & Water Commrs.

Grand Island, Neb.—Arnold C. Koenig, City Engr., writes that it is proposed to construct 2,400 ft. of 8 in. and 200 ft. of 15 in. sewers. Other extensions are being discussed.

Oskaloosa, Ia.—There is said to be a proposition before the Council to employ an engineer to prepare plans for a system, but the construction of sewers will not begin this year.

Darby, Pa.—Bids are wanted June 5 for sewers. J. F. Wilby, Clk. of Council.

Dubuque, Ia.—Bids are wanted June 1 for 8-in. tile pipe sanitary sewers in Alpine and Cornell Sts. L. M. Langstaff, City Recorder.

Newark, N. J.—Bids are wanted May 31 for underdraining and grading the northern division of Branch Brook Park. A. Church, Secy. Essex Co. Park Com.

Newark, N. J.—Ordinances have been passed for construction of sewers in 6 streets.

Buffalo, N. Y.—Bids are wanted June 7 for a 12, 15 and 18-in. tile sewer in Cable St. R. G. Parsons, Secy. Bd. Pub. Wks.

St. Louis, Mo.—Hussey & McIntyre are reported the lowest bidder for sewer work at $38,031.50.

Auburn, Ind.—The following bids for a sewerage system are reported by City Eng. J. J. Van Auken as opened May 17 by Chmn. Bd. Town Trustees.

		1 Ring Brick Sewers.			Pipe Sewers.										
Bidders.	Residence.	600' 36", 8' cut.	500' 30", 4' cut in bottom of open ditch.	500' 27", 4' cut in bottom of open ditch.	3,000' 24" brick or pipe, 4' cut in bottom of open ditch.	400' 20", 11' cut.	13,000' 18", 12' cut.	5,500' 15", 10' cut.	15,000' 12", 8' cut.	2,500' 10", 8' cut.	9,000' 8", 8' cut.	5,000' 6", 6' cut	1,000' 4", 4' cut.	75 M. H. 10' each. 50 L. H. 8' " 250 C. B. = 5' " 900 6" House Specials. 15 Perch of Stone. 15 Tons Castings.	Totals.
G. H Bodette	Toledo Ohio	$696	$392.50	$370	$1,950	$424	$9,880	$2,860.00	$5,550	$ 800.00	$2,520.00	$ 850	$120	$3,566.80	$29,979.30
Jos. Derheimer	Fort Wayne, Ind	810	490.00	420	2,250	480	10,270	2,915.00	5,550	825.00	2,677.50	750	80	4,870.00	30,387.50
Wagner Water Supply Co	Dayton, Ohio	1,440	700.00	485	2,160	528	11,960	3,190.00	5,100	762.50	2,160.00	650	90	3,638.71	32,864 21
Ulrich-Nissley & Williams	Springfield, Ohio.	1,140	650.00	550	2 700	4-0	11,050	2,805.00	5,700	850.06	2,700.00	1,050	150	3,967.01	33,772.00
Sebert & Co. (per V. M. Backus)	Indianapolis, Ind	792	535.00	525	2,640	496	10,4.0	3,300.00	6,150	92 .00	2,880.00	1,300	250	3,808.30	33,995.30
Latta Bros. & Co	Goshen, Ind	1,788	970.00	750	2,550	420	11,700	3,125.00	5,850	800.00	2,340.00	800	80	3,3 2.00	34,516.80
M. V. Kennedy	Des Moines, Ia	900	475.00	475	2,070	374	11,.50	4,125.00	6,450	1,025.00	2,610.00	1,150	220	3,818.70	34,740.70
M. S. Jackson	Cedar Rapids, Ia	1,200	725.00	575	2,850	500	9,750	3,575.00	8,250	1,125.00	3,150.00	1,000	150	3,372.00	36,222.00
E. Woods & Co	Decatur, Ind	1,026	640.00	550	2,400	432	11,050	3,740.00	7,500	1,100.00	3,400.00	1,300	100	2 984.30	36,222.20
Wm. Erler & Co	Terre Haute, Ind	1,026	695.00	660	2,730	5 2	13,260	3,630.00	7,350	975.00	2 340.00	1,000	160	4,354.50	38,662.50
J. H. Roche	Chicago, Ill	1,110	625.00	550	2,70	640	15,600	4,125.00	6,750	1,000.00	2,250.00	1,250	180	3,851.50	40,6 1.50
C. Hatcher & Co	Tiffin, Ohio	1,200	825 00	795	2,640	576	15,600	4,125.00	7,500	1 200.00	3,960.00	1,300	110	2,961.20	40,995.00
John Munger & Co	Dayton, Ohio	1,080	750 00	600	2,850	540	14,300	6,125.00	7,500	1,125.00	3,600.00	1,250	200	3,330.75	43,326.75
O'Sullivan & Doran	Port Huron, Mich	1,110	750.00	650	3,300	560	14,950	4,175.00	7 500	1,250.00	4,050.00	1,350	140	3,544 30	43,329.30
Porter-Bohn & Hadley	Tipton, Ind	1,758	500.00	490	2 520	652	18,400	5,018.75	6,375	875.00	2,3 2,00	750	84	4,198.15	44 043.40
W. W. Hatch & Sons	Goshen, Ind	1,068	775.00	740	3,270	494	13,780	5,170.00	11,050	1,350.00	4,545.00	1,550	145	2,612.35	46,549.35
Roney & Gaasberg	Indianapolis, Ind	1,068	750.70	720	3,360	580	14,170	4 950.00	10,500	1,325.00	4,500.00	1,500	150	3,569.90	47,142.90
Wm. Bossert	Indianapolis, Ind	714	465.00	450	2,610	468	17,000	4,400.00	10,200	1,600.00	5,400.00	1,500	200	3,008.40	48,015.40
F. H. Cooper	Terre Haute, Ind	1,230	760.00	850	3,000	720	17,550	4 675.00	9,750	1,625.00	4,500.00	1,900	250	2,983.00	49,583.00
Greenville Construction Co	Greenville, Ohio	1,020	700.00	675	3,000	800	18,200	5,775.00	9 750	1,500.00	2,700.00	1,500	200	4,161.00	49,981.00
W. P. Glann Construction Co	Chicago, Ill	1,038	610.00	525	3,000	568	16,120	5,500.00	10,500	1,675.00	5,130.00	2,150	250	5,023.00	52,089.00
Engineer's estimate, with 16⅔ per cent. risk and profit		1,236	685.00	570	2,580	464	11,830	3,410.00	6,450	975.00	2,790.00	1,050	120	2,363.05	35,523.05

Mayville, N. D.—Bids are wanted June 9 for 2,500 ft. of 8 and 12-in. sewer pipe. N. D. Nelson, Supt. of Construction of the Mayville Normal School.

Fergus Falls, Minn.—Bids are wanted June 5 for 1,475 ft. of 10-in. pipe sewer on Bismarck Ave. G. A. Ericson, City Clk.

Stevens Point, Wis.—Bids are wanted June 1 for the necessary work in laying 4,386 ft. of main sewer, etc. A. F. Wyatt, City Clk.

Jacksonville, Ill.—Bids are wanted May 31 for a sewer on South Diamond St. S. A. Fairbank, Chmn. Bd. Local Improvements.

Kansas City, Mo.—Bids are wanted June 3 for sewers in Sewer Dist. No. 160, to cost about $15,000. Henry A. Wise, City Engr.

Lancaster, Pa.—See "Paving and Road Making."

Lowell, Mass.—The Sewer Committee has recommended building two sewers at $8,700.

Wilkesbarre, Pa.—The Sewer Committee has been authorized to receive bids for sewers in several streets.

Depew, N. Y.—The citizens are stated to have voted May 16 to issue $97,000 bonds to build lateral sewers.

Sheridan, Pa.—The following bids for about 16,000 ft. 10 to 18 in. sewers, 23 manholes, 16 inlets, were opened May 19. Borough Eng. Jas. B. Smith, 434 Fourth Ave., Pittsburg, estimates the trench will average 11 ft., with a quarter of it in shale: Sheets & Fishburn, Pittsburg, $14,284; Jas. McQuade, 3535 Fifth Ave., Pittsburg, $15,684; Keeling & Ridge, Miltonberger St., Pittsburg, $16,164; Cronin & O'Herron, West Carson St., Pittsburg, $14,992; Ott Bros., South Side, Pittsburg, $16,708; Angelo Pondolpho, New Kensington, Pa., $16,886; C. J. Harrold, Beaver Falls, Pa., $17,086; Wm. H. Roberts, Carnegie, Pa., $14,809; Edward H. Post, Wilkesbarre, Pa., $15,952.

Honolulu, H. I.—The itemized tenders of parties receiving contracts for sewer material for the system designed by Rudolph Hering are reported as follows by W. E. Rowell, Supt. Bd. Pub. Wks.: Session Foundry Co., Bristol, Conn., 180 manhole covers at 2.84c. per lb.; Ridson Iron Works, San Francisco, steel outfall pipe, $5.50 per ft. and 180 dirt pails at $2.40; Adams & Co., York, England, sluice, tide and flush gates, $551.25; Gladding & McBean, San Francisco, 80,340 ft. of pipe 6 to 24 in. diameter, and 8,952 bends, branches and slants, $46,672; William R. Grace & Co., San Francisco, 6,500 bbls. Josson and Eiffel Tower cement, $21,255, or $20,685 substituting 2,400 bbls. Rooster cement for the same amount of Josson brand; Ludlow Valve Mfg. Co., Troy, N. Y., 124 valves of different types, $263.

BRIDGES.

Denver, Colo.—Engineer Lowrie of the Board of Public Works estimates the cost of constructing the West Colfax viaduct at $623,700.

Des Moines, Ia.—Plans and specifications have been prepared by H. V. Hinckley for a 250-ft. Melan arch bridge to be constructed across the Des Moines river at Sixth ave., to cost about $50,000.

Clear Lake, S. D.—Bids are wanted June 5 for a bridge across the creek between Blom and Grange township. O. E. Olson, Town Clk. of Blom township.

Idaho Springs, Colo.—Plans and specifications are wanted June 5 for a bridge across Clear Creek, at Big Bar. Addison J. McCune, State Engr., Denver.

Lebanon, O.—Bids are wanted June 19 for the superstructure and masonry of the bridges over Caeser's Creek, Turtle Creek and Dry Run. I. N. Walker, Co. Aud.

Albuquerque, N. M.—Bids are wanted June 5 for a bridge over the Rio Grande River, near Cochiti. James A. Summers, Clk. Bd. Co. Commrs.

Painesville, O.—Bids are wanted June 7 for the superstructure and substructure for a highway bridge across Grand River. W. C. Tisdel, Co. Aud.

Holton, Kan.—Bids are wanted June 6 for 2 iron bridges. G. D. Abele, Co. Aud.

Cape May, N. J.—Bids are wanted June 5 for a 105-ft. steel bridge over Cape Island Creek, at Schillinger's Island. Address H. S. Rutherford.

Corralitos, Cal.—It is stated that bids are wanted by the Board of Supervisors June 5 for a combination bridge, 100 ft. span, over Corralitos Creek.

California, Ky.—Bids are wanted June 5 for the erection of the iron spans over Ten Mile and Phillips creeks. E. E. Ball, Co. Surveyor.

Paris, Ont.—It is stated that bids are wanted June 5 for a steel highway bridge. S. Dadson, Town Clk.

Petaluma, Cal.—It is stated that bids are wanted by the Board of Supervisors June 8 for a trestle bridge over Green Valley Creek.

Elkhorn, Ore.—It is stated that bids are wanted by the Council June 7 for a bridge across the North Fork of the Santiam River.

Reading, Pa.—A bill passed the Select Council for a bridge across Spring St., to cost $65,000.

Fitchburg, Mass.—See "Paving and Roadmaking."

Victoria, Tex.—The County Commissioners of Victoria and Refugio counties have agreed, it is stated, to build an iron bridge over the San Antonio River. Another bridge is said to be projected over the Guadalupe River.

Red Cloud, Neb.—The County Commissioners have been petitioned for a steel bridge across the Republican River at Amboy.

Louisville, Ky.—Press reports state that the Board of Park Commissioners will build a stone and concrete bridge, in Eastern Park, to cost about $10,000.

Cohoes, N. Y.—The Governor has signed a bill appropriating $5,000 for a bridge over the Champlain Canal at Ontario St.

Goshen, Ind.—It is stated that the County Commissioners have under consideration plans for a bridge in Olive township.

Buffalo, N. Y.—The Governor has signed a bill appropriating $18,000 for a bridge over Black Rock Harbor.

Kansas City, Mo.—See "Business Buildings."

Clarinda, Ia.—It is stated that the Humeston & Shenandoah Ry. will put in several steel bridges this summer. E. C. Murphy, Gen. Mgr.

Sewickley, Pa.—The construction of an iron bridge across the Ohio River is said to be under consideration.

Owatonna, Minn.—Press reports state that the City Auditor has been instructed to have estimates and plans submitted by bridge builders for a steel bridge at Rose St.

Norwalk, O.—Bids are wanted June 20 for the superstructure and substructure of the Linwood Ave. viaduct. T. P. Kellogg, City Clk.

Anderson, Ind.—It is stated that the County Commissioners contemplate the construction of 5 bridges.

Frankfort, Ind.—Bids are wanted June 5 for 7 bridges; also June 19 for 3 bridges. J. R. Brown, Co. Engr.

Dakotah, Ia.—Bids are wanted June 6 for a steel bridge. Harwood Sharp, Co. Aud.

McKeesport, Pa.—The United Traction Co. is said to have under consideration the construction of a viaduct across the McKeesport & Bellevernon Ry.

Keswick, Cal.—It is stated that the Board of Supervisors contemplate the construction of a bridge across the Sacramento River.

Jalapa, Mexico.—The City of Mexico Herald, of May 12, states that bids are wanted for 2 steel bridges. Address S. A. Souther, Supt. Jalapa R. R. & Power Co., P. O. Box 91.

Novelty, Wash.—Bids are wanted by the County Commissioners June 16 for a 250 ft. steel highway bridge.

Grand Rapids, O.—Press reports state that the County Commissioners of Wood and Lucas counties intend replacing the wooden river bridge with a steel one.

Pittsburg, Pa.—The following bids for 13 plate girder bridges were opened by the Commissioners of Allegheny Co. May 20: Pittsburg Bridge Co., Pittsburg, Pa., *$18,995; Schultz B. & I. Co., McKees Rocks, $19,800; Fort Pitt Bridge Works, Pittsburg, $19,995; King Bridge Co., Cleveland, Ohio, $20,685; Wrought Iron Bridge Co., Canton, Ohio, $21,250; Youngstown Bridge Co., Youngstown, Ohio, $21,253.

*Contract awarded.

PAVING AND ROADMAKING.

Troy, N. Y.—It is stated that bids are wanted June 2 for brick paving on 3 streets. E. Ogden Ross, Secy.

Scottdale, Pa.—Bids are wanted June 8 for 17,366 sq. yds. brick paving on Broadway St. Isaac D. Evans, Boro. Engr.

Philadelphia, Pa.—Wm. C. Haddock, Dir. Pub. Wks., will receive bids June 2 for paving several streets with asphalt, brick and Belgian block.

Canandaigua, N. Y.—Bids are wanted June 13 for about 3,100 yds. brick paving and about 2,800 lin. ft. of stone curbing. Geo. A. MacGrevey, Clk. Bd. Village Trustees.

Mt. Vernon, N. Y.—It is stated that bids are wanted June 6 for macadamizing and brick paving on North 10th Ave. Wm. N. Hoyt, City Clk.

Rockville, Ind.—It is stated that bids are wanted by the County Commissioners, June 8, for improving 9 highways in Penn township.

New Orleans, La.—The General Asphalt Co., and the Barber Asphalt Paving Company, New York, have received contracts at $2.22 and $2.26 respectively per sq. yd.

Montreal, Que.—The following contracts are reported awarded for different streets: Northern Cons. & Pavement Co., asphalt, $2.25 per sq. yd., 10 years' guarantee; F. D. Lawrence, scoria block, $1.57 per sq. yd. for blocks, 80 cts. hauling and laying in sand; Sicily Asphaltum Co., $1.50 per sq. yd.

Buffalo, N. Y.—Bids are wanted June 7 for paving Carroll St. R. G. Parsons, Secy. Bd. Pub. Wks.

Lawrence, Kan.—An ordinance has been passed for paving Massachusetts St. with brick on 9-in. bed of macadam and 4-in. bed of sand.

Grand Forks, N. D.—Bids are wanted June 5 for paving numerous streets. F. A. Brown, City Aud.

Topeka, Kan.—Resolutions for paving have been adopted.

Paterson, N. J.—Bids are wanted June 2 for macadamizing Milton road in West Milford township. Edw. N. Kevitt, Dir. Bd. Chosen Freeholders.

Danville, Va.—The citizens voted May 18 to issue $100,000 street improvement bonds. Robt. Brydon, City Auditor.

Pittsburg, Pa.—Bids are wanted June 7 for improving 5 roads. W. E. Thompson, Co. Compt.

Plaquemine, La.—See "Water."

Stamford, Conn.—The Hastings Pavement Co., 68 Broad St., New York City, has received the contract for paving Main St. with asphalt blocks at $2.55 per yd. exclusive of excavation. Paul Nash, City Engr.

Natchez, Miss.—See "Government Work."

Paterson, N. J.—Bids are wanted June 5 for asphalt paving on 4 streets. Thos. McLean, City St. Commr.

Chicago, Ill.—Bids are wanted May 31 (re-advertisement) for improving Diversey Ave. Boulevard. Paul Redieske, Supt. Commrs. Lincoln Park. The lowest bid was that of Sackley & Peterson, $85,108.50, $1.36 ped sq. yd.

Philadelphia, Pa.—See "Water."

Washington, Ind.—The County Commissioners, it is reported, have ordered an election June 13 on the proposition to build 59 miles of stone roads at an estimated cost of $286,610.

Crestline, O.—Bids are wanted June 3 for improving 2 miles of road in Jackson township. S. E. Fonst, Clk. Jackson township.

Glen Olden, Pa.—An election is reported for July 18 to grant $10,000 for improvements.

Ft. Wayne, Ind.—Bids are wanted June 8 for paving Lewis St.

Alexandria, Ind.—The City Council has voted to receive bids for improving Walnut St.

Burlington, Ia.—The City Engineer has been instructed to receive bids for paving Alley 7 with brick.

New Rochelle, N. Y.—Bids are wanted June 6 for $150,000 bonds to be used to improve the streets and highways. Andrew J. Selz, City Clk.

Springfield, O.—Bids are wanted June 20 for $6,526 street improvement bonds. Philip Huonker, City Clk.

Mahoney City, Pa.—The Street Committee has been directed to receive bids for paving two streets.

Rochester, N. Y.—The Executive Board has awarded two contracts for paving between the street-car tracks with Medina stone. Contractors are, Brayer & Albaugh, $30,654; Lauer & Hagaman, $17,541.

Camden, N. J.—The Camden & Suburban Railway Co. has been granted permission to pave Market St. with vitrified brick.

Camden, N. J.—The Board of Freeholders, it is said, have appropriated $34,000 for stone roads, an increase of $14,000 over last year.

Cambridge, Mass.—The Board of Aldermen have appropriated $50,965 for granite block and vitrified brick paving.

Easton, Pa.—Bids are wanted June 2 for about 8 miles of macadam and telford macadam road. William Coyle, Chmn. Co. Commrs.

Mt. Sterling, Ky.—It is reported that Jennings township has voted to build 16 miles of road.

Milwaukee, Wis.—The Board of Public Works has recommended paving National Ave. with brick; estimated cost, $35,000.

Jersey City, N. J.—See "Sewerage and Sewage Disposal."

Moline, Ill.—Fourth Ave., it is said, will be paved this summer.

Newburgh, N. Y.—Liberty St., it is said, is to be paved with asphalt block, at a cost of $26,-667. A bond issue has been ordered.

Crown Point, Ind.—Bids are wanted June 5 for macadamized roads in Cedar Creek township. Michael Grimmer, Co. Aud.

Johnstown, N. Y.—The Common Council has decided to pave Washington St. with brick.

Chicago, Ill.—The following bids, according to reports, were received by Commr. of Pub. Wks. McGann for cycle path to connect north and south boulevards: Barber Asphalt Co., $1.20 per sq. yd.; Bermudez Asphalt Co., $1.79; Schillinger Bros.' Co., $1.97, and R. F. Conway Co., $2.48.

Boston, Mass.—A $17,960 contract has been awarded to Patrick McGovern, Boston, at the following rates on items: Edge stone, 17c.; granite block paving, $1.97; crosswalk flagging, $4; foundations for plank sidewalks, 37c.

Erie, Pa.—The following bids per sq. yd. are reported received for brick paving of Holland St.: Kraft & Walther, $1.73 for fire clay wire-cut Park brick, contract awarded; John McCormick & Son, $1.74 for Mack brick, $1.77 for Park, $1.83 for Canton red granite and $1.82 for Johnsonburg brick; Mayer Bros., $1.92 for Advance fire-clay, $1.94 for Park and for Canton shale wire-cut, and $1.99 for Canton repressed imperial.

Merchantville, N. J.—The following bids were received by the Camden County Commissioners, Camden, N. J., for constructing a stone road 2½ miles through this place: J. R. Shanley,* $12,900; J. W. Ireland, $13,632; Dennis Roe, $13,100.

*Contract awarded.

Birmingham, Ala.—The following contract has been awarded to C. M. Burkhalter & Co., Birmingham, for grading, curbs and chert-slag pavement; Julian Kendrick, City Engr.: 30,000 ft. 6x20-in. granite curb, 34¼ cts.; 3,000 ft. granite curb, same size, on 10-ft. radius, 36 cts.; 18,-000 cu. yds. excavation, 20 cts.; 3,000 cu. yds. slag, 50 cts.; 2,000 cu. yds. chert, 75 cts.

Washington, D. C.—The following bids for various pavements were opened May 20 by the District Commissioners; *a* being for 2½-in. asphalt surface, 2-in. binder and 6-in. hyd. base; *b* for vitrified block on 6-in. hyd. base, and *c* for granite block: Ayres Asphalt Paving Co., Zanesville, O.; *a*, $1.80; *b*, $1.40; *c*, 58 cts. Cranford Paving Co., Washington; *a*, $1.78; *b*, $1.38; *c*, $1.30. Barber Asphalt Paving Co., New York; *a*, $1.79; *b*, $1.40; *c*, $1.35. Southern Asphalt Paving Co., Baltimore; *a*, $1.79½; *b*, $1.47; *c*, $1.44. The Barber company also bid at the rate of $1.69, $1.40 and $1.35 for the three classes, provided all work scheduled to be done in sheet asphalt, asphalt block or granite block during the fiscal year should be done as sheet asphalt and awarded under this bid.

Bids were also opened for asphalt block pavements at the same time; *a*, on gravel; *b*, on 4 ins. concrete. Maryland Paving Co., Baltimore; *a*, $1.80. Southern Asphalt Paving Co., Baltimore; *a*, $1.75; *b*, $1.95. Washington Asphalt Block & Tile Co., Washington; *a*, $1.77; *b*, $2.00.

POWER PLANTS GAS AND ELECTRICITY.

Newark, N. Y.—The new Light, Heat & Power Co. is stated to have received the contract for lighting the village for 5 yrs. with arc lights of 2,000 c. p. at $19.95 per light per yr. Frank Garlock, Pres.

Colorado Springs, Colo.—The Colorado Springs Light & Power Co. is said to be considering the extension of its plant and the purchase of additional machinery.

Red Oak, Ia.—It is stated that the Red Oak Electric Co. will expend about $15,000 on improvements.

Newport, R. I.—See "Government Work."

Durand, Wis.—The Durand Light & Power Co. is stated to have decided to rebuild the water power dam at Eau Galle and transmit power to this city. Directors: Geo. Tarrant, Jr., Frank Pierce and others.

Scottsboro, Ala.—The Council is reported to be negotiating with the Stegall Co. to put in an electric plant in its mill.

Princeton, Minn.—See "Water."

Redwood City, Cal.—See "Water."

Elk Rapids, Mich.—The Elk Rapids Iron Co. is stated to have decided to install an electric plant for lighting its mill and store. Later the village will probably be furnished.

Lakefield, Minn.—See "Water."

Jackson, Minn.—The citizens have voted to issue $10,000 bonds for an electric light plant.

Indianapolis, Ind.—The Central Power Co. has been incorporated, with a capital of $10,000, to furnish electric power. Directors: Peter Kretzer, Albert Nicholas and others.

Brownstown, Ind.—See "Water."

Defiance, O.—The Frank B. Rae Engineering Co. of Chicago has been authorized by the Council to prepare plans for an electric light plant.

Rochester, N. Y.—The Elwood Electric Co. has been incorporated; capital, $2,500. Directors: Alfred Elwood, Chas. A. Elwood and W. Irving Peacock, Rochester.

Plaquemine, La.—See "Water."

Coraopolis, Pa.—The Council is stated to have accepted the proposition from the Bellevue & Glenfield Natural Gas Co. to furnish gas. The borough has an electric light plant, and it is proposed to add new machinery and remodel the plant. A generating plant sufficient to supply 2,000 lights for street purposes will be put in.

Washington, D. C.—See "Government Work."

Buffalo, N. Y.—The Empire State Natural Gas Co. has been incorporated; capital, $12,000. Directors: Chas. O'Day, Pittsburg; Edwin A. MacPherson and Geo. W. Sloan, Buffalo.

East Grand Fork, Minn.—See "Water."

Ft. Benton, Mont.—The City Clerk writes that the city wants estimates on a 500 incandescent light plant.

Creighton, Neb.—It is stated that bids are wanted June 1 for machinery for the plant of the Creighton Electric Light Co.; probable cost, $3,500. Address A. P. Schneider.

Jonesboro, Ill.—It is stated that the Council will receive bids June 5 for an electric light plant, from plans of R. W. Shaw of the Ft. Wayne Electric Light Co., Ft. Wayne, Ind.

New York, N. Y.—See "Schools."

New Hartford, Ia.—A franchise has been granted for a gas plant.

Springfield, O.—The Board of Snyder Park Commissioners is said to be considering the matter of erecting a light and power plant in the upper park, from plans prepared by Wm. Bayley.

Washington, D. C.—See "Government Work."

Gainesville, Ga.—D. E. Evans, 9 E. Spring St., Gainesville, writes that bids are wanted June 10 for an electric plant to cost about $265,000.

Beaver Dam, Wis.—C. D. Smith of Fond du Lac, is said to be interested in the question of erecting and maintaining an electric power and light plant for Beaver Dam, Horicon, Mayville and Juneau.

Covington, Ky.—It is stated that bids will soon be asked for lighting the city.

Ft. Lee, N. J.—R. H. Story, of New York City, is stated to have petitioned the Township Committee for a franchise for an electric light plant.

La Salle, Ill.—The Enterprise Light, Heat and Power Co. is stated to have applied for a franchise for an electric light plant.

Three Oaks, Mich.—See "Water."

Dorranceton, Pa.—It is stated that it is proposed to build an electric plant, jointly with Luzerne. Councilman Kileen, of Luzerne, Pa., and C. B. Johnson, of Dorranceton, are reported interested.

Williamsport, Md.—Bids are wanted May 31 for an electric light plant. L. T. Byron, Chmn. Bd. Superv.

Wallingford, Conn.—Bids are wanted June 1 for an electric light plant. Isaac W. Bull, Chmn. Electric Lighting Com.

Oakland, Cal.—Bids are wanted June 5 for lighting the streets and public buildings with electricity. J. W. Tompkins, City Clk.

Abbeville, S. C.—Bids are wanted June 15 for lighting the streets with electricity for 3 or more years. Dr. G. A. Neuffer, Chmn.

Camden, N. Y.—The Vrooman Gas Co. has been incorporated; capital, $10,000. Directors: Lyman P. Haviland, Hiram G. DuBois, Chas. W. Vrooman and others, all of Camden.

Richmond, Va.—The following bids were opend May 16 by the Virginia Electric Ry. & Development Co. for the construction of dams across James River, enlarging canal and power house foundations for the water-power station. Winston & Co., Louisa, Va., $128,930; Walter Bradley & Co., Oswego, N. Y., $142,996; Warren-Scharf Asphalt Paving Co., New York, $153,381; J. M. Douglas & Co., Baltimore, $169,350.50; S. W. Travers, A. R. Ellerson and E. T. D. Myers, Jr., of Richmond, $191,235; Lane Bros. & Co., Esmont, Va., $203,-932; Engineering Contract Co., New York, $222,-800; Gooch, Rhinehart & Dennis, Richmond, $232,800.

The contract was awarded to Winston & Co., whose itemized bid was as follows: Coffer dams, $7,000; 40,000 cu. yds. earth excavation, 26 cts.; 40,000 cu. yds. rock excavation, 69 cts.; 10,000 cu. yds. Portland cement concrete, $4.85; 6,000 cu. yds. natural cement concrete mixed 1, 2½ and 5, $3.65; 4,000 cu. yds. natural cement concrete mixed 1, 3 and 6, $3.25; 8,500 sq. yds. half-inch neat Portland cement floor surfacing, 50 cts.; 3,000 lbs. ironwork in place, 3½ cts.

ELECTRIC RAILWAYS.

Mt. Vernon, N. Y.—The Union Ry. Co. is stated to have received a franchise to build a line from Chester Hill to West Mount Vernon to connect with the Yonkers line.

Kalamazoo, Mich.—The Council has granted a franchise to the Grand Rapids & Kalamazoo Electric Ry. Co. to enter the city and construct a line to Gull lake.

Lebanon, Pa.—The Lebanon Valley St. Ry. Co. is stated to have secured right of way for a line between Annville and Palmyra, a distance of 5 miles.

Youngstown, O.—It is stated that the Mahoning Valley Electric Ry. Co. will expend about $300,000 in improving its system. A. A. Anderson, Gen. Mgr.

Madison, Wis.—It is stated that the Madison Electric Ry. Co. will expend $7,000 on improvements this summer. F. W. Oakley, Pres.

Auburn, N. Y.—The Auburn Interurban Electric R. R. Co. has applied for a franchise.

Columbus, O.—It is stated that a company has been formed here to build an electric railway from Columbus to Johnstown, a distance of about 22 miles. Incorporators: D. J. Ryan, former Secretary of State; Thos. Cassidy, former County Commissioner, and others.

Hagerstown, Md.—Douglass Bros. have received a franchise for a trolley line between this place and Myersville.

Hampton, Va.—The Newport News & Old Point Ry. & Electric Co. is stated to have received a franchise.

Penn Yan, N. Y.—The Penn Yan, Lake Keuka & Southern R. R. Co. has been incorporated with a capital of $400,000 to construct an electric railway 35 miles long. Directors: A. P. Zimmerman of Bradford, Henry D. Mason of New York City, Clement C. Covert of Binghamton, Coleman Graves of Hoboken, N. J., and others.

White Bear Lake, Minn.—The Twin City Rapid Transit Co. has received a franchise.

Pomeroy, O.—Bids will be received by the Council June 5 for the construction and operation of an electric railway from the Kanawha & Michigan Railway to Racine.

Camden, O.—Bids are wanted June 12 for the construction and operation of a street railroad on Main St. Jos. F. Decker, Village Clk.

RAILROADS.

Trenton, Ont.—Bids are wanted June 6 for extending the Central Ontario R. R. 21 miles to Bancroft. John D. Evans, Ch. Engr.

Chicago, Ill.—D. Grant & Co. of Faribault, Minn., are stated to have secured the contract for about 85 miles of railroad for the Chicago, Milwaukee & St. Paul Ry. Co. in Iowa.

PUBLIC BUILDINGS.

(See also Schools and Government Work.)

Rome, N. Y.—The Governor has signed the bill appropriating $75,000 for the equipment and for additional buildings at the Rome Custodial Asylum.

Newport, Ore.—It is stated that bids are wanted June 8 by the County Judge for a court house.

Sparta, Wis.—The Poorhouse Building Committee is stated to have adopted the plans of Chandler & Parks, of Racine, for a building for Monroe County; probable cost $15,000. J. W. Leverich, Chmn., Angelo.

Appleton, Wis.—It is stated that contracts were let May 16 for the city hall and library as follows: Mason and stone work, Hackworthy Construction Co., $16,283; carpenter work, Sager & Boeske, $9,130; plumbing, Henry Nichols, $1,027; all of Appleton.

Baton Rouge, La.—See "Water."

Philadelphia, Pa.—Chas. P. Nesbitt, 425 Locust St., has received the contract to erect granite church at 8th and Daily Sts. for Mizpah Presbyterian Church; cost $10,500. Thos. P. Lonsdale, Archt., Manhattan Bldg.
Burd P. Evans, 706 N. 9th St., has received the contract to erect church at 12th and Lehigh Av. for Lehigh Avenue Baptist Church. Cost $21,000. Isaac Purcell, Archt., 119 S. 4th St.

Elwood, Ind.—J. J. Woods, of Elwood, is stated to have received the contract for the city building, at $27,772.

Chicago, Ill.—Henry L. Newhouse, 3640 Prairie Ave., is stated to have prepared plans for a synagogue to be erected on Indiana Ave. near 35th St.; estimated cost $25,000.

Dannemora, N. Y.—The Governor has signed the bill appropriating $72,910 for the construction of a boiler house for the Dannemora State Hospital.

St. Johns, Mich.—Bids are wanted June 10 for a church. P. E. Walsworth, Chmn.

Wayne, Neb.—The contract for building the court house is stated to have been awarded to Rowles & Moore, of Omaha, at $25,000.

New York, N. Y.—Bids are wanted June 2 for estimates for preparing for and for completing the recreation building at North 2d St., Borough of Brooklyn. J. Sergeant Cram, Chmn. Commrs. composing the Bd. of Docks.

New York, N. Y.—The Trustees of St. Patrick's Cathedral, 50th St. and 5th Ave., will soon receive bids for the Lady Chapel, to cost about $100,000.

Central City, Colo.—Lamont & Ballard are stated to have received the contract to erect the court house at $21,751.

Peoria, Ill.—It is stated that the Commissioners of the Peoria Hospital for the Incurable Insane will receive bids for the construction of buildings costing $206,000. There will be 9 cottages costing $15,000 each, one hospital costing $25,000, one dining hall costing $10,000, besides buildings for stock, etc.

Albany, N. Y.—Bids are wanted June 5 for a public bath. Thos. J. Lanahan, Clk. Bd. Contract & Apportionment.

Faribault, Minn.—Bids are wanted in June for a hospital for the State School for the Feeble-minded, to cost about $20,000. Clarence H. Johnson, Archt., St. Paul.

Dover, N. J.—Bids are wanted by the Board of Trustees of the Hoagland Memorial Church June 8 for a church.

Wellington, Kan.—It is stated that bids are wanted by the County Commissioners June 20 for a jail.

Oglethorpe, Ga.—Bids are wanted June 15 for a jail. A H. Perry, Clk. Co. Commrs.

New York, N. Y.—A $50,000 building will be added to the Woman's Hospital, 50th St. & Park Ave.

Schenectady, N. Y.—Bids are wanted for an edifice for St. John's Church, as advertised in "The Engineering Record."

Columbus, O.—The following bids are stated to have been opened May 17 by the State House Building Commission for the construction of the new boiler plant: Borger Bros. & Co., Columbus, $12,990; Fitzpatrick & Hoepfner, Columbus, $13,435; Pittsburg Heating Co., $13,994; Turner Engineering Co., Marion, $12,750.52; Rarig Engineering Co., Columbus, $17,200; W. H. Drayer, Middletown, $13,458.65; Saunders & Esswein, Columbus, $13,400; Chaffer & Becker, Cleveland, $17,376.

Des Moines, Ia.—Bids are wanted June 3 for a library. Smith & Gutterson, Archts.

Rochester, N. Y.—Wm. J. Brockett, Powers Blk., is stated to have prepared plans for a $50,000 edifice for the Evangelical Church of the Reformation, on Grove St.

BUSINESS BUILDINGS.

Lewisburg, Pa.—Bids are wanted June 13 for a bank. J. Thompson Baker, Pres. Union Natl. Bank.

Philadelphia, Pa.—Geo. F. Payne & Co., 401 S. Juniper St., have received the contract to erect a new plant for the Charles Scott Spring Works, Hancock and Market Sts. Cost $50,000.

A. Raymond Raft, 1635 Thompson St., has received the contract to erect a 5-story building on 13th and Hamilton Sts. for David Stewart. Cost $70,000.

Worcester, Mass.—Chas. H. Lincoln, 6 Park Ave., has prepared plans for a $12,000 addition to the factory of the Graton & Knight Mfg. Co.

Peekskill, N. Y.—It is stated that the contract for the plant which Fleischmann & Co. of Long Island City is to erect here has been awarded to F. G. & G. T. Van Riper of Long Island City. The contract covers 28 brick buildings.

Lancaster, O.—Yost & Packard of Columbus will prepare plans for a $15,000 depot to be erected here.

LaCrosse, Wis.—The Board of Trade is said to be interested in a project to build a $125,000 hotel. Col. F. A. Copeland, Chmn.

Russellville, Ala.—J. W. McClain & Co. of Birmingham have prepared plans for a $12,000 bank and business building for W. A. Orman.

Newport News, Va.—J. T. Patterson will erect an $18,000 brick building and store on Washington Ave.

P. T. Mayre has prepared plans for a department store for Griffith & Lewis, to cost $16,000.

Americus, Ga.—The Directors of the Planters' Bank are stated to have decided to erect a $30,000 bank.

New Haven, Conn.—The plans of Brown & Van Beren, of New Haven, have been accepted for the new Y. M. C. A. building; probable cost, $150,000.

Newark, N. J.—It is stated that the Newark Athletic Club will erect a $100,000 club house.

Leavenworth, Kan.—Wm. P. Feth has prepared plans for a $15,000 Y. M. C. A. building.

NEW INDUSTRIAL PLANTS.

Mr. John J. Holmes, Detroit, Mich., is having plans drawn and estimates prepared for a cement factory at Iola, Kan. It is to have a capacity of 2,500 bbls. per day and the necessary power and machinery are wanted.

The Diamond State Steel Co., Wilmington, Del., will build an addition for an open-hearth steel plant, of 400 tons daily capacity, together with necessary blooming and universal mills. The contracts have not yet been placed.

The Seneca White Lime Co., Fostoria, O., has begun the erection of a lime manufacturing plant of 1,000 bbls. daily capacity. Mr. W. S. Sutliff, Mngr., writes that considerable machinery will be required, including a power plant of 150 H.-P., machinery for grinding, conveying, packing, weighing and hoisting, and automatic furnace stokers. Eight kilns of brick and steel will be built.

W. M. Armstrong, Wye Mills, Md., is erecting a 23x65-ft. ice plant of 5 tons capacity.

The Rockford Mitten & Hosiery Co., Rockford, Ill., is erecting an addition to its plant, 54x90 ft., 3 stories high.

J. A. Campbell & Son are to erect at once a wood and brick mill and elevator at Atlantic, Ia., at a cost of $10,000, and equipped with 60-H.-P. automatic engine and 75-H.-P. boiler.

A. G. Winter, Genl. Mgr. The Marsden Co., writes from Owensboro, Ky., that it will erect a factory near Newport News, Va., and another at Linden, Indiana; covering in each case about 5 acres. A power plant, including electric lighting, of 200-H.-P., is yet to be contracted for. Cellulose for packing cofferdams of war vessels, making smokeless powder, dynamite, etc., will be made from corn stalks and the remainder will be made into cattle food.

H. C. Bradley, Bridgeport, Conn., is about to build a stone factory, 50x190 ft., 3 stories high, and will want a 100-H.-P. medium-speed engine and a 100-H.-P. boiler, together with elevator, main shafting and hangers.

The Milwaukee Harvester Co., Milwaukee, Wis., is considering making some addition to its factory.

BUSINESS NOTES.

The exhibits at the Annual Convention of the American Water-Works Association last week at Columbus were unusually interesting and the profit to be derived by the members from the sessions was enhanced by the care with which various features were arranged.

Thomas Watkins, Johnstown, Pa., showed various sizes of the patent pipe jointer which he manufactures.

Henry R. Worthington, Brooklyn, displayed an interesting set of meters, including a 2-inch all brass hot-water meter, with an adjustable buffer, a 1-inch hot-water meter, with connections for testing, several of the standard type for water, an oil meter having a vertical counter, sectional and test meters of a new pattern, a quarter-inch special oil meter and various fittings and parts of such apparatus. The company also showed a number of large photographs of pumping engines.

The Thomson Meter Company, Brooklyn, displayed a full line of Lambert meters from 5/8 to 2 inches in size.

The Neptune Meter Company, New York, was represented by a line of Trident meters up to 4 inches in size, which illustrated the new features recently added by Mr. John Thomson, M. Am. Soc. C. E.

The Washington-Goodwin Meter Company, No. 1 Broadway, New York, a new concern, exhibited several meters which it is just putting on the market. These are of the positive displacement type, and have a method of taking up wear which it is claimed makes repairs unusually easy.

The Lead-Lined Iron Pipe Co., Wakefield, Mass., exhibited samples of lead-lined iron pipe and fittings, which have been in successful use for a number of years.

The National Meter Company, New York, had an exhibit of Nash and Crown meters and photographs of large meters and of gas engines, the latter attracting particular attention on account of the favor with which gas engines have been received for operating small pumping stations.

The Ross Valve Company, Troy, N. Y., showed a water engine for blowing church organs, various types of valves, and the oil filter which was recently described in these pages.

The Hersey Manufacturing Co., South Boston, was represented by the various types of water meters which it manufactures.

The Union Water Meter Co., Worcester, showed both its types of water meters of various sizes and also the pressure regulator which it has introduced into many plants.

The Pittsburg Meter Company, East Pittsburg, Pa., exhibited a line of disk meters up to 6 inches in size, and showed the new Westinghouse fish trap.

The H. Mueller Manufacturing Company, Decatur, Ill., displayed a large line of pressure regulators, pipe tapping machines, valves, couplings, branches and other fittings.

The Columbus Brass Co., Columbus, showed the Wilkins universal water lift, valves, cocks, faucets, hooks and various bath room fittings, which it is introducing.

The Fischer Governor Company, Marshalltown, Ia., showed the Fischer governor for pumping engines, which is already well known by many water-works engineers and superintendents.

The Waterhouse-Forbes Co., Philadelphia, Pa., displayed two types of the water sterilizer which it has recently been introducing, one for portable use and the other for permanent installation.

The Eddy Valve Company, Waterford, N. Y., displayed a line of hydrants, valves and sluice gates of various forms.

The A. P. Smith Manufacturing Co., Newark, N. J., showed a line of lead furnaces, special fittings, valves, and the tapping machines which Mr. Smith has been making for a number of years.

The R. D. Wood Company, Philadelphia, showed the Mathews hydrant, an indicator valve post, gate valves and other water-works supplies, with which every superintendent should be familiar.

The Payne Tapping Machine Co., Fostoria, O., showed new patterns of corporation cocks and fish traps, as well as its tapping machine.

PROPOSALS OPEN.

Bids Close		See Eng. Record

WATER-WORKS.

June 1.	Pipe, Tupper Lake, N. Y.	May 20
June 1.	Reservoir, Media, Pa.	May 20
	Adv., Eng. Record, May 20.	
June 1.	North Braddock, Pa.	May 20
	Adv., Eng. Record, May 20, 27.	
June 5.	Well, Indianola, Miss.	May 20
June 5.	Winnipeg, Man.	May 6
	Adv., Eng. Record, May 6 to 20.	
June 5.	Montgomery, Ala.	May 27
June 5.	Pipe, etc., Albany, N. Y.	May 27
June 6.	Tyler, Minn.	May 20
June 6.	Pipe, etc., New York, N. Y.	May 20
June 6.	Pipe, etc., Albany, N. Y.	May 20
June 6.	Well, Arvilla, N. D.	May 27
June 9.	Water Tower, Murphysboro, Ill.	May 20
	Adv., Eng. Record, May 20.	
June 13.	Pipe, Cincinnati, O.	May 13
	Adv., Eng. Record, May 13 to 27.	
June 15.	Tank, Nappanee, Ind.	May 27
June 15.	Hartford, Mich.	May 27
	Adv., Eng. Record, May 27.	
June 27.	St. Louis, Mo.	May 6
July 3.	Softening plant, Winnipeg, Man.	May 27
——	Grand Forks, N. D.	Apr. 22
——	Peekskill, N. Y.	Apr. 15
	Adv., Eng. Record, Apr. 15, 22.	
——	Napoleonville, La.	Mar. 25
——	Corinth, Miss.	Mar. 25

SEWERAGE AND SEWAGE DISPOSAL.

May 31.	Jersey City, N. J.	May 27
May 31.	Newark, N. J.	May 27
June 1	Stevens Point, Wis.	May 27
June 1.	Brussels, Ont.	May 20
June 2.	Cincinnati, O.	May 13
June 3.	Kansas City, Mo.	May 27
June 3.	East Cleveland, O.	May 27
June 5.	Jamestown, N. D.	May 13
June 5.	Hillsboro, N. D.	May 13
June 5.	Albany, N. Y.	May 20
June 5.	Hackensack, N. J.	May 20
	Adv., Eng. Record, May 20, 27.	
June 5.	Fergus Falls, Minn.	May 27
June 5.	Darby, Pa.	May 27
June 6.	Glencoe, Ill.	May 27
June 6.	St. Louis, Mo.	May 27
June 6.	Waterbury, Conn.	May 27
	Adv., Eng. Record, May 27.	
June 6.	Pipe, Oberlin, O.	May 13
June 6.	Trenton, N. J.	May 20
June 6.	Stoneham, Mass.	May 20
	Adv., Eng. Record, May 20, 27.	
June 7.	Elkhart, Ind.	May 20
June 7.	Buffalo, N. Y.	May 27
June 8.	New Brighton, Pa.	May 27
	Adv., Eng. Record, May 27.	
June 9.	Mayville, N. D.	May 27
June 12.	Muncie, Ind.	May 20
June 15.	Glenville, O.	May 20
June 17.	East Cleveland, O.	May 27
July 5.	New Orleans, La.	Apr. 29
	Adv., Eng. Record, May 6 to 27.	

BRIDGES.

June 2.	Wyalusing, Pa.	May 20
June 3.	Superstructure, Buffalo, N. Y.	May 27
	Adv., Eng. Record, May 27.	
June 5.	Corralitos, Cal.	May 27
June 5.	Paris, Ont.	May 27
June 5.	California, Ky.	May 27
June 5.	Cape May, N. J.	May 27
	Adv., Eng. Record, May 27.	
June 5.	Albuquerque, N. M.	May 27
June 5.	Idaho Springs, Colo.	May 27
June 5.	Clear Lake, S. D.	May 27
June 5.	Gallatin, Mo.	May 20
June 5.	Frankfort, Ind.	May 27
June 6.	Humboldt, Ia.	May 13
June 6.	Cumberland, Md.	May 13
June 6.	Gibson, Ga.	May 20
June 6.	Holton, Kan.	May 27
June 6.	Dakotah, Ia.	May 27
June 7.	Painesville, O.	May 27
June 7.	Elkhorn, Ore.	May 27
June 7.	Elkhorn, Ore.	May 20
June 8.	Plymouth, Ind.	May 13
June 8.	Petaluma, Cal.	May 27
June 14.	Hillsboro, N. D.	May 20
June 16.	Fullerton, Neb.	May 20
June 16.	Novelty, Wash.	May 20
June 19.	Lebanon, O.	May 27
June 19.	Frankfort, Ind.	May 27
June 20.	Norwalk, O.	May 27
June —.	Rodney, Miss.	May 20
——	Quincy, Ill.	Feb. 25
	Adv., Eng. Record, Feb. 25.	
——	Bradford, Pa.	Apr. 15
——	Randolph, Utah	Apr. 15

PAVING AND ROADMAKING.

June 1.	Elizabeth, N. J.	May 20
June 1.	Buffalo, N. Y.	May 20
June 1.	North Adams, Mass.	May 20
	Adv., Eng. Record, May 20.	
June 1.	Ann Arbor, Mich.	May 27
	Adv., Eng. Record, May 27.	
June 2.	Shelby, O.	May 13
	Adv., Eng. Record, May 13.	
June 2.	Bethlehem, Pa.	May 20
June 2.	Orville, O.	May 20
June 2.	Easton, Pa.	May 27
June 2.	Philadelphia, Pa.	May 27
June 2.	Troy, N. Y.	May 27
June 2.	Paterson, N. J.	May 27
June 3.	Kansas City, Mo.	May 27
June 3.	Crestline, O.	May 27
June 5.	Natchez, Miss.	May 27
June 5.	Paterson, N. J.	May 27
June 5.	Crown Point, Ind.	May 27
June 5.	Bond Hill, O.	May 20
June 5.	Hasbrouck Heights, N. J.	May 20
June 5.	Muncie, Ind.	May 13
June 5.	Grand Forks, N. D.	May 27
June 6.	Mt. Vernon, N. Y.	May 27
June 6.	Portsmouth, O.	May 13
June 6.	Maintenance, Terre Haute, Ind.	May 20
	Adv., Eng. Record, May 20, 27.	
June 6.	Coldwater, Mich.	May 27
	Adv., Eng. Record, May 27.	
June 7.	Pittsburg, Pa.	May 27
June 7.	McConnelsville, O.	May 20
June 7.	Buffalo, N. Y.	May 27
June 8.	Rockville, Ind.	May 27
June 8.	Scottdale, Pa.	May 27
June 8.	Ft. Wayne, Ind.	May 27
June 12.	Muncie, Ind.	May 20
June 12.	Camden, N. J.	May 27
June 13.	Canandaigua, N. Y.	May 27

POWER, GAS AND ELECTRICITY.

May 31.	Williamsport, Md.	May 27
June 1.	Wallingford, Conn.	May 27
June 3.	Washinfiton, D. C.	May 27
June 5.	Darby, Pa.	May 20
June 5.	Jonesboro, Ill.	May 27
June 5.	Oakland, Cal.	May 27
June 10.	Gainesville, Ga.	May 27
June 15.	Abbeville, S. C.	May 27
June 15.	Washington, D. C.	May 27
June 15.	Petrolia, Ont.	May 13
June 20.	Danville, Ky.	May 20
——	Pleasantville, O.	Dec. 24

GOVERNMENT WORK.

May 27.	San Francisco, Cal.	Apr. 29
	Adv., Eng. Record, Apr. 29, May 6.	
May 29.	Dredging, San Francisco, Cal.	May 6
May 29.	Louisville, Ky.	May 6
May 31.	Armor plate, Washington, D. C.	Apr. 8
May 31.	St. Louis, Mo.	Apr. 22
	Adv., Eng. Record, Apr. 22, 29, May 13, 27.	
May 31.	Rock Island, Ill.	Apr. 29
	Adv., Eng. Record, Apr. 29 to May 27.	
May 31.	St. Augustine, Fla.	May 6
	Adv., Eng. Record, May 6, May 20, 27.	
May 31.	Bldgs., Atlanta, Ga.	May 13
May 31.	Bldg., etc., Spokane, Wash.	May 13
June 3.	Excavating, etc., New York City	May 6
	Adv., Eng. Record, May 6 to 27.	
June 3.	Dredging, New York City	May 6
	Adv., Eng. Record, May 6 to 27.	
June 3.	Addition, etc., hospital, Washington, D. C.	May 27
June 5.	Natchez, Miss.	May 27
June 5.	Hospital, Shoshone Agency, Wyo.	May 20
June 5.	Hospital, etc., Madison Barracks, N. Y.	May 13
June 7.	Repairing Custom House, Detroit, Mich.	May 13
	Adv., Eng. Record, May 13, 20.	
June 8.	Dredging, New London, Conn.	May 6
June 8.	Dredging, Newport, R. I.	May 13
	Adv., Eng. Record, May 13 to 27.	
June 8.	Levee work, New Orleans, La.	May 13
	Adv., Eng. Record, May 13 to 27.	
June 8.	Wreck and dredging, Philadelphia, Pa.	May 13
June 8.	Cement, Portland, Me.	May 27
	Adv., Eng. Record, May 27.	
June 9.	Piers, Holland, Mich.	May 13
June 9.	Dredging, Cleveland, O.	May 13
	Adv., Eng. Record, May 27.	
June 9.	Dredging, Mobile, Ala.	May 13
	Adv., Eng. Record, May 13 to 27.	
June 9.	Dredging, New London, Conn.	May 6
June 10	Bremerton, Wash.	May 6
June 10.	Dry dock, San Francisco, Cal.	Apr. 15
June 10.	Dredging, Grand Haven, Mich.	May 20
June 10.	Bldg., Fort Monroe, Va.	May 27
June 12.	Breakwater, New York, N. Y.	May 13
	Adv., Eng. Record, May 13 to 27.	
June 12.	Dredging, Portland, Me.	May 13
	Adv., Eng. Record, May 13 to 27.	
June 12.	Excavation, Portland, Me.	May 13
	Adv., Eng. Record, May 13 to 27.	
June 12.	Breakwater, Cleveland, O.	May 20
	(2 advts.) Eng. Record, May 27.	
June 14.	Piers, Muskegon, Mich.	May 20
June 14.	Post office, Newport, Ky.	May 20
	Adv., Eng. Record, May 20, 27.	
June 15.	Dredging, Portland, Me.	May 13
	Adv., Eng. Record, May 13 to 27.	
June 15.	Htg., etc., Washington, D. C.	May 13
June 15.	River Work, Galveston, Tex.	May 20
June 15.	Dredging, Tampa, Fla.	May 20
	Adv., Eng. Record, May 20, 27.	
June 15.	Dredging, Chicago, Ill.	May 20
	Adv., Eng. Record, May 20, 27.	
June 15	Dredging, etc., Newport, R. I.	May 20
	Adv., Eng. Record, May 20, 27.	
June 15.	Power Plant, New Orleans, La.	May 20
	Adv., Eng. Record, May 20, 27.	
June 15.	Dredging, New Orleans, La.	May 20
	Adv., Eng. Record, May 20, 27.	
June 15.	Elec. light plant, Washington, D. C.	May 27
June 15.	Bldg., Ft. Trumbull, Conn.	May 27
	Adv., Eng. Record, May 27.	
June 17.	Dump scows, Chattanooga, Tenn.	May 20
	Adv., Eng. Record, May 20, 27.	
June 19.	Fort Meade, S. D.	May 27
June 19.	Bldg., htg., etc., Ft. Ethan Allen, Vt.	May 27
	Adv., Eng. Record, May 27.	
June 20.	Bldg., Helena, Mont.	May 20
	Adv., Eng. Record, May 20, 27.	
June 21.	Riprap rock and brush, Rock Island, Ill.	May 27
	Adv., Eng. Record, May 27.	
June 22.	Iron, etc., Watertown, Mass.	May 27
June 22.	Removing rock, dredging, etc., New York, N. Y.	May 27
	Adv., Eng. Record, May 27.	
June 22.	Breakwater, Chicago, Ill.	May 27
	Adv., Eng. Record, May 27.	
June 22.	Flat boats, St. Louis, Mo.	May 27
	Adv., Eng. Record, May 27.	
June 24.	El. light plant, Newport, R. I.	May 27
	Adv., Eng. Record, May 27.	
June 24.	Dreding and excavation, New York, N. Y.	May 27
	Adv., Eng. Record, May 27	
July 25.	Jetties, Portland, Ore.	May 27
	(3 advs.) Eng. Record, May 27.	
June 26.	Gates, Cincinnati, O.	May 27
June 27.	Gates, St. Paul, Minn.	May 27
	Adv., Eng. Record, May 27.	

BUILDINGS.

May 29.	Schools, New York, N. Y.	May 27
May 29.	School, Salina, Kan.	May 27
May 30.	School, Mansfield, O.	May 27
May 30.	School, Tebamah, Neb.	May 13
May 30.	Drill hall, Vancouver, B. C.	May 13
May 30.	Elevator, Hamilton, O.	May 13
May 31.	School, Pleasantville, Ia.	May 13
May 31.	Home, Danville, Ill.	May 13
	Adv., Eng. Record, May 13 to 27.	
May 31.	Sitka, Alaska	May 13
May 31.	Heating, etc., court house, Dartford, Wis.	May 13
May 31.	Steam mains, etc., Danville, Ill.	May 20
	Adv., Eng. Record, May 20.	
May 31.	Dormitory, Elk Point, S. D.	May 27
May 31.	School, Ortonville, Minn.	May 27
June 1.	School, Granville, O.	May 27
June 1.	Additions, etc., school, Cobleskill, N. Y.	May 27
June 1.	St. htg. hospital, Mankato, Minn.	May 27
June 1.	Bus. bldg., Altoona, Pa.	May 27
June 1.	School, Walnut, Ia.	May 27
June 1.	Htg. school, Ellendale, N. D.	May 6
June 1.	School, Beattyville, Ky.	Apr. 22
June 1.	Town hall, Utica, Ia.	Apr. 29
June 1.	Htg. school, Ludden, N. D.	May 13
June 1.	School, Lima, O.	May 20
June 1.	Church and htg., Newport News, Va.	May 20
June 2.	School, Pomeroy, Ia.	May 20
June 2.	New York, N. Y.	May 27
June 2.	Court house, Auburn, Cal.	May 27
June 2.	School, Unionville, Ia.	May 27
June 3.	Library, Des Moines, Ia.	May 27
June 3.	School, Hamilton, O.	May 27
June 3.	School, Columbus, Mont.	May 27
June 3.	School, Canton, O.	May 27
June 3.	School, Mayfield, O.	May 13
June 3.	School, Ames, Ia.	May 20
June 3.	School, Marblehead, O.	May 20
June 3.	Bus. bldg, Newport News, Va.	May 20
June 3.	School, Millbury, O.	May 20
June 3.	Court-house, Parkersburg, W. Va.	May 20
June 3.	Asylum, Little Rock, Ark.	May 20
June 3.	School, Ellerton, O.	May 20
June 5.	School, Murray, Utah	May 20
June 5.	School, Marietta, O.	May 20
June 5.	School, Ely, N. D.	May 20
June 5.	Market house, San Antonio, Tex.	May 13
June 5.	Schools, Pullman, Wash.	May 20
June 5.	Jails, Boulder, Mont.	May 20
June 5.	Addition schools, New York, N. Y.	May 27
June 5.	Schools, New York, N. Y.	May 27
June 5.	Bath, Albany, N. Y.	May 27
June 5.	School, Frostburg, Md.	May 27
June 6.	Jail, Marshall, Minn.	May 20
June 6.	Htg. School, Devil's Lake, N. D.	May 20
June 6.	Htg. College, Corvallis, Ore.	May 20
	Adv., Eng. Record, May 20, 27.	
June 6.	Hospital, Auburn, Cal.	Apr. 29
June 6.	Addition school, Oshkosh, Wis.	May 27
June 6.	School, Elkader, Ia.	May 27
June 8.	Church, Dover, N. J.	May 27
June 8.	Court house, Newport, Ore.	May 27
June 8.	Schools, Dayton, O.	May 27
June 9.	Htg., etc., in school, Defiance, O.	Ma[illegible]
June 10.	Church, St. Johns, Mich.	May 27
June 10.	Town hall, Herring, O.	May 20
June 10.	School, Cleveland, O.	May 20
June 12.	Htg. asylum, New Albany, Ind.	Apr. 29
June 13.	School, Bottineau, N. D.	May 20
June 13.	Bank, Lewisburg, Pa.	May 27
June 14.	Court house, Williston, N. D.	May 20
June 15.	Capitol Annex, Charleston, W. Va.	May 20
June 15.	Plans, school, Madison, Wis.	Apr. 29
June 15.	Jail, Oglethorpe, Ga.	May 27
June 15.	School, Gardner, Ia.	May 27
June 19.	School, Williston, O.	May 27
June 20.	Jail, Wellington, Kan.	May 27
June 22.	Remodeling court house, Marietta, Ga.	May 1[illegible]
June —.	Hospital, Faribault, Minn.	May 2[illegible]

MISCELLANEOUS

May 29.	Fire Alarm, New Orleans.	May [illegible]
	Adv. Eng. Record, May 6.	
May 31.	Coal and ash conveyor, Danville, Ill.	May 1[illegible]
	Adv., Eng. Record, May 13 to 27.	
May 31.	El. Ry. franchise, Redlands, Cal.	May 1[illegible]
June 1.	Street cleaning, Utica, N. Y.	May 1[illegible]
June 1.	Garbage collection, West Spring-Mass.	May 2[illegible]
June 1.	Canal work, Wormser, Mont.	May 2[illegible]
June 2.	Park work, New York, N. Y.	May 2[illegible]
June 3.	Garbage collection, etc., Pittsburg, Pa.	May 2[illegible]
June 5.	El. Ry., Pomeroy, O.	May 2[illegible]
June 6.	Removal of garbage, etc., Harrison, N. J.	May 2[illegible]
June 6.	R. R., Trenton, Ont.	May 2[illegible]
June 7.	Street cleaning, Cleveland, O.	May 2[illegible]
June 7.	Garbage dis., Birmingham, Ala.	May 2[illegible]
June 9.	Excavation, etc., Boston, Mass.	May 2[illegible]
	Adv., Eng. Record, May 20, 27.	
June 10.	Street sweeper, Halifax, N. S.	May 2[illegible]
	Adv., Eng. Record, May 27.	
June 12.	El. Ry., Camden, O.	May [illegible]
June 16.	Pig lead, Cleveland, O.	May [illegible]
June 30.	El. Ry., Shanghai, China	Mar. [illegible]
Oct. 1.	Railroad, Moscow, Russia	Feb. [illegible]
——	Garbage plant, Savannah, Ga.	Apr. [illegible]
	Adv., Eng. Record, Apr. 29, May 6.	

SCHOOLS.

Oshkosh, Wis.—Bids are wanted June 6 for an addition to the Normal School. A. E. Thompson, Pres. Bd. Regents.

Raton, N. M.—It is stated that plans have beep prepared for a $25,000 school.

Superior, Wis.—H. F. Cowdin, of Superior, has received the contract for the addition to the Blaine school, at $24,965.

Canton, O.—Plans are stated to have been prepared for the $24,000 school.

Odebolt, Ia.—Liebbe, Nourse & Rasmussen, of Des Moines, are stated to have prepared plans for the $20,000 school.

LeRoy, Ia.—Bonds to the amount of $12,000 are stated to have been voted for a school.

Charles City, Ia.—The plans prepared of Liebbe, Nourse & Rasmussen of Des Moines are stated to have been accepted for a $30,000 school.

Bancroft, Ia.—It is stated that the St. John the Baptist Catholic Society will build a $12,000 school. Rev. A. J. Schemmel, Pastor.

Davenport, Ia.—The plans of Clausen & Barrows, Demokrat Bldg., have been accepted for No. 13 school.

Stevens Point, Wis.—The bids received May 15 for an addition to the State Normal have all been rejected, they being in excess of the appropriation, $30,000. A. E. Thompson, Chmn. Executive Com., Madison.

Blair, Neb.—The citizens are stated to have voted to issue $32,000 bonds for a school.

Geneseo, N. Y.—An appropriation of $15,000 for improvements in Geneseo State Normal School is stated to have been approved by the Governor.

Austin, Tex.—An election will be held June 26 to vote on issuing $50,000 bonds for a high school.

Baton Rouge, La.—See "Water."

Morgantown, W. Va.—Work on the library, mechanic arts building and armory for the West Virginia University will begin this summer.

Carnegie, Pa.—School bonds amounting to $40,000 have been sold.

Salina, Kan.—Bids are wanted May 29 for a school. Thos. H. Davis, Clk. Bd. Educ.

Burlington, N. J.—The Board of Education is stated to have been authorized to borrow $42,000 for a new school house and the remodeling of the old ones.

Huntington (L. I.), N. Y.—Bunce & Holmes of Huntington have received the contract to erect a school, at $23,745.

Walnut, Ia.—Bids are wanted June 1 for a school. L. Schaeffer, Secy.

Boulder, Colo.—School bonds amounting to $14,000 have been sold.

Defiance, O.—Bids are wanted June 9 for ventilating and heating the Central school. Geo. A. Heatley, Clk.

La Crosse, Wis.—A $20,000 school will be erected east of the Green Bay tracks.

Dayton, O.—Bids are wanted June 8 for 2 schools. Wm. G. Haeussler, Clk.

Charleston, Ill.—Alex. Briggs of Charleston is stated to have received the contract for the high school at $31,-27.

Unionville, Ia.—Bids are wanted June for a school. A. S. Doane, Pres. Bd.

Homestead, Pa.—R. M. Elliott & Co., Homestead, are stated to have received the contract for the 5th ward school at $32,500. McGinnis, Smith & ., of Pittsburg, received the contract for heating, at $3,500.

Ortonville, Minn.—Bids are wanted May 31 for a school in District No. 48. J. Bloodleson, Clk.

Stanford University, Cal.—The McGilvay Stone Co., of Denver, is stated to have received the contract for the stone and brick work for the memorial chapel of the university, at $180,000.

Mansfield, O.—Bids are wanted May 30 for a school in District No. 11. Gustav Baer, Clk.

Hastings, Minn.—The citizens are stated to have voted to issue $30,000 bonds for a school.

Gardner, Ia.—Bids are wanted June 15 for a school in Garfield township. John Spalla, Secy. School Bd. of Garfield township.

Frostburg, Md.—The plans of Alfred Mason of Baltimore have been accepted for the Frostburg Normal School, estimated cost $20,000. Bids will be received at once.

Columbus, Mont.—Bids are wanted June 3 for a school. Geo. H. Simpson, Clk.

Canton, O.—Bids are wanted June 3 for a school in Jackson township. G. M. Stausser, Clk.

Elk Point, S. D.—Bids are wanted May 31 for a Normal School dormitory. H. H. Blair, Pres.

Granville, O.—Bids are wanted June 1 for a school. W. E. Clemons, Township Clk.

Williston, O.—Bids are wanted June 19 for a school. D. O. Shepherd, Clk. Bd. Educ. of Allen township.

Cobleskill, N. Y.—Bids are wanted June 1 for additions, alterations and repairs, ventilating, heating and plumbing the Cobleskill high school. M. S. Decker, Chmn. Bd. Educ.

Elkader, Ia.—Bids are wanted June 6 for a school. G. M. Gifford, Secy.

Indianapolis, Ind.—It is proposed to expend about $133,000 on new schools. David K. Gross, Supt. of Schools.

Hamilton, O.—Bids are wanted June 3 for a school in Madison township. L. L. Creder, Chmn.

Gloucester, Mass.—School bonds to the amount of $30,000 have been sold.

New York City.—Bids are wanted June 5 for alterations and repairs to several schools in the Borough of Manhattan. Richard H. Adams, Chmn. Com. on Bldgs.

Bids are wanted May 29 for electric lighting plants, ventilating and heating apparatus, plumbing, etc., in several schools and the new hall of the Board of Education in the Boroughs of Manhattan and the Bronx.

Bids are wanted June 5 for an addition to school No. 53 and alterations and additions to school No. 63, Borough of Brooklyn. Richard H. Adams, Chmn. Com. on Bldgs., New York, N. Y.

STREET CLEANING AND GARBAGE DISPOSAL.

Birmingham, Ala.—Bids are wanted June 7 for the removal and disposal of garbage. F. V. Evans, City Clk. & Aud.

Harrison, N. J.—Bids are wanted June 6 for the removal of garbage, etc. B. P. Waish, Town Clk.

Pittsburg, Pa.—Bids are wanted June 3 for the collection, removal and disposal of garbage. J. O. Brown, Dir. Dept. Pub. Safety.

Lancaster, Pa.—See "Paving and Road Making.

Cleveland, O.—Bids are wanted June 7 for street cleaning. Walter P. Rice, Dir. Pub. Wks.

Long Branch, N. J.—It is stated that David A. Groves and Edw. Handy have proposed to the Board of Health to erect a crematory and dispose of garbage at a price to be set by the Board.

Spokane, Wash.—The Spokane Crematory Co. has applied for a franchise to build a crematory. Dr. N. Fred Essig, of Spokane, is interested.

Canton, O.—The Council is said to be considering the matter of purchasing some machinery for street sweeping. Louis N. Ley, City Clk.

Halifax, N. S.—Bids are wanted June 10 for a two-horse street sweeper, as advertised in "The Engineering Record."

GOVERNMENT WORK.

Washington, D. C.—Bids are wanted June 3 for an addition to Barnes Hospital, including plumbing, electric lighting, heating, etc. Capt. Chas. W. Taylor, 9th U. S. Cavalry, Secy. & Treas., U. S. Soldiers' Home.

Natchez, Miss.—Bids are wanted June 5 for repairing government roadway to the Natchez National Cemetery. Col. J. W. Scully, A. Q. M. Gen., New Orleans, La.

Ft. Trumbull, Conn.—Bids are wanted June 15 for a hospital, stewards' quarters, and heating hospital at Plum Island, as advertised in "The Engineering Record."

Washington, D. C.—Bids are wanted June 15 for an electric lighting system at the Chilocco Indian School, O. T. A. C. Tonner, Acting Commr. Dept. of the Interior, Office of Indian Affairs.

Fort Monroe, Va.—Bids are wanted June 10 for a hospital steward's quarters. C. P. Townsley, Q. M.

Washington, D. C.—Bids are wanted June 3 for remodeling the King Building and erecting 2 wings, extension to boiler house, remodeling the ventilating and heating apparatus in King Building, etc. Capt. Chas. W. Taylor, 9th U. S. Cavalry, Secy & Treas. U. S. Soldiers' Home.

Watertown, Mass.—Bids are wanted June 22 for furnishing iron, steel, etc., at the Watertown arsenal. Lieut. Col. J. W. Reilly, Ord. Dept., Comd'g.

Fort Meade, S. D.—Bids are wanted June 19 for 2 barracks, also for heating, gas piping and plumbing in the same. Geo. E. Pond, Ch. Q. M., St. Paul, Minn.

Newport, R. I.—Bids are wanted June 24 for an electric light and power plant in the gun implacement at the Dumplings, Conanicut Island, as advertised in "The Engineering Record."

Rock Island, Ill.—Bids are wanted June 21 for about 109,000 cu. yds. rip-rap rock and about 262,000 cu. yds. brush, as advertised in "The Engineering Record."

Portland, Ore.—Bids are wanted July 25 for constructing jetties at Coquille River, Sinslaw River and Coos Bay, Ore., as advertised in "The Engineering Record."

New York, N. Y.—Bids are wanted June 22 for removal of rock and dredging in Hudson River between Coxsackie and State Dam at Troy, N. Y.; also on June 24 for dredging and excavation in Mamaroneck Harbor, N. Y., as advertised in "The Engineering Record."

St. Louis, Mo.—Bids are wanted June 22 for 60 flat boats, as advertised in "The Engineering Record."

Chicago, Ill.—Bids are wanted June 22 for constructing breakwater, Calumet Harbor, Ill., as advertised in "The Engineering Record."

Ft. Ethan Allen, Vt.—Bids are wanted June 19 for the construction, plumbing, heating and gas piping of one 2-company barrack, 2 double set officers' quarters, one storehouse, 2 cavalry stables and a stable guard house, as advertised in "The Engineering Record."

Cleveland, O.—Bids are wanted June 9 for dredging in Cleveland Harbor, and on June 12 for constructing part of west breakwater at Fairport Harbor, O., and at Conneaut Harbor, O., as advertised in "The Engineering Record."

Portland, Me.—Bids are wanted June 8 for American Portland cement for Cushing Island, Me., as advertised in "The Engineering Record."

Cincinnati, O.—Bids are wanted June 26 for constructing gates for lock No. 8, Kentucky river. Capt. H. F. Hodges, Corps Engrs., U. S. A.

Oswego, N. Y.—The following bids were received by Capt. Graham D. Fitch, U. S. Engr's. Office, May 22, for removal of 2,370 cub. yds. of rock in St. Lawrence River, near Ogdensburg. W. J. Daly, Ogdensburg, $7.00 per yd., $16,590; Geo. A. Rogers, Plattsburgh, N. Y., $9.49 per yd., $22,491.30.

St. Paul, Minn.—Bids are want 27 for 5 steel Tainter gates, as tised in "The Engineering Reco

St. Louis, Mo.—The following b the construction of lock and Osage River, were opened Ma Capt. H. M. Chittenden, Secy. M River Com. A, J. V. Hoag, Jr. gheny City, Pa.; B, James S. Po Joseph D. Wallace, Champaign, ceived the contract: 20,000 cu. y earth excavation, A, $2.30; B, 5,000 cu. yds. dry earth excavat $2.30; B, 70 cts.: 800 cu. yds. rock vation, A, $2.30; B, $1.00; 800 s stone paving, A, $3.00; B, $1.40 bbls. cement, A, $3.50; B, $2.95: yds. mortar, A, $3; B, $5; 5,500 c concrete, A, $3; B, $4.50; 332,000 ll frames, A, 11 cts.; B, 6½ cts.: 18,0 iron castings, A, 7 cts.; B, 15 cts.: ft. piles, A, 75 cts.; B, 50 cts.: 24, 10-in. sheet piling, A, 75 cts.; B, 5 180 M ft. floor and apron lumber, B, $46: 110 M ft. sheathing lumb $60; B, $63: 135 M ft. grillage l A, $60; B, $37: lock gates, A, $8, $5,000: removing old coffer dam, 120; B, $1,360; total tender, A, $2 B, $142,465.

Ellis Island, New York Harbor following bids for the plumbing and slate work in the main of the immigrant station w May 22 by J. K. Knox, Su Arch., Treasury Dept., Was Leonard D. Hosford, New Yor Wells & Newton Co., New Yor James Armstrong, New York, W. H. Spelman, $27,242; Edward Syracuse, $29,613; Howe & Barnett, Rochester, $29,337; James Harley & Co., Brooklyn, $23,238; Jacob Manneschmidt, Brooklyn, $28,018.

New London, Conn.—Bids for dredging, etc., were opened May 22 by Maj. S. S. Leach, Corps Engrs., U. S. A., and are reported as follows: Thames River, 1,415 cub. yds.: John P. Randerson, Albany, N. Y., 16 cts., $22,640; Frank H. Brainerd, New York, 11¾ cts., $15,-989.50; Edgar M. Payn, Albany, 17.9 cts., $25,328.50; Hartford Dredging Co., 18 cts., $25,470. Stamford Harbor, 375 cub. yds., Edgar M. Payn, 23.7 cts., $8,887.50; Hartford Dredging Co., 16 cts., $6,000; P. J. Brummelkemp, Syracuse, 24 cts., $9,-000. Rock removal, Mystic River, 500 cub. yds., Thos. A. Scott, New London, $8 per cub. yd., $4,000; Chas. T. Stoll, New London, $8.50; H. Herbert Sturgis, So. Standish, Me., $9.45; Frank Pidgeon, New York, $16.63; P. Sanford Ross, Jersey City, $17; Isaac T. Brown, New York, $12.45; Chas. W. Johnson, Lewes, Del., $11.75; Harris & Letteny, Boston, $13.60.

Milwaukee, Wis.—The following bids for dredging five harbors on Lake Michigan were opened May 17 by Capt. J. G. Warren, Corps of Engrs.: A, Menominee River, 172.000 cu. yds.; B, Oconto Harbor, 20,000 cu yds.: C, Green Bay Harbor, 200.000 cu. yds.; D, Two Rivers Harbor, 23.000 cu yds.; E, Milwaukee Harbor, 100,000 cu. yds.

	A cts.	B cts.	C cts.	D cts.	E cts.
Samuel O. Dixon, Milwaukee	9 7	12 5	9¼	14 5	.
Lydon & Drews Co, Chicago	15.0	14.0	14.0	14 0	17 0
Wm. T Casgrain Chicago	17.0	....	17.0	....	15.0
FitzSimons & Connell Co., Chicago	13 0	12.5	12 0	14 0	18 0
E. J. Pryer, Houghton	9.0	....	9 0	....	....
C. E. Mitchell, Ludington	14 5	....	13.0	....	....
Horatio Truman, Manitowoc	....	12¼	....	....	..
Chas. Simone, Two Rivers	....	....	....	13¾	...
Adolph F. Bues, Milwaukee	....	....	..	....	14 4

MISCELLANEOUS.

Albany, N. Y.—Governor Roosevelt has signed a bill appropriating $5,000 for constructing a retaining wall on east side of the Oneida feeder to the Erie Canal.

Rat Portage, Ont.—An appropriation of $75,000, $15,000 available this year and the rest next year, is said to have passed the Canadian Parliament for the construction of a dam and locks at the Longe Sault rapids, Rainy river.

Providence, R. I.—An appropriation of $300,000 for dredging harbor, building docks, retaining walls, etc., is under consideration.

·land, O.—Bids are wanted June 100 tons of pig lead. Walter P. Dir. Pub. Wks.

York, N. Y.—Bids are wanted for improving the park at 114th l Manhattan Ave. Geo. C. Clau- ·mn. Commrs. of Parks.

mser, Mont.—Bids are wanted for 2 canal systems. A. Worm- es. Holland Irrigation Canal Co.

ingham, Ala.—Bids are wanted 7 for $20,000 improvement bonds. Evans, City Clk. & Aud.

ticello, N. Y.—Brummelkamp & of Syracuse, N. Y., are reported to the contract for changing the of a portion of Pine Creek, Sulli- ., for $3,780.

imore, Md.—The Harbor Board, it ·ed, has decided to extend the 30- p channels dredged by the govern-

do, O.—The following bids for the nation of 50 acres of submerged nd filling 50 acres of low land, at 'iew Park, were opened May 13 by oledo Centennial Com., W. J. Sher- Eng.: J. M. & W. G. Spence, land, $433,004; Chas. H. Strong & 'eveland, $422,311; Carkin, Stick- ram, Detroit, $393,100; James Toledo, $361,886; J. B. & G. H. Toledo, $355,217; Joseph oledo, $305,955; Joshua J. Har- 'edo, $305,000; Rabitt, Garrigan Toledo, $282,772; J. N. Bick, nd Albert Hussey, New York, ; engineer's estimate, $217,300. The itemized tender of the lowest bidder was as follows: 150,000 cu. yds. bluff grading, 15 cts.; 780,000 cu. yds. filling, 16⅞ cts.; 42,000 ft. white oak piles, driven, 27 cts.; 57,000 ft. elm piles, driven, 19 cts.; 470 M ft. white oak sheet piling in place, $37; 169 M ft. white pine lumber in place, $28.50; 17 M ft. white oak lumber in place, $30; 78 M ft. hemlock plank in place, $20; 154,000 lbs. anchor rods in place, 3 cts.; 10,000 lbs. screw bolts in place, 3 cts.; 16,000 lbs. cast-iron washers in place, 3 cts.; 10,500 lbs. spikes, driven, 4 cts.; 3,000 lbs. drift bolts in place, 3 cts.

PROPOSALS.

U. S. ENGINEER OFFICE, ARMY Building, New York, N. Y., May 24, 1899.— Sealed proposals for dredging and excavating in Mamaroneck Harbor, N. Y., will be received here until 12 M., June 24, 1899, and then publicly opened. Information furnished on application. H. M. ADAMS, Major Engrs.

U. S. ENGINEER OFFICE, 185 EUCLID Ave., Cleveland, O., May 12, 1899.—Sealed proposals for Constructing Part of West Breakwater at Fairport Harbor, Ohio, will be received here until 2 o'clock P. M., central standard time, June 12, 1899, and then publicly opened. Information furnished on application. JARED SMITH, Col. Engrs.

U. S. ENGINEER OFFICE, 1637 INDIana Ave., Chicago, Ill., May 23, 1899.— Sealed proposals for constructing breakwater, Calumet Harbor, Ill., will be received until noon (central time), June 22, 1899, and then publicly opened. Information furnished on application. W. L. MARSHALL, Maj., Engrs.

U. S. ENGINEER OFFICE, PORTland, Oreg., May 25, 1899.—Sealed proposals for constructing jetty, etc., at Siuslaw River, Oreg., will be received here until 12 noon, July 25, 1899, and then publicly opened. Information on application. WM. W. HARTS, Capt. Engrs.

U. S. ENGINEER OFFICE, PORTland, Oreg., May 25, 1899.—Sealed proposals for constructing jetties, etc., at Coquille River, Oreg., will be received here until 12 noon, July 25, 1899, and then publicly opened. Information on application. WM. W. HARTS, Capt. Engrs.

U. S. ENGINEER OFFICE, PORTland, Oreg., May 25, 1899.—Sealed proposals for constructing jetty, etc, at Coos Bay, Oreg., will be received here until 12 noon, July 25, 1899, and then publicly opened. Information on application. WM. W. HARTS, Capt. Engrs.

QUARTERMASTER'S OFFICE, FORT Trumbull, Conn., May 27, 1899.—Sealed proposals in triplicate for construction of hospital, hospital steward's quarters and heating hospital, Plum Island, N. Y., will be received here until 12 o'clock M., June 15, 1899, and then opened. United States reserves right to reject or accept any or all proposals or any part thereof. Information furnished on application. Envelopes containing proposals will be endorsed "Proposals for Hospital, etc." GEORGE A. NUGENT, Q. M.

PROPOSALS.

Notice.

Parties wishing to estimate on work for St. John's Church, Schenectady, N. Y., will address me as soon as possible so I can make arrangements for forwarding the plans and specifications.

The building will be of stone with slate and sheet metal roofing, and the work to be awarded will be Masonwork, Stonecutting, Carpenterwork, Slating and Ornamental Sheet Metalwork, Interior Carpenterwork, Electric Light Installation, Seating, Installation of Heating Apparatus and Structural Metalwork.

EDWARD W. LOTH, Archt.,
253 Broadway,
Troy, N. Y.

Proposals for a New Steel Bridge.

CAPE MAY CITY, N. J.

Plans, specifications and estimates for a New Steel Bridge, 105 ft. long and 20 ft. wide, will be received until 8 p. m., June 5, 1899, with and without a Draw in it, over Cape Island Creek, at Schillingers Landing. For any information, or if anyone wishes we will accompany them to the Bridge and give them any points desired.

H. S. RUTHERFORD,
Box 863. Cape May City, N. J.

Sewerage System.

NOTICE TO CONTRACTORS.

NEW BRIGHTON, PA., May 17, 1899.

Sealed proposals will be received at the office of the President of the Council in the Borough of New Brighton, Pa., endorsed, "Proposals for Sewerage System," until 12 o'clock noon, standard time, on Thursday, the 8th day of June, 1899, for furnishing material and performing labor necessary to complete all, or so much of the system of sewerage shown on plans as the Council may determine after receiving said proposals.

The quantities of the entire work are approximately as follows:

600	lin. ft.	6-in.	pipe sewer laid complete.
60,000	"	8-in.	" " " "
5,500	"	10-in.	" " " "
6,500	"	12-in.	" " " "
800	"	15-in.	" " " "
3,500	"	18-in.	
10,000	"	6-in.	drain pipe laid complete.
5,000	"	8-in.	" " " "
3,000	"	10-in.	" " " "
1,000	"	12-in.	
1,700	"		of manhole construction built complete.

43 Flush Tanks and connections built complete.
500 cu. yds. of rock excavation removed.
500 " " extra earth excavation removed and trench backfilled.
100 cu. yds. of concrete in place.
10,000 feet B. M. plank and timber in place.

The above quantities will be used only for the comparison of bids. Plans and specifications can be seen at the office of the Borough Council, in New Brighton, Pa., and also at the office of the Consulting Engineer, at Canton, Ohio. And specifications can be obtained by bidders upon application to the Secretary of the Council at New Brighton, Pa.

Each proposal must be accompanied by a certified check in the sum of Five Hundred Dollars ($500.00), made payable to the order of the Borough Secretary, as a preliminary bond in accordance with the terms of the specifications.

The Borough Council reserves the right to reject any or all bids, and also to construct the whole or any part of the work as set forth in the specifications and as shown on the plans on the basis of the bids made in the accepted proposal, as it may appear to the Council to be to the best interest of the Borough after receiving such proposals.

By order of the Borough Council,
FRANK C. READER,
Secretary,
New Brighton, Pa.

L. E. CHAPIN, Consulting Engineer,
Canton, Ohio.

U. S. ENGINEER OFFICE, 537 Congress St., Portland, Me., May 15, 1899.—Sealed proposals for American Portland Cement and Sand, for Cushing Island, Me., will be received here until 12 M., June 8, 1899, and then publicly opened. Information furnished on application. S. W. ROESSLER, Maj., Engrs.

PROPOSALS FOR TAINTER GATES. U. S. Engineer Office, Globe Building, St. Paul, Minn., May 27, 1899.—Sealed proposals for furnishing five steel Tainter Gates will be received here until 2 oclock p. m., June 27, 1899, and then publicly opened. Information furnished on application. FREDERIC V. ABBOT, Maj., Engrs.

PROPOSALS FOR DREDGES.—MISSISsippi River Commission, Fullerton Building, St. Louis, Mo., April 19, 1899.—Sealed proposals, in triplicate, for construction and delivery of two self-propelling hydraulic dredges complete with machinery, cabin, outfit, etc., will be received here until 12 o'clock noon, standard time, May 31, 1899, and then publicly opened. Information furnished on application. MASON M. PATRICK, Capt., Eng'rs, Sec'y.

PROPOSALS.

Paving.

ANN ARBOR, MICH., May 17th, 1899.

The Board of Public Works will receive sealed proposals for the construction of three blocks of pavement on Washington St., according to plans and specifications on file in the Engineer's office till Thursday, June 1st, 1899, at 6 P. M. Bids for both brick and asphalt will be considered. The approximate quantities are:

5,250 sq. yd. pavement,
2,150 cu. ft. curbstone,
1,750 cu. yd. excavation,
875 cu. yd. concrete,
150 lin. ft. trenching under 6 ft. deep,
150 lin. ft. 12-inch vitrified sewer pipe,
4 sewer inlets,
1 catch-basin,
1 man-hole.

Certified check of $500.00 to accompany bid.

J. E. HARKINS, Clerk.

GEO. F. KEY,
City Engineer.

Street Sweeper.

Sealed proposals will be received by the undersigned until 12 o'clock noon, on Saturday, June 10th, 1899, for one two-horse street sweeper (pickup preferred) delivered in Halifax, Nova Scotia, free of all charges for freight, duty, etc.

The right is reserved to reject any or all tenders or to accept any tender that in the judgment of the City Engineer will be in the best interest of the City.

F. W. W. DOANE,
City Engineer.

Notice to Contractors.

SEWERS.

WATERBURY, CONN.

Sealed proposals for the construction of sewers and appurtenances in South, Cooke, Clark, Putnam, Madison, Ridgewood, Ludlow, Walnut, Baldwin, South View, South Elm streets, and Hillside avenue, will be received by the Board of Public Works until 8 oclock p. m., Tuesday, June 6, 1899, at which time they will be publicly opened and read. A certified check for four hundred ($400) dollars, made payable to the order of the city comptroller, must accompany the bid as a guarantee that the bidder, if successful, will enter into a contract according to the terms of his proposal.

The engineer's estimate of the principal items of the work is as follows:

725 lineal feet of 12-inch vitrified pipe sewer.

280 lineal feet of 10-inch vitrified pipe sewer.

733 lineal feet of 9-inch vitrified pipe sewer.

4,004 lineal feet of 8-inch vitrified pipe sewer.

33 manholes.

Proposals must be made on blanks furnished by the board. Forms of contract and specifications may be seen and blank forms of proposal and bond may be obtained at the Bureau of Engineering, No. 9 Leavenworth street.

The board reserves the right to reject any or all bids.

By order of the Board of Public Works.

R. A. CAIRNS, City Engineer.

May 20, 1899.

U. S. ENGINEER OFFICE, NEWPORT, R. I., May 24, 1899.—Sealed proposals for furnishing and installing electric light and power plant in gun emplacement at the Dumplings, Conanicut Island, R. I., will be received here until 11 A. M., June 24, 1899, and then publicly opened. Information furnished on application. D. W. LOCKWOOD, Major, Engrs.

U. S. ENGINEER OFFICE, ARMY Building, New York, May 22, 1899. Sealed proposals for removal of rock and for dredging in Hudson River, between Coxsackie and State Dam at Troy, N. Y., will be received here until 12 M., June 22, 1899, and then publicly opened. Information furnished on application. J. W. BARLOW, Col. Engrs.

U. S. ENGINEER OFFICE, 185 EUCLID Ave., Cleveland, O., May 9, 1899.—Sealed proposals for dredging in Cleveland Harbor, Ohio, will be received here until 2 o'clock P. M., standard time, June 9, 1899, and then publicly opened. Information furnished on application. JARED A. SMITH, Col. Engrs.

U. S. ENGINEER OFFICE, 185 EUCLID Ave., Cleveland O., May 12, 1899.—Sealed proposals for constructing Part of West Breakwater at Conneaut Harbor, Ohio, will be received here until 2 o'clock P. M., central standard time, June 12, 1899, and then publicly opened. Information furnished on application. JARED A. SMITH, Col. Engrs.

PROPOSALS FOR CONSTRUCTION OF Flat Boats.—U. S. Engineer Office, Custom House, St. Louis, Mo., May 23, 1899.—Sealed proposals for construction and delivery of sixty flat boats will be received here until 12 o'clock noon, June 22, 1899, and then publicly opened. Information furnished on application. EDW. BURR, Captain Engrs.

PROPOSALS.

Brick Paving.

Sealed proposals will be received by the City Clerk of Coldwater, Mich., up to two o'clock P. M., June 6, 1899, for the furnishing of all material and the construction of vitrified brick pavement on concrete foundation, on Chicago street, between the east line of Hanchett street and the east line of South Clay street, extended across West Chicago street at right angles therewith; also that part of Monroe street lying between the south line of Pearl street and the south line of Chicago street; also that part of Monroe street lying between the south line of crossing on the north line of Chicago street and a line two hundred fifty-four feet north of the north line of Chicago street, according to the plans and specifications on file with the city clerk.

A certified check for $600 must accompany each bid.

Plans may be seen at the office of the City Clerk or at the office of Riggs & Sherman, 613 The Nasby, Toledo, Ohio.

The city reserves the right to reject any or all bids.

P. H. SWEENEY, City Clerk.

Dated Coldwater, Mich., May 18, 1899.

Water-Works.

Bids will be received by F. M. Deane Village Clerk of Hartford, Mich., until o'clock P. M., June 15, 1899, for work and materials for construction of water-works

Cast-iron or riveted steel pipe, 2¼ miles one ton special castings; 1 triplex powe pump, 750,000 gals. per 24 hours, with fir pressure 150 pounds per square inch; triplex power pump, 500,000 gals. per hours, when pumping against 80 pound per square inch; 1 40-H.-P. gasoline engine 1 25-H.-P. gasoline; 18 hydrants; 11 ga valves and gate boxes; brick pump hous 26x26x12 ft., steel roof and ceiling; stan pipe 100x12 ft., or 70-ft. steel tower wit 50,000-gal. tank. Address Village Cler Hartford, Mich., or L. C. Colburn, E gineer, Paw Paw, Mich., for specificatio and plans.

F. M. DEANE, Village Clerk.

OFFICE OF THE GRADE CROSSIN COMMISSION.

Room No. 436 Ellicott Square Building,
BUFFALO, N. Y., May 20th, 189

SEALED PROPOSALS for work and m terial as set forth below will be received the office of the Engineer of the Gra Crossing Commission until 11 o'clock a. June 3rd, 1899.

No proposal will be considered unless be accompanied by a certified check, pa able to the order of R. B. Adam, Chairm Grade Crossing Commissioners, in amount of two thousand ($2,000.00) doll or by a bond conforming to law, such b to be fifty (50) per cent. of the sum na in proposal.

Plans and specifications can be seen, printed forms of proposals, instruction bidders, and any desired information be had, on application at the office of ward B. Guthrie, Chief Engineer of Grade Crossing Commissioners, Room 436, Ellicott Square Building, on and this date.

Proposals must be made for the work material as indicated on the plans specifications on file.

The right to reject any and all prop is reserved.

For the construction and erection o superstructure for a viaduct over the York, Chicago & St. Louis R. R., the ern New York & Pennsylvania Ry., the Buffalo Creek R. R., in Abbott Ro

Proposals will be received by the Engineer of the Grade Crossing Con sioners at his office, No. 436 Ellicott Sq Buffalo, N. Y.

F. V. E. BARDOL,
Chief Engineer Bureau of Engineer

OFFICE CONSTRUCTING QUAR master, Fort Ethan Allen, Vt., Ma 1899.—Sealed proposals, in triplicate, received here until 12 o'clock, M., Ju 1899, and then opened, for constru plumbing, heating and gas-piping he one 2 Company Barrack, two doub Officers' Quarters, one Subsistence house, two Cavalry Stables and one Guard House. Information furnish application. Right reserved to acc reject any or all bids, or any part t Envelopes containing proposals sho marked: "Proposals for——," add to Capt. J. W. HEARD, Q. M.

PROPOSALS FOR RIP RAP ROC Brush on Upper Mississippi River, Engineer Office, Rock Island, Ill., 1899.—Sealed proposals, in duplicate, received here until 11 a. m., June and then publicly opened, for fu about 109,000 cubic yards rip rap r about 262,000 cubic yards brush, at lo between Alma, Wis., and mouth souri River. For information appl McD. TOWNSEND, Capt., Engrs.

Proposals continued on pages xi a